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Fakultet for økonomi
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Environmental Management Systems: barriers to successful integration

Case studies of how organizations overcome barriers to the integration of Environmental Management Systems through knowledge integration

Masteroppgave i Strategy and International Business Development
Veileder: Prof. Marta Morais-Storz
Medveileder: Prof. Daniela Bolzani

Februar 2022

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Environmental Management Systems: case studies of how organizations overcome barriers to the integration of EMSs through knowledge integration

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Abstract

Organizations around the world have adopted environmental management systems (EMS) to manage environmental impacts. The main certifications for these systems are ISO 14001 and EMAS.

In the literature, the process of integrating environmental management systems is ignored. So, after analysing the barriers to integration, I hypothesized that they could be overcome through the integration of knowledge. The research was carried out through interviews to understand how the integration of the necessary knowledge can help in overcoming the barriers to EMSs integration.

From the research it is clear that, for the managers, a successful integration of the EMS passes through the involvement of the employees. Managers exploit knowledge integration within employees because the barriers to EMS integration are overcome mainly through employees' involvement. Furthermore, during the whole process of the EMS integration, information comes from different sources and knowledge integration is an important key to overcome the difficulties related to the management of diverse information.

In the end, this thesis highlights the need to extend qualitative research on the integration process of EMSs in order to understand the different strategies that firms develop, especially in the case organizations lacking complementary capabilities.

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INTRODUCTION

All over the world, stakeholders' pressures on environmental matters have led companies to manage the sustainable aspect of their activities. A widespread strategy to respond to these pressures is the voluntarily adoption of the so-called Environmental Management Systems. The two most popular systems that have been created are certified ISO 14001 (according to the requirements of the International Organization for Standardization) and Eco-Management and Audit Scheme (EMAS, developed by the European Commission).

The current estimate is 300,000 ISO 14001 certified companies in 171 countries (ISO, 2021) and 3,975 organizations certified to EMAS in all 27 States belonging to the European Union plus the three countries of the European Economic Area Member States (European-Commission, 2021). The ISO 14001 certification was introduced in 1996 and the EMAS certification in 1993. Both are management systems adopted voluntarily and can be adopted by any company regardless of size or sector of activity (Ghisellini & Thurston, 2005). Obviously, all companies must comply with the environmental regulations in force in their territory, but these EMSs are formal systems used to set objectives to highlight environmental aspects, to acquire information on how to increase sustainability within the company, and to communicate its commitment to external stakeholders (Florida & Davison, 2001). The reasons for adopting an EMS can vary, both from the internal will to improve environmental performance and from external pressures seeking a competitive advantage in the market (Boiral, 2007) so, among researchers there is no consensus on what could be the main reason (Heras-Saizarbitoria et al., 2011).

To be certified EMAS or ISO 14001 companies must draw up a plan to meet the requirements imposed: through a Plan-Do-Check-Act (PDCA) process, organizations must identify the main environmental factors to be controlled, set the objectives, define the roles and responsibilities of the staff, train the employees, document and communicate for the proper integration of the system, continuously monitor both the achievement of objectives and the improvement of environmental performance, and if necessary initiate corrective actions (Ghisellini & Thurston, 2005).

From the literature review it seems that the scientific research takes for granted the process of EMSs integration, as if it was standardized and equal for all companies, and

the analysis focuses more on the results achieved, the costs, the documents to manage, the timing and motivation for the adoption of an EMS. However, from the analysis of these aspects it can be noticed, within the companies, the lack of knowledge both at the environmental level and with regard to EMSs' requirements (Boiral, 2011). The lack of knowledge about EMSs leads to an underestimation of the commitment they require and the resources involved: the integration of the system needs knowledge of the necessary documents and their purpose, the introduction of an environmentally-friendly culture and especially employee awareness (Boiral, 2011). Another consequence of the lack of knowledge, is the need to rely on external consultants who, however, should not have full responsibility for planning the integration of the EMS as it could create a gap between what is planned and the real work activities (this knowledge is in the hands of employees) (Boiral, 2011). In addition, if the knowledge of the consultants is not integrated, there is a risk of not being able to perform a fundamental aspect of the EMS, namely the continual improvement both of the system and of the environmental performance, as the organization has not developed the capabilities necessary to do so (Boiral, 2011).

EMSs must be adapted to the company and, as there is no single way to integrate them, managers must know how to do it and how to create the structure necessary to share information needed to create knowledge. To investigate how EMSs are integrated in the company, the study of these systems and of knowledge integration must be treated together: the lack of environmental knowledge, within the entire company (not only concerning top managers), can lead to different level of commitment and affects the organizational capabilities (Essid & Berland, 2018). Knowledge integration is the key to reaching a responsible and committed integration of an EMS.

The relation between EMSs integration and knowledge integration has been studied limitedly by the literature. Integration of the EMS is intended to adapt the system to the company (and not vice versa), making it consistent with the activities carried out within the organization. This integration should simplify procedures for achieving environmental objectives and should encourage employee participation in the continuous improvement of environmental performance, allowing the system to be seen not only as a bureaucratic requirement to be met. Knowledge integration is defined by Zahra et al. (2020) as "an organizational capability for creating novel combinations of different strands of knowledge, which have utility for solving organizational problems, from component knowledge sourced from within and beyond the organization, and

across time, and which derive from individual and group contributions, facilitated by both formal and social processes" (p. 163).

The focus of this thesis is on the integration of knowledge (internal and external) for the integration of an EMS and on the analysis of the aspects that influence knowledge integration, both within the company and within work teams. Therefore, the research question is: how do organizations integrate environmental knowledge in the process of Environmental Management Systems integration?

The research carried out so far on these systems has been mainly quantitative (based on questionnaires) and focused on assessing any changes in environmental performances, with a scant number of qualitative studies focusing mainly on managers' perceptions of the obstacles and costs of Environmental Management Systems (Boiral et al., 2018). At present, it is important to expand the amount of qualitative research because different strategies, that each company develops to integrate the EMS, will have different qualitative consequences and the available quantitative research does not clarify whether the result of integrating an EMS are influenced by those strategies (Heras-Saizarbitoria & Boiral, 2013).

Each organization responds differently to the need to improve the environmental performance and it is useful to understand how they adapt proactively to changes, both in terms of new routines and in terms of involvement of employees (Boiral et al., 2018). It is not possible to understand in depth how EMSs are integrated and how the capabilities necessary to manage them are developed and adapted through quantitative analysis, in particular with the use of questionnaires (Testa et al., 2018). To investigate how enterprises integrate environmental knowledge in the process of Environmental Management Systems integration, the questions to be asked to the managers responsible for the system must be open, adaptable to the specific business environment and, therefore, of a qualitative nature. For this reason, this thesis was based on qualitative research made through interviews. The data collection was focused on how these systems were integrated within companies, what were the necessary capabilities and how the knowledge was acquired to implement EMSs to the best (involving all employees) and adapt them properly to the organization.

CONCEPTUAL BACKGROUND

The preparation of the thesis was based on a literature review, to analyse articles to better understand the Environmental Management Systems (EMSs). The literature review was organized in two steps.

In the first step, the aim was to find out what gaps in knowledge about the EMSs needed to be filled. The articles dealing with EMSs were analysed and, in particular, those that summarized the deficiencies found in the knowledge of these systems. A further aim of this step was to understand how studies have been carried out so far (research methodology and the main factors investigated). Thanks to this first approach, several knowledge gaps concerning EMSs have been identified. The gap on which this thesis focuses is how companies integrate the knowledge necessary for the integration of an EMSs within the organization.

The next step was the search for more detailed articles on knowledge integration related to EMSs, even if this field was not yet deepened widely by the literature. In fact, given the limited research in this field, were also analysed articles dealing with knowledge integration more generally at the level of environmental strategy (therefore, not specifically related to the EMSs) and articles on fundamental aspects for the integration of EMSs to understand how they were identified and chosen. The result of this research process was the identification of barriers to the integration of an EMS (in relation to knowledge integration) that need to be investigated and the right methodology to conduct my research (that is qualitative, in particular, through interviews).

1.1. Starting point: literature review

The research was initiated by referring to two recent literature reviews, namely "The effect of mandatory and voluntary regulatory pressures on firms' environmental strategies: a review and recommendations for future research" (Aragon-Correa et al., 2020) and "Adoption and Outcomes of ISO 14001: A Systematic Review" (Boiral et al., 2018).

Subsequently, from these two articles cited above, the empirical studies referenced in these two articles were analysed. The purpose of this process was to deepen the knowledge about EMSs, how these had been studied previously, and begin to understand what the gaps in the analysis of these systems were. Most of the studies were made using a quantitative approach, so to understand the EMSs' field many of the articles using this methodology were read. Subsequently, the focus was on studies carried out through qualitative research because factors that have not been thoroughly analysed, regarding EMSs, should be investigated with such methodology.

1.1.1. Articles selection process and analysis

The process by which the analysed articles were selected is explained in Figure 1 and Figure 2. The arrows start from the study in which the articles were cited and then selected.

Figure 1: Articles selected from the (Aragon-Correa at al., 2020) literature review.

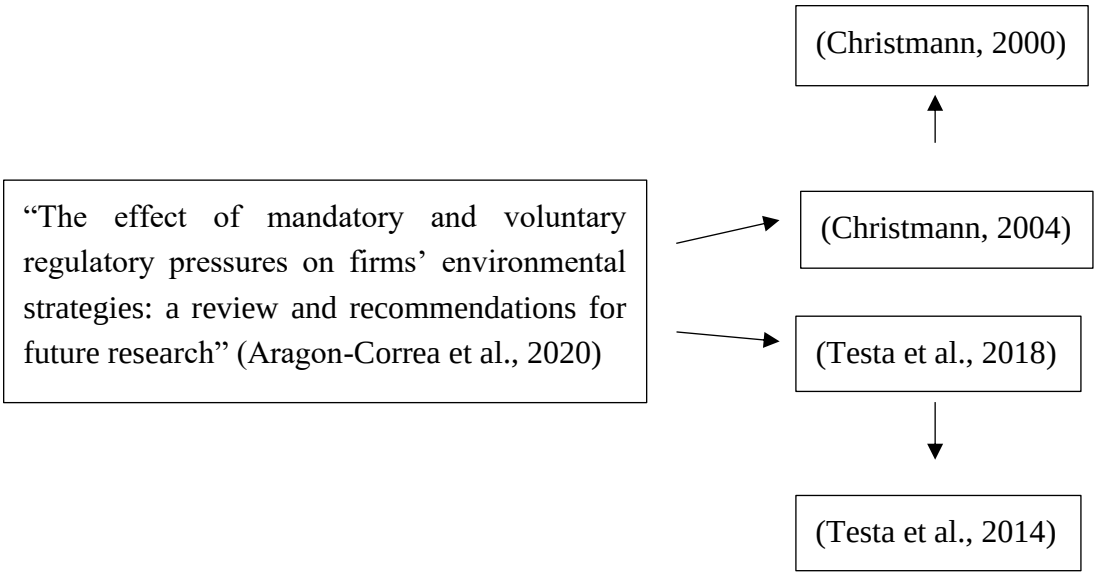
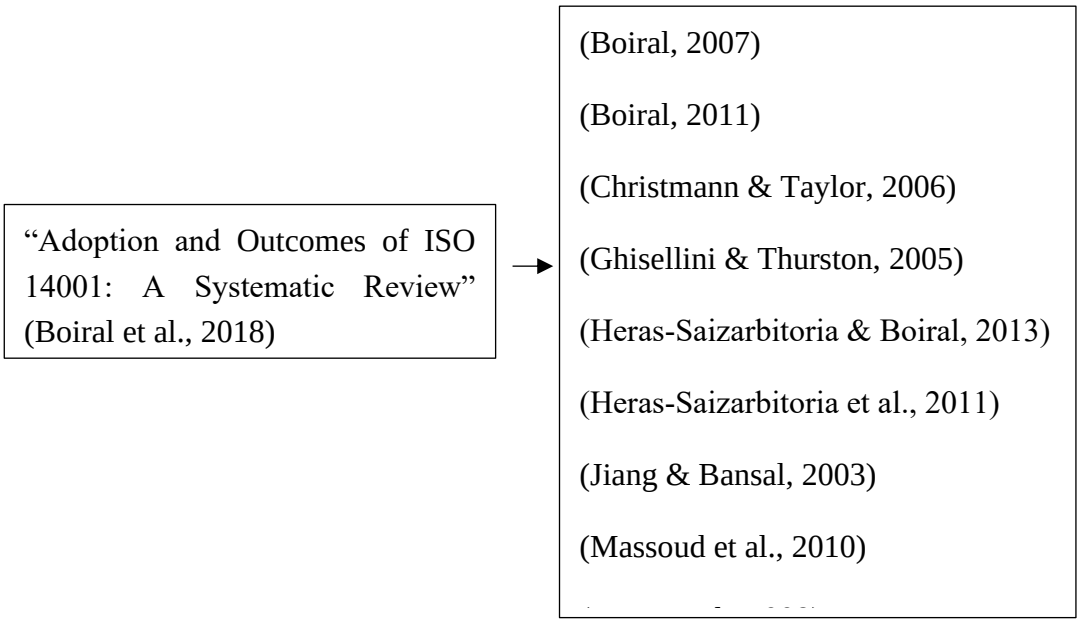


Figure 2: Articles selected from the (Boiral et al., 2018) literature review.



In addition, two other articles on complementary capabilities and indicators were analysed: (Comoglio & Botta, 2012) and (Darnall & Edwards Jr, 2006).

The journals of publication and the number of articles are summarised in Table 1.

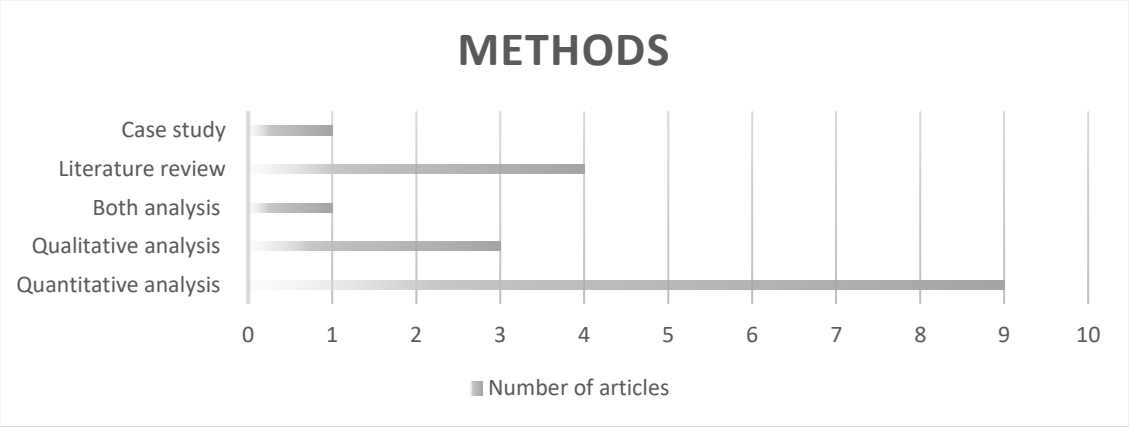
Table 1: Journals of publication.

Academy of Management Annals	1
Academy of Management Journal	2
European Management Journal	1
International Journal of Management Reviews	2
International Journal of Operations & Production Management	1
Journal of Cleaner Production	4
Journal of International Business Studies	1
Journal of Management Studies	1
Law and Society Review	1
Long Range Planning	1
Organization & Environment	1

Organization Science	1
Strategic Management Journal	1

The number of articles and the related methodology are summarised in Figure 3.

Figure 3: Methods and number of articles.



The two starting literature reviews and the analysed articles with their findings are summarised in Table 2.

Table 2: Starting literature reviews and articles.

Authors, Year	Title	Method	Findings
(Aragon-Correa et al., 2020)	The effects of mandatory and voluntary regulatory pressures on firms' environmental strategies: A review and recommendations for future research.	Literature review	Research gaps are: what are the processes leading to the adoption of ISO 14001, why different firms have different environmental strategies and how main departments are involved.
(Boiral, 2007)	Corporate greening through ISO 14001: a rational myth?	Qualitative analysis	Lack of knowledge about ISO 14001 leads to a superficial implementation of the EMS. Employees and managers are only involved to pass the audit.

(Boiral, 2011)	Managing with ISO systems: lessons from practice.	Qualitative analysis	The implementation of ISO 14001 is different in each firm and benefits depend on it. The standard needs huge efforts in documentation, follow-up, resources, time, and knowledge.
(Boiral et al., 2018)	Adoption and outcomes of ISO 14001: A systematic review.	Literature review	Research gaps are: qualitative analysis, the commitment of consultants, the role of internal capabilities and firm's culture in ISO 14001 implementation.
(Christmann, 2000)	Effects of "best practices" of environmental management on cost advantage: The role of complementary assets	Quantitative analysis	The analysis of complementary assets explains why only some firms can gain competitive advantage from implementing environmental management best practices.
(Christmann, 2004)	Multinational companies and the natural environment: Determinants of global environmental policy.	Quantitative analysis	Multinational companies can standardize their environmental communication policy. Local managers with lower environmental responsibility could be not committed to sustainability. Different stakeholders influence different internal environmental policies.
(Christmann & Taylor, 2006)	Firm self-regulation through international certifiable standards: Determinants of symbolic versus substantive implementation.	Quantitative analysis	Certifiable standards are substantively implemented only if customers can monitor their suppliers or if certification audits acquire more credibility.
(Comoglio & Botta, 2012)	The use of indicators and the role of environmental management systems for environmental performances improvement: a survey on ISO 14001 certified companies in the automotive sector.	Quantitative analysis	Firms choose as indicators those that deals with aspects which are related to high costs, not high environmental issues.

(Darnall & Edwards Jr, 2006)	Predicting the cost of environmental management system adoption: the role of capabilities, resources and ownership structure.	Quantitative analysis	Having internal complementary capabilities lowers EMS adoption costs and external assistance. Firms with expertise can reach higher environmental performance and continuous improvement.
(Ghisellini & Thurston, 2005)	Decision traps in ISO 14001 implementation process: case study results from Illinois certified companies.	Quantitative analysis	There are no strict requirements for ISO 14001, most of the focus concerns legal issues.
(Heras-Saizarbitoria & Boiral, 2013)	ISO 9001 and ISO 14001: towards a research agenda on management system standards	Literature review	Research gaps are: perceptions of managers, employees and external stakeholders on ISO standards. Quality and transparency of third-party audits are in doubt.
(Heras-Saizarbitoria et al., 2011)	Do drivers matter for the benefits of ISO 14001?	Literature review	There is no consensus about which are the main drivers. Internal drivers to implement ISO 14001 perceive greater satisfaction.
(Jiang & Bansal, 2003)	Seeing the need for ISO 14001.	Qualitative analysis	ISO 14001 as a response of external pressures. Managers still need a reason to employ the standard (even if sustainability is an accepted value in the society).
(Massoud et al., 2010)	Drivers, barriers and incentives to implementing environmental management systems in the food industry: A case of Lebanon.	Quantitative analysis	Lack of knowledge, government incentives and resources are the main barriers for ISO 14001 certification.
(Perez et al., 2009)	The dynamic of corporate self-regulation: ISO 14001, environmental commitment, and organizational citizenship behavior.	Quantitative and qualitative analysis	ISO 14001 certified firms are institutionally committed to environmental issues.

(Rondinelli & Vastag, 2000)	Panacea, common sense, or just a label?: The value of ISO 14001 environmental management systems.	Case study	ISO 14001 improved internal environmental aspects but it is not a guarantee of such an improvement.
(Testa et al., 2018)	The effectiveness of EMAS as a management tool: A key role for the internalization of environmental practices.	Quantitative analysis	The level of EMAS internalization influences the number of investments. EMAS needs time to be fully implemented since it needs to be fully understood and requires a learning process.
(Testa et al., 2014)	EMAS and ISO 14001: the differences in effectively improving environmental performance	Quantitative analysis	EMAS satisfies also ISO 14001 requirements, but it needs more time to me implemented. At the same time, EMAS works better in the long-run while ISO 14001 focuses more on the performance in the short-run.

1.1.2. Findings from the literature review

Environmental Management Systems are adopted on a voluntary basis and can be implemented in any organization regardless of size, sector of activity or geographical location (Ghisellini & Thurston, 2005). The most used systems are the Eco-Management and Audit Scheme (EMAS, created in 1993 by the European Commission) and the ISO 14001 (developed in 1996 by the International Organization for Standardization). EMAS is currently certified in 3,975 companies located in the 27 countries of the European Union (and in the three of the European Economic Area) (European-Commission, 2021) and ISO 14001 in 300,000 companies in 171 countries (ISO, 2021).

The reasons for adopting an EMS can be various: there is no consensus among researchers on which is the main reason to introduce an EMS in a company (Heras-Saizarbitoria et al., 2011). Among the most common ones: pressure from the parent company, the search for a competitive advantage on the market, the real interest of management in improving environmental performance and the attempt to involve employees to innovate the processes and make them more sustainable (Boiral, 2007).

Environmental Management Systems require the development of a plan for compliance with the requirements imposed to obtain the certification: the fundamental environmental aspects to be checked and the objectives to be achieved must be evaluated, the method to continue to improve environmental performance is to be set and how to act in case of deviations from the plan. The entire system, therefore, needs to be properly integrated but also continuously overhauled throughout its implementation (Florida & Davison, 2001).

Both EMSs, to be internalized into the organization, require a Plan-Do-Check-Act (PDCA) process (Ghisellini & Thurston, 2005).

- Plan: assess the main environmental aspects and factors and set the objectives to be achieved to improve the sustainability of the business;

- Do: define roles and responsibilities for the activities to be carried out, train staff, document processes and communicate for the proper integration of the system;

- Check: keep track of performance to ensure that goals and the requirements for EMS certification are met. When problems arise communicate it to the responsible persons;

- Act: periodic management review to ascertain the continuous improvement of the performance and, in case of deviations from the objectives, take corrective actions.

Once the EMS has been implemented, the company must be assessed by an external company authorised by the authority (by the International Organization for Standardization for ISO 14001 and by a specifically trained verifier for EMAS). The certified company is then checked every six months (to check the continuous improvement of the system) and every three years must be subject to a new audit.

In general, EMAS includes the requirements of ISO 14001 certification and imposes compliance with other conditions such as the obligation to communicate the results externally (involving stakeholders) and the real involvement of employees (while the ISO 14001 standard is limited to simple training) (Testa et al., 2014). In addition, the European Commission's EMS needs more time to be put into operation than ISO 14001 because it needs to be more deeply integrated and requires more drastic changes in

business procedures (Testa et al., 2014) that must be adopted by employees through learning by doing (Testa et al., 2018).

The certification by a third party makes the message of the firm's attention to the environmental issue easier to communicate, without having to explain in detail to all stakeholders what are the activities and processes put in place (Jiang & Bansal, 2003).

According to Ghisellini and Thurston (2005), the problem with ISO 14001 is that it turns out to be more a standard that evaluates the management structure and not the actual change in environmental performance: in fact, the certification can also be adopted for commercial or marketing purposes to respond to external pressures. For Rondinelli and Vastag (2000), the certifications in substance guarantees the existence of a management system dedicated to the improvement of polluting processes but this does not always result in a real commitment to achieve the objectives set and, above all, it is not possible to verify it from outside the enterprise. Multinational companies, for example, tend to set high environmental targets to avoid breaching international pollution laws but are more concerned with standardising communication on their environmental commitment to meet customer demand, while at the same time leaving a lot of flexibility to their subsidiaries on how to meet environmental requirements (Christmann, 2004). Some managers said they remember the existence of ISO 14001 certification only in the weeks before the audits, when it suddenly became the most important topic of the day and in addition, how they prepare internally for audits (and if these audits contribute to the learning process) has not been deepened by any study (Boiral, 2011). It is clear that managers have great freedom in integrating an EMS and for this reason certifications cannot replace the environmental laws in force at national and international level (Perez et al., 2009).

The same problem also concerns EMAS: the level of integration of the environmental system and the seriousness with which it is implemented depends on the perception of managers regarding the benefits that the company can derive (Boiral, 2007). In addition, the degree of certification satisfaction also depends on the perception and therefore on the motivation of the managers (Heras-Saizarbitoria et al., 2011). Often, it is enough a symbolic implementation to ensure the certification of the EMS, therefore if the managers do not perceive its usefulness, they will do the minimum necessary to convince the certifier while, on the contrary, they would set serious environmental objectives if the customers and the suppliers had the necessary ability to monitor the environmental performance of their partners (Christmann & Taylor, 2006). In particular, small and

medium-sized enterprises do not have a specific department dedicated to the environment and decisions are centralised and taken by a small number of people. Therefore, compared to large companies, they do not have the necessary skills to consider the adoption of an EMS as a priority (Massoud et al., 2010). In addition, the perception of managers regarding their sector of activity and the level of pollution related to that field, further influences the sense of need to control their environmental emissions (Massoud et al., 2010). Lack of knowledge about the implementation of EMSs leads to under-estimation of the human and financial resources and time required for their adoption and can turn into a refusal of employees to adapt quickly to these new systems (Boiral, 2011).

From the literature review it seems that the research takes for granted the process of integration of the EMSs, as if it was standardized and equal for all companies, and the analysis focuses more on the results achieved, the costs, the documents to manage, the timing and motivation for the adoption of an EMS. From the analysis of these other aspects, however, it can be noticed the lack of knowledge both at the environmental level and about the EMS itself within the companies. Available research focuses on the quantitative aspect of the integration of Environmental Management Systems (like the implementation costs, the improvement in the chosen environmental indicators, the perceptions of managers and the effects on environmental performance), but these results cannot be generalized because, given the lack of a single method of adoption of EMSs, each company has different objectives and activities (Heras-Saizarbitoria & Boiral, 2013). According to Aragon-Correa et al. (2020), each company responds differently to external pressures regarding the sustainable aspect of its activities and, as found by Boiral (2011), it can happen that some organizations see certification as the ultimate goal while the right approach would be to consider it as a learning process involving the whole company. Consequently, the adoption of an EMS is not a guarantee of effective improvement of environmental sustainability (Boiral et al., 2018).

The integration of the EMS needs knowledge on the necessary documents and their purpose, the introduction of an environmentally-friendly culture and especially employee awareness (Boiral, 2011). If companies lack knowledge about environmental aspects and EMSs, they need to rely on external consultants who, however, should not have full responsibility for planning the integration of the EMS as it could create a gap between what is planned and the real work activities (this knowledge is in the hands of employees) (Boiral, 2011). In addition, if the knowledge of the consultants is not

integrated, there is a risk of not being able to perform the continual environmental performance improvement requested by the EMS, as the organization has not developed the capabilities necessary to do so (Boiral, 2011). EMSs must be adapted to the company and, as there is no single way to integrate them, managers must know how to do it and how to create the structure necessary to share information to create knowledge. Furthermore, in order to exploit the benefits deriving from environmental management strategies, companies must possess complementary assets, that is resources and capabilities (Christmann, 2000) that allow to reduce integration costs and allow to pursue a continuous environmental improvement (Darnall & Edwards Jr, 2006).

To investigate how EMSs are integrated in the company, the study of these systems and of knowledge integration must be treated together: the relation between EMSs integration and knowledge integration has been studied limitedly by the literature.

1.2. Focusing on the knowledge gap

The preliminary review of the literature based on the two recent literature reviews revealed that a significant knowledge gap exists when it comes to knowledge integration in the context of EMSs integration. Knowledge integration is necessary both to allow the adaptation of the EMS to the activities of the organization and for the continuous improvement of the environmental performance. The focus is on knowledge integration because the integration of an EMS requires the combination of different types of knowledge: the technical one related to operational activities, the environmental one and that of the system itself. In addition, this knowledge has different sources such as, for example, employees, consultants, managers, customers, and suppliers. In turn, the level of coding of knowledge influences its communicability: if it is explicit, it can be represented by writing or graphically, while, on the contrary, if it is tacit it is linked to personal skills, experiences and is therefore more difficult to communicate (Nonaka et al., 2006). Knowledge integration is defined by Zahra et al. (2020) as "an organizational capability for creating novel combinations of different strands of knowledge, which have utility for solving organizational problems, from component knowledge sourced from within and beyond the organization, and across time, and which derive from individual and group contributions, facilitated by both formal and social processes" (p. 163).

One of the attempts made was to try to understand if there were already some articles that, even if mainly dealing with quantitative aspects, could better clarify how to explore these knowledge gap, concerning EMSs, that was often only named and not analysed. In fact, given the limited availability of articles closely related to knowledge integration and EMSs integration, were also analysed articles that more generally dealt with environmental strategies (and the related environmental knowledge) and articles dealing with fundamental aspects in the integration of an EMS to understand their possible connection with knowledge integration.

1.2.1. Keywords research on Scopus database and articles selection process

To continue the research, the Scopus database has been used: the portal has over 81 million scientific documents, 17 million researcher profiles and 80,000 institutional profiles (Scopus, 2021). Initially, two separate research were carried out, focusing first on Environmental Managements Systems and then on knowledge integration in companies. Given the high number of results, both themes were then associated with other keywords (explained in detail later) to limit the number of articles found in Scopus and be able to deepen the chosen aspects.

To choose the articles to be analysed articles' abstracts have been read. The selected articles dealt with EMSs and their integration into the company, the choice of indicators for performance improvement, the capabilities needed for implementation and of course knowledge integration. Research have been carried out for very precise keywords as every time an article was analysed, new aspects were presented that it was necessary to deepen (sometimes certain factors had not been analysed in the context of EMSs by the literature, therefore more general research in environmental management's field was opted for). With regard to knowledge integration, the associated keywords covered environmental strategies, transdisciplinary cooperation (given that the integration of an EMS involves more than one organization's department), and environmental management.

Among the articles with qualitative analysis, mainly, those that had interviews as methodology were chosen. The focus was on analysis made through interviews because it was the most appropriate methodology to deal with the theme of EMSs and

knowledge integration, since I wanted to understand processes, experiences and opinions (Rowley, 2012) which were different for each organization given that there is no single way to integrate an EMS (Heras-Saizarbitoria & Boiral, 2013). The selected language was English, and all the articles were published between 2000 and 2021. Given the context of this study which pertains to the management of organizations the subject area filter "Business, Management and Accounting" has been added.

The algorithms used to search for articles on the Scopus database and the number of results obtained are described in Table 3 and Table 4. Each research is then explained under the tables.

Table 3: EMSs' articles research algorithm.

Search using only: “Environmental Managements Systems”	3,878 document results
Search with keywords: TITLE-ABS-KEY ("environmental management systems") AND (“knowledge integration”) AND (LIMIT-TO (SUBJAREA , "BUSI")) OR ((“Green management”) AND (LIMIT-TO (SUBJAREA , "BUSI")) OR (("ISO 14001" "Eco-Management and Audit Scheme")	32 document results
Final selected results: 5	

TITLE-ABS-KEY ("environmental management systems") AND (“knowledge integration”) AND (LIMIT-TO (SUBJAREA , "BUSI")) → 4 document results.

> The aim of this research was to analyse the limited research about EMSs and knowledge integration. Articles were limited to business area.

TITLE-ABS-KEY ("environmental management systems") AND ((“Green management”) AND (LIMIT-TO (SUBJAREA , "BUSI")) → 9 document results.

> The aim of this research was to investigate more generally the world of EMSs trying to understand if the strategies of green management analysed could clarify how to integrate an EMS. Articles were limited to business area.

TITLE-ABS-KEY ("environmental management systems") AND (("ISO 14001" "Eco-Management and Audit Scheme") AND (LIMIT-TO (SUBJAREA , "BUSI"))) → 19 document results.

The aim of this research was to learn more about ISO 14001 and EMAS certifications specifically, to try to understand how companies chose between the two standards. Articles were limited to business area.

Table 4: Knowledge integration's articles research algorithm.

Search using only: "Knowledge Integration"	3,332 document results
Search with keywords: TITLE-ABS-KEY ("knowledge integration") AND ("environmental strategy") OR (("transdisciplinary cooperation") AND (LIMIT-TO (EXACTKEYWORD , "Knowledge Integration")) AND (LIMIT-TO (LANGUAGE , "English"))) OR (("environmental management") AND (LIMIT-TO (DOCTYPE , "ar") AND (LIMIT-TO (EXACTKEYWORD , "Decision Making"))	13 document results
Final selected results: 4	

TITLE-ABS-KEY ("knowledge integration") AND ("environmental strategy") → 2 document results.

The aim of this research was to investigate more generally the role of knowledge integration in the field of environmental strategy (since it is not analysed in depth in relation to EMSs).

TITLE-ABS-KEY ("knowledge integration") AND (("transdisciplinary cooperation") AND (LIMIT-TO (EXACTKEYWORD , "knowledge integration")) AND (LIMIT-TO (LANGUAGE , "English"))) → 3 document results.

The aim of this research was to analyse how the cooperation and knowledge integration with customers and suppliers works. The search was filtered by

language (English) and the articles had to contain exactly the words "knowledge integration".

TITLE-ABS-KEY ("knowledge integration") AND (("environmental management") AND (LIMIT-TO (DOCTYPE , "ar") AND (LIMIT-TO (EXACTKEYWORD , "decision making")) → 8 document results.

The aim of this research was to investigate more generally the role of knowledge integration in the field of environmental management, in particular, decision making (since it is not analysed in depth in relation to EMSs). The search was filtered by language document type (articles) and the articles had to contain exactly the words "decision making".

The total number of articles resulting from this research was 45. Reading the abstracts, I excluded 36 articles: many of these articles, rather than dealing with the integration process, dealt strictly with the environmental consequences of EMSs (and so they were already a step further, directly explaining the effects and not the causes). Other articles, instead, had the focus on the legislative aspect and not on the managerial aspect, therefore, were not useful to understand the process of integration of EMSs in terms of adaptation of the operational activities of the organization. In other cases, the words "environmental management systems" and "knowledge integration" were simply quoted in the article but did not represent the main subject of the analysis. In the end, nine articles were useful in this step focused on the knowledge gap.

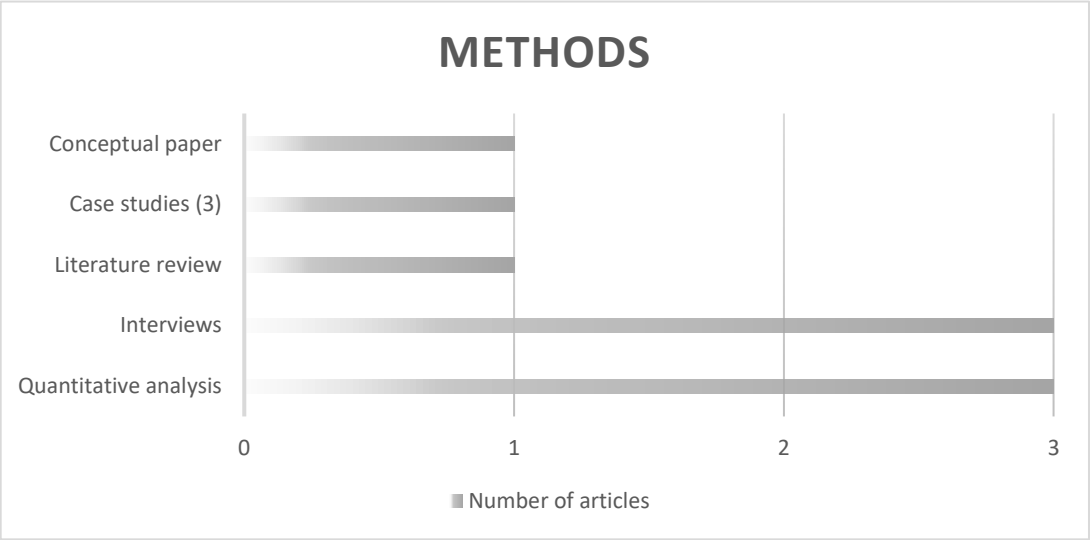
The journals of publication and the number of articles are summarised in Table 5.

Table 5: Journals of publication.

Journal of Cleaner Production	1
Accounting, Auditing & Accountability Journal	1
California Management Review (University of California)	1
Computational Water, Energy, and Environmental Engineering	1
Environmental Education Research	1
International Business Review	1
International Journal of Operations & Production Management	1
Journal of environmental management	1
Sustainability Accounting, Management and Policy Journal	1

The number of articles and the related methodology are summarised in Figure 4.

Figure 4: Methods and number of articles.



The articles related to this research point and their findings are summarised in Table 6.

Table 6: Articles from the Scopus research.

Authors, Year	Title	Method	Findings
(Essid & Berland, 2018)	Adoption of environmental management tools: the dynamic capabilities contributions.	Interviews	The presence of both internal antecedents leads to dynamic capabilities and to evolutionary environmental fitness. Dynamic capabilities allow the adoption of environmental management tools.
(Florida & Davison, 2001)	Gaining from green management: environmental management systems inside and outside the factory.	Quantitative analysis	Highly innovative firms use EMSs to improve their efficiency and relation with stakeholders (sharing information and exploiting employees' knowledge).
(Godemann, 2008)	Knowledge integration: A key challenge for transdisciplinary cooperation.	Conceptual paper	To integrate and create new knowledge transdisciplinary groups must share a common base and mental models.

(González et al., 2008)	Environmental management system certification and its influence on corporate practices: Evidence from the automotive industry.	Interviews	EMS is related to more pressure on suppliers to improve their sustainability (the extent depends on the firm's size but not on the internationalization). No difference between who implemented just one EMS and firms with both EMAS and ISO 14001. Larger companies have more capabilities and resources that lead to more environmental practices.
(Li et al., 2017)	The supply-side of environmental sustainability and export performance: The role of knowledge integration and international buyer involvement.	Quantitative analysis	International buyers could improve their performance by sharing environmental knowledge with suppliers. Through knowledge integration in the supply-chain firms can enhance market-oriented environmental sustainability.
(Perez et al., 2007)	Environmental management systems as an embedding mechanism: a research note	Interviews	Better integration of EMAS through the development of intangible assets and the drive for change starting from training and awareness, commitment to environmental improvement, consideration of stakeholders' interest and organizational learning.
(Pranugrahaning et al., 2021)	Corporate Sustainability Assessments: A systematic literature review and conceptual framework.	Literature review	It is not known how firms select environmental indicators. Reporting is useful for corporate sustainability.
(Raymond et al., 2010)	Integrating local and scientific knowledge for environmental management.	Conceptual model and a three case studies as an example	Firms must be aware on how to deal with existing and different types of knowledge that should be identified in an environmental project,

			evaluated, and integrated.
(Rebelo et al., 2014)	A methodology to develop the integration of the environmental management system with other standardized management systems.	Quantitative analysis	Integrating all management systems could cut costs, audits and improve competitiveness.

1.2.2. Findings from the Scopus research on EMSs and knowledge integration

From the analysis of the articles selected at this point in the literature review, several barriers have been deduced that may arise in the process of integration of an EMS and that are related to environmental knowledge integration. These barriers related to the knowledge involved in the integration of an EMS are summarised in Table 7.

Table 7: Barriers to the integration of an EMS.

Barriers to the integration of an EMS
Lack of strict requirements to obtain ISO 14001/EMAS certification.
Lack of managers commitment.
Lack of employees' awareness and environmental knowledge.
Lack of complementary capabilities.
Challenge in accessing diverse information.
Lack of dynamic capabilities.

- Lack of strict requirements to obtain ISO 14001/EMAS certification.

For Boiral (2011) the success of an EMS does not depend on the standard itself but on how it is integrated and implemented. However, as analysed by Aragon-Correa et al. (2020), the comparison between several companies adopting an EMS is not possible (even if it is the same ISO 14001/EMAS certification) because each organization implements a different strategy in response to external factors. Consequently, for Pranugrahaning et al. (2021), the analysis is impaired by the lack of data comparability because each company is free to set its own objectives and control them through the chosen indicators, which are therefore different from organization to organization. In general, the considered indicators are strictly related to costs reduction (Comoglio & Botta, 2012) and there are no major differences between who is EMAS certified and who is ISO 14001 certified (or even both) (González et al., 2008). Furthermore, the literature does not systematically analyse how these indicators are developed, what skills are needed and who is involved in the decision (Boiral et al., 2018).

- Lack of managers commitment.

Another important aspect for the integration of EMSs underlined by Boiral (2011) is the managers commitment: the integration process starts from the top of the company structure. Managers need to be aware that adopting an EMS (and then obtaining a certification) without integrating it seriously, limits the chances of benefiting from it both in terms of cost and efficiency (Testa et al., 2018).

It is essential that at least one manager for each department is involved in the integration process of an EMS, especially if the activities they manage have a high environmental impact (Ghisellini & Thurston, 2005). However, when managers are not aware of which are the environmental aspects to control and how EMSs work, they perceive the process of integration and adoption of the standard as a purely bureaucratic matter, influencing their perception and the desire to work to spread knowledge within the company (as a result, the EMS could be implemented in a superficial way) (Boiral, 2011). Furthermore, their level of participation also depends on the benefits that their department could derive from it: those involved in marketing, for example, will be more willing to commit because they can benefit from the certification more easily (Aragon-Correa et al., 2020). In addition, if managers do not have the necessary knowledge, they will not be able to centre efforts on the essential activities that can add value in the context of an environmental standard and will not be able to involve employees (Boiral, 2011).

- Lack of employees' awareness and environmental knowledge.

All systems, whether for quality, environmental or safety management, have as main actors the individuals involved in the development of the organization: managers at the top must take this into account and know how to ensure employee involvement in the lower levels because they carry out the daily activities (Rebelo et al., 2014). That is why, as noted by Perez et al. (2007), for a better integration of an EMS, training and awareness of employees is very important, not only with regard to the technical aspect of the activity with which they work but also with regard to environmental knowledge in general. The participation of employees in the process of EMSs integration allows top management to receive information that would otherwise remain unshared (they relate, in particular, to what is called tacit knowledge, namely knowledge that is not encoded and is therefore difficult to communicate) (Perez et al., 2007).

From the complete involvement of the employees and from the managers' support to the development of the EMS, the continuous improvement of the environmental performance can be assured (Perez et al., 2007). Furthermore, the firm can reach the creation of an integrated management system that includes multiple standards coordinated between them (Perez et al., 2007).

- Lack of complementary capabilities.

The strategy used to address the problem of environmental sustainability is based on specific features of the company: a set of tangible and especially intangible assets (Christmann, 2000). Complementary capabilities are assets necessary to implement strategies and exploit the related benefits (Christmann, 2000) like, for example, the capabilities needed to manage quality or safety management systems or the inventory can make it easier and profitable to integrate an EMS.

Larger firms have more resources and capabilities to implement environmental practices (González et al., 2008). The lack of complementary capabilities in the integration of EMSs requires the intervention of consultants and external experts to acquire the skills necessary to improve environmental performance. Relying on external professionals can put at risk the continuous improvement of the EMS (in the long-term) because if the knowledge of experts does not become an integral part of the organization, then in the future there will be no basis for process innovation (Darnall & Edwards Jr, 2006). That

can happen because the internal individuals lack the necessary knowledge to react to changes (Darnall & Edwards Jr, 2006).

For Boiral (2011), there may be a gap between what is set at the managerial level (as an environmental objective) and what is actually practiced every day at the operational level, since the knowledge necessary to integrate new objectives to daily activities comes mainly from employees, not external consultants. To prevent this misalignment from happening, innovative management practices (like self-managing work teams) are needed to best exploit of environmental and employee knowledge (Florida & Davison, 2001).

- Challenge in accessing diverse information.

The EMS strategy must consider the stakeholders' interests: their concerns must be understood and included in the decision-making process, whether they are individuals external or internal to the company (Perez et al., 2007). The inclusion of their interests can broaden the knowledge of all the staff, increase their commitment and improve communication between departments (Perez et al., 2007). The problem that could arise in developing the EMS strategy is that those who are responsible for and involved in the project do not have the necessary skills and knowledge to deal with the related issues. Another problem concerns the combination of different knowledge and disciplines in the same project: participants tend to share information already known to other members because having a shared information avoids conflicts and therefore knowledge that should be shared, so the unshared one, remains outside the debate and is not discussed. For successful knowledge integration, the group must be free to exchange information, understand points and create a common knowledge base (Godemann, 2008).

Some types of knowledge are explicit, easy to communicate while others are more personal and intrinsic (Raymond et al., 2010). In addition, the perception and interpretation of knowledge changes from person to person according to one's beliefs, so managers must be aware of this fact when trying to create a common knowledge (Raymond et al., 2010). The first step is to identify the problem (so how to integrate the EMS in the organization), subsequently discover the existing knowledge, join the different types of knowledge needed to find a solution, evaluate, and finally apply them (Raymond et al., 2010).

- Lack of dynamic capabilities.

The process of environmental knowledge integration must be continuous and allow to adapt to the changes that occur both during the creation of new knowledge within the company and in the long-term (in practice, knowledge needs to be adapted according to signals requiring a rapid response) (Raymond et al., 2010). It is a process that can be used in various situations such as, for example, the assessment of the seriousness with which customers and suppliers adopt an EMS or the exchange of resources with them: knowledge integration requires an awareness about dynamic capabilities within the company (Li et al., 2017). As defined by Helfat et al. (2009) a dynamic capability is "the capacity of an organization to purposefully create, extend, or modify its resource base" (p. 4). Dynamic capabilities concern the entire organization and are necessary to react to opportunities and threats through the reconfiguration of its resources using knowledge integration (Essid & Berland, 2018). Dynamic capabilities influence the integration of an EMS because if they are already well developed within the company, it becomes easier to integrate and exploit the new environmental knowledge (Essid & Berland, 2018).

In conclusion, all these barriers to the integration of an EMS are due to lack of environmental and EMSs related knowledge and have not been analysed in depth by the scientific literature. Consequently, this thesis provides a contribution to understanding how knowledge integration is managed in the context of the adoption of an Environmental Management System.

ENVIRONMENTAL MANAGEMENT SYSTEMS AND KNOWLEDGE INTEGRATION

2.1. Introduction to knowledge integration

Some companies superficially integrate the EMS and there are differences between what is declared as an environmental goal and what is actually done in practice (Boxenbaum & Arora-Jonsson, 2008). The superficial integration of an EMS can happen in case of strong external pressures, lack of resources and knowledge (Boxenbaum & Arora-Jonsson, 2008). In order to adopt actions consistent with the stated environmental objectives, the commitment of managers is necessary and the right acquisition of the knowledge of environmental experts (Heggen et al., 2018).

The purpose of knowledge management is to analyse how individuals, groups and organizations use knowledge to create a competitive advantage (Zahra et al., 2020). As competitive advantage is created through the exploitation of knowledge within the company, organizations need to know how to use the knowledge that already resides within them and integrate the missing knowledge from outside (Zahra et al., 2020).

In order to have a competitive advantage, organizations must be able to carry out their operations better than the competition: for this reason, they must integrate the knowledge necessary to improve their capabilities (Zahra et al., 2020). Knowledge integration is defined by Zahra et al. (2020) as "an organizational capability for creating novel combinations of different strands of knowledge, which have utility for solving organizational problems, from component knowledge sourced from within and beyond the organization, and across time, and which derive from individual and group contributions, facilitated by both formal and social processes" (p. 163). However, from the literature it is not clear how organizations carry out the process of knowledge integration (Zahra et al., 2020).

Knowledge integration is based on the exchange of information and the creation of a common understanding base (Godemann, 2008). Knowledge can come from external sources (Zahra & George, 2002) and from within the organization itself (both from the different departments and levels of the company) (Grant, 1996a). The knowledge of all

the company's participants must be combined together (Zahra et al., 2020) and an important role is played by the middle managers as they can identify the capabilities to be developed (Hornsby et al., 2002). Creating new knowledge and exploiting existing knowledge are both fundamental activities: just using the existing knowledge without producing new one can make it difficult for the company to survive in the long term (March, 1991). Therefore, the organization must foster the creation of knowledge by individuals (Nonaka, 1994).

The adoption and implementation of an environmental management system is influenced by complementary capabilities, that is, resources and capabilities (Christmann, 2000) that reduce integration costs and allow continuous environmental improvement (Darnall & Edwards Jr, 2006). The useful expertise, in order to avoid errors and excessive costs in the integration of an EMS, often derives from other management systems already used in the company (like, for example, the inventory management systems, health and safety standards) (Darnall & Edwards Jr, 2006). Companies that have developed the skills necessary for integrating a management system, already have in part a structure and a culture aimed at improving business efficiency and a continuous evaluation of the factors to be controlled to achieve the objectives set. In particular, in the case of companies with pollution prevention practices, employees have already been trained and already have skills regarding the environmental aspect of their activities (Darnall & Edwards Jr, 2006). For example, as shown by Florida and Davidson (2001), companies that already had a pollution prevention system were more likely to implement advanced and innovative environmental and management practices.

Companies must find the right structure to exploit the knowledge of individuals: this implies not only exploiting information but also knowing how to create new knowledge proactively to meet internal needs (such as, for example, wanting to gain a competitive advantage through innovation) and changes outside the organization. To innovate, the company must be able to understand what the new issues are, to investigate and address them through the development of new knowledge (Nonaka, 1994). The success of an environmental management system is based on the ability of the enterprise to integrate the environmental and managerial knowledge necessary to develop its capabilities.

2.1.1. Knowledge integration in the literature

Knowledge integration is interpreted by literature both as a process and as a capability (Zahra et al., 2020). The organizational process of knowledge integration concerns the collection of information from different sources, analysis, sharing and awareness of knowledge that leads to a commercial exploitation of it (Zahra et al., 2020). For this process, communication is necessary between the various levels, departments and individuals within the company to allow the development of a common knowledge base useful for the problem management and, in general, the achievement of objectives (Mitchell, 2006). However, from the current research on knowledge integration it is not clear how this process is carried out and, consequently, case studies are needed to understand the steps leading to the development of knowledge in an organization (Zahra et al., 2020).

When knowledge integration is designed as an organizational capability, the focus is on an organization's success in gaining a competitive advantage through knowledge integration and transformation (Zahra et al., 2000). To achieve this competitive advantage, routines are developed that aim to facilitate knowledge integration by identifying changes in the environment, the necessary information and their sharing (Zahra et al., 2020). The last two steps concern the creation of connections between the various types of knowledge and their deployment in specific situations (Mitchell, 2006).

2.1.2. The knowledge based-view (KBV)

The knowledge-based view highlights the importance of knowledge for the success of an organization: knowledge is the basis of strategies, capabilities and, consequently, competitive advantage in the market (Grant, 1996a). It is essential that organisations know how to efficiently exploit existing knowledge and implement mechanisms to integrate new knowledge in order to create innovation and value (Grant, 1996a).

2.1.3. Steps of knowledge integration

The first step of the knowledge integration process concerns the knowledge development and acquisition, that is the collection of the necessary knowledge deriving from different sources (Inkpen & Tsang, 2005). Subsequently, a knowledge valuation is performed (Cohen & Levinthal, 1990) to understand what information is useful and select the knowledge to integrate (Zahra & George, 2002). At this point, knowledge is transferred and shared where it is needed (Mitchell, 2006).

2.2. Employees' role in the integration of knowledge and of EMS

For Darnall and Edwards Jr (2006) there are differences related to the ownership structure that affect knowledge integration. On the one hand, publicly traded organizations have more economic and human resources and environmental skills. Private companies, on the other hand, tend to have a centralized control and decision-making structure and therefore the skills on which they develop their EMSs are mainly identified with those of the top management (Darnall & Edwards Jr, 2006). In this case, however, companies that limit their capabilities to a few individuals risk being fragile. Processes involving the entire organisational structure must be put in place in order to be competitive (Teece, 2007). In addition, private companies limit the training of their staff because they fear that employees can take advantage of the new skills acquired to be hired by larger organizations (Darnall & Edwards Jr, 2006).

The choice not to involve employees in the EMS could isolate managers from the reality of the lower levels that have more contact with the business and practical aspects of the organization. The involvement of all the staff in the decision-making process and the sharing of opinions are part of the aspects that develop capabilities needed to sense threats and opportunities. In addition, employees who lack knowledge become resistant to change: the existence of repeated standard procedures over time can create a barrier to innovation (Teece, 2007). Furthermore, Florida and Davison (2001) found that employees are a key part of the information sharing system and their knowledge helps to strengthen external relations with stakeholders in the field of environmental issues

because they act as proactive subjects in communicating with society (especially if they are local residents).

2.2.1 Knowledge integration in individuals

Knowledge integration in an organization is influenced by the characteristics of individuals as they, in turn, influence knowledge integration at the group level (Zahra et al., 2020).

Different individuals have different knowledge and the perspective of each one on the same knowledge is different (Grant, 1996b). According to the model developed by Mayer (1996), knowledge integration in individuals follows a selection-organization-integration process (SOI). The first step concerns the selection, that is the realization of what information is important and that are stored in short-term memory. In the next step, that is organization, the most important information is organized so that it is structured in a coherent way (Mayer, 1996). The final step (integration) consists in creating a link between the pre-existing knowledge that is localized in the long-term memory (Mayer, 1996). Eventually, the individual will have integrated the new knowledge into a logical and consistent structure with pre-existing knowledge (Zahra et al., 2020).

During the knowledge integration process, especially in the first two steps of the SOI model, attention plays a fundamental role at the individual level: when it comes to new knowledge, new situations or important decisions, conscious attention is required (Norman & Shallice, 2000). The attention is one of the cognitive capabilities and vary between different individuals by limiting the amount of information that a person can process and integrate into their memory (Zahra et al., 2020). In addition, the cognitive capacity needed to integrate knowledge varies depending on the individual's experience and the difficulty of the action to be carried out: the higher the experience the less attention is needed, on the contrary, the more complex the action the more attention is needed (Bower & Hilgard, 1981). As a result, individual skills influence knowledge integration at the group level, and in addition, the characteristics of the information to be processed (such as complexity, field, localization) may have an influence on the success of the integration (Zahra et al., 2020).

At the individual level, participation in the process of knowledge integration in an organization, can influence behaviours and strengthen the personal relationships of employees creating trust and facilitating information sharing (Zahra et al., 2020). Through participation in knowledge integration individuals can broaden their knowledge and understand the value of their activities, learn new skills that will also benefit the organization (Zahra et al., 2020).

2.2.2. External environmental consultants and knowledge integration

Companies that have gaps in sustainability skills rely on external consultants and experts who provide their expertise to implement the EMS (Darnall & Edwards Jr, 2006). However, for Cohen and Levinthal (1990), when the company tries to fill its gaps by expanding the number of human resources or by contacting external consultants, the success of such action is limited. Organizations may fail to integrate the external competencies with its own operations because is demanded a deep acquaintance of the activities of the company that only the employees can have (Cohen & Levinthal, 1990).

Anyway, external professional knowledge when exploited in the right way can get a different point of view from that of management, trying to solve the information asymmetries and biases that can lead to wrong decisions in the planning and implementation of an EMS. In particular, managers tend to introduce changes that are based on knowledge and assets already available (Teece, 2007), thus avoiding to really innovate the firm's techniques and achieving a relatively lower environmental performance improvement than the potential one.

Knowledge integration not only concerns the company's internal processes or external consultants, but it also concerns relations with buyers/suppliers in the development of sustainable practices. To coordinate their environmental efforts and monitor the proper implementation of the EMS, companies need to be able to share information. This coordination of their environmental actions can lead to a competitive advantage for all the organizations involved, because they share values born from the integration of the interests of the stakeholders, resulting in more sustainable products and better corporate image. Furthermore, companies have greater access to resources and create unique, non-replicable collaborative processes (Li et al., 2017).

However, for Boiral (2011), the choice of involving external consultants and actors, in the long term may hamper one of the main objectives of the EMS, namely the continuous improvement of environmental performance, because the necessary knowledge for this activity has not been integrated into the company and therefore lacks the internal capacity that deals with these environmental improvements. Therefore, with regard to the acquisition of environmental knowledge and the inclusion of external consultants, companies should see the introduction of an EMS as for a learning process that can last one - two years that aims to create new skills and not simply as a goal itself (Boiral, 2011). This different view of the environmental management system can decrease the dependence on external professionals and reduce the distance between the requirements to achieve the set performance and the internal practices (Boiral, 2011).

Companies, to be able to continuously improve their EMSs, should rely on organizational learning. Organizational learning can happen either by using the knowledge that comes from outside the organization (Zahra & George, 2002) or from inside the company (Tsai, 2002). In case of knowledge coming from outside we speak of absorptive capacity (Zahra & George, 2002). Absorptive capacity is the ability of an organizational to recognize the value of external knowledge and exploit it (Cohen & Levinthal, 1990). The absorptive capacity is highly relevant to integrate an EMS because organizations would have the ability to utilize the accumulated knowledge to integrate the EMS more efficiently (Tseng et al., 2021). Furthermore, the ability to integrate external knowledge depends on the learning capacity of the organization that serves to recognize and use new knowledge (Grant, 1996a).

2.3. How to deal with knowledge integration within an organization

To start a process of knowledge management and creation, the company must begin from the creation of groups in which individuals can share their knowledge in a constructive way for the team (and consequently for the entire organization) (Nonaka, 1994). The group could potentially also involve individuals from outside the company such as members of other firms or EMSs consultants. An important aspect is the redundancy of information: people sharing the same type of information can communicate effectively avoiding misunderstandings (Landau, 1969).

For Nonaka (1988), the ideal model for knowledge management is middle-up-down management: a fundamental role is also played by middle managers, not only by top management. It shall be possible for the information to circulate in all directions within a firm, both vertically and horizontally. This is because top management must give the vision and goals of the organization but the knowledge of how to achieve these goals is found in the lower hierarchical levels: employees have to deal every day with the fundamental activities of the company and are therefore fundamental in communicating their specific knowledge to those at the higher levels that have a knowledge that is often more generic and far from reality (Nonaka, 1988). Consequently, the creation of knowledge should start from the formation of groups led by middle-managers that integrate the expectations of top managers (Nonaka, 1994). In Boiral's (2011) research, most of the interviewed managers pointed out the importance of their support and commitment to the implementation of an ISO system, both for integration success and for employee participation. In fact, when leadership is lacking and these systems are perceived negatively by top managers, integration takes place in a superficial way within the whole company (Boiral, 2011).

2.3.1. Knowledge repository systems in organizations

Unlike individuals, who have a limited ability to manage and remember large amounts of information, organizations use knowledge repository systems that allow them to preserve past experiences making it possible to develop performances in the future (Argote & Guo, 2016). The two most known forms of knowledge repository systems are transactive memory systems and routines.

A transactive memory system consists of the individual memory systems of each individual and the communication that takes place between them (Wegner, 1987). Consequently, for the knowledge integration process, it is necessary that the members of a group are aware of who holds certain information useful for the creation of new knowledge (and that will be transferred through interpersonal exchanges) (Lewis, 2003). These systems are defined as integrated when all members of the group have a common knowledge and are aware of this fact, while they are defined as differentiated when different individuals have different information, but each member is aware of what information is held by whom (Wegner, 1987).

Transactive memory systems develop through the training of members and the sharing of experiences (Ren & Argote, 2011) in the context of problem solving. An organization with a transactive memory system benefits from being able to access the necessary information more easily and quickly and from a better use of the same information (Heavey & Simsek, 2017).

Routines are essential to understand the process of knowledge integration in organizations (Zahra et al., 2020). Routines are actions repeated and interdependent that are carried out by many individuals (Feldman & Pentland, 2003).

In routines, knowledge and past experiences are accumulated (March, 1963). Routines as they are repetitive and consolidated, avoid the reproduction of the process that led to the creation of the same routines and thus leave room for the use of cognitive skills for more complex actions (Weick & Roberts, 1993). Through small changes in routines, employees can expand their knowledge and skills: they learn how to integrate old knowledge and how to use it differently (Eisenhardt & Martin, 2000).

2.3.2. The learning behaviour in work teams

The process of knowledge integration at the group level is obviously influenced by the characteristics of the members and the set of experiences of the individuals and their relationships (therefore by the trust that exists between them and the amount of shared experiences) (Gardner et al., 2012). In addition, each information is interpreted differently by each member of the group, based on their knowledge, experiences, perceptions and fears related to the position of power: if there is a fear of loss of control, conflict situations could arise in which the sharing of information becomes complex (Zahra et al., 2020).

According to Cohen and Levinthal (1990) "learning is cumulative, and learning performance is greatest when the object of learning is related to what is already known" (p. 131). The ability to use information already developed to integrate new one is called absorptive capacity (Cohen & Levinthal, 1990). The concept of absorptive capacity leads to the conclusion that if a company does not invest in creating an initial knowledge concerning a fundamental field of its activities, in the future this same company will not be able to capture the opportunities regarding this field and will not be able to respond

proactively when necessary, therefore stopping to grow or doing it very slowly (and generally it will only activate when other factors are threatened, such as profit) (Cohen & Levinthal, 1990).

The learning behaviour of a work team within a company is based on activities that allow the group to adapt and improve, such as exchanging information, support, help, exchange opinions and assessments on the work done. The problem, however, is that these interactions often do not arise because group members tend to exchange common information rather than sharing new knowledge that is unfamiliar to others (Edmondson, 1999). In order for each member of the group to feel free to share new information, unknown to others without fear of consequences, there is the need to create a team psychological safety environment in which participants feel safe in interpersonal relationships, with the perception of not being criticized for their opinions and the belief that the group is able to use the information shared effectively (Edmondson, 1999). Psychological safety is defined by Edmondson (1999) as “a shared belief that the team is safe for interpersonal risk taking” (p. 350) and it involves the presence of relationships of trust and respect between the members of the group (Edmondson, 1999).

When information from outside is too complex, within the groups one or more individuals assume the role of gatekeepers/boundary-spanners (Tushman, 1977). However, for Cohen and Levinthal (1990), these gatekeepers are not enough: the target group must already have a common level of knowledge in order to communicate the new information effectively. Once a common basis has been found, the combination of different types of knowledge leads to new knowledge (Cohen & Levinthal, 1990).

Learning behaviour is also influenced by the individual’s ability to admit mistakes to other members of the group, but people find it difficult to do so because they are afraid to seem incompetent (Edmondson, 1999). The will to put into practice actions that are perceived as risky to one’s own image (for example asking for help) depends on the beliefs of each member with respect to the context in which it is located and the consequences it perceives as probable (Edmondson, 1999).

Edmondson (1999) describes learning within a group as "an ongoing process of reflection and action, characterized by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions" (p. 353).

2.3.3. Knowledge transformation

It is important that managers know how to structure and manage knowledge within the company because it is not enough that a small group is educated on what can be recognized as the knowledge necessary for the organization's field: knowledge should not be seen as a static factor but rather, interaction between different individuals can develop new knowledge (Nonaka, 1994). In order to implement environmental strategies, employee involvement across the organisation is crucial (Russo & Fouts, 1997). Through knowledge integration it is possible to increase employee involvement and to increase the level of organisational learning on how to best carry out operational activities (Wouters & Wilderom, 2008).

To manage the process of knowledge integration, it is necessary to know that organizational knowledge is composed by tacit and explicit knowledge (Zahra & George, 2002). Through training, employees can acquire the explicit knowledge needed to integrate the EMS (Biscotti et al., 2018). Employees interaction and exchange can transform tacit knowledge into explicit knowledge: tacit knowledge concerns the most hidden aspect of knowledge, that is, the whole part of knowledge that is not possible to communicate to others because it is not translated in a systematic and comprehensible way through a common language for all other people and it is influenced by the individual's perspective and beliefs (Nonaka, 1994). When knowledge can be communicated and transferred, we speak of explicit knowledge (Nonaka, 1994).

Tacit knowledge is acquired through experiences and therefore different people with different experiences may struggle to communicate with each other (Nonaka, 1994). Through socialization, or the process of sharing experiences, this tacit knowledge can be shared between multiple individuals (Nonaka, 1994). To be transformed into explicit knowledge, it must undergo an outsourcing process, using a metaphor (such as, for example, the creation of a prototype) (Nonaka, 1994). Conversely, the starting point could be external knowledge: to become tacit knowledge it must undergo a process of internalization (through the "knowledge of experience" or the ability to rationalize the lived experience, learning) while through combination can remain explicit but create new knowledge via the use and management of existing knowledge (Nonaka, 1994). At

the company level all these processes should ideally take place simultaneously and continuously (Nonaka, 1994).

2.4. Dynamic capabilities and EMSs

Organizational capabilities play a fundamental role when environmental management systems are introduced and adopted: organizations do not all possess the same capabilities, intangible and tangible assets (Peteraf, 1993) and this may explain the fact that there are multiple strategies to integrate the same EMS. The study of organizational capabilities can be carried out using the dynamic capabilities approach. Dynamic capabilities are important because organizational capabilities are influenced by knowledge management or, by the creation, integration, and exploitation of knowledge (Teece, 1998). Furthermore, dynamic capabilities are essential to creating new knowledge to change the organization's resources in order to react to external changes (Makadok & Barney, 2001).

Dynamic capabilities are the means used by companies to change their resources (both at the management level and acquisition level), are essential to create a competitive advantage (Grant, 1996b) and allow the continuous renewal of company capabilities (Teece et al., 1997) . However, for Eisenhardt and Martin (2000), the competitive advantage, does not depend on and is not assured by dynamic capabilities: a fundamental role is played by the speed with which organizations adapt their capabilities to take advantage of new emerging dynamics (beating its competitors on timing).

Dynamic capabilities represent a company's ability to: capture (sensing), exploit threats/opportunities (seizing) and reconfigure its resources to integrate new knowledge (reconfiguring) (Essid & Berland, 2018). Resources include the organization's individuals, tangible, and intangible assets (Essid & Berland, 2018).

Dynamic capabilities make it possible to reconfigure a company's ordinary operational capabilities in order to evolve and develop. These capabilities play a fundamental role in responding to aspects associated with the environment but how they intervene and what are the factors that influence the formation in the context of the EMS remains a field unexplored by research. There is also no consensus on how dynamic capabilities are formed (Essid & Berland, 2018).

Organizational learning takes place both thanks to knowledge management and dynamic capabilities (Easterby-Smith & Prieto, 2008). Furthermore, dynamic capabilities depend on the creation and exploitation of knowledge (Levinthal & March, 1993). Knowledge can also be considered a capability (Gold et al., 2001) as it develops business routines and serves to reconfigure resources based on knowledge derived from different departments (which manage different activities of the organization) (Easterby-Smith & Prieto, 2008). The learning process connects knowledge management to dynamic capabilities: the exploration and exploitation of knowledge undergoes a learning process that in turn influences both dynamic capabilities and knowledge management (Easterby-Smith & Prieto, 2008).

Dynamic capabilities are developed through several antecedents, which are both internal (individuals, pre-existing processes, and structure) and external (networks/relations and changes in institutional environment, technology, and market) to the company (Essid & Berland, 2018).

Antecedents and capabilities are linked in many ways:

- Individuals and processes participate in identifying threats/opportunities that may arise from both internal and external antecedents (sensing capabilities).

- The ability to manage threats and opportunities develops through leadership, corporate culture, and business model, therefore through all internal antecedents (seizing capabilities).

- Knowledge management, administration and decentralization of the decision-making process contribute to reshaping the capabilities themselves (reconfiguring capabilities).

The research of Essid and Berland (2018) identified the following antecedents of dynamic capabilities in French companies:

- Visibility and legal constraints for the institutional environment
- Existing organizational processes and accumulated knowledge for the structure and processes
- Leadership and managerial commitment for the individuals

An example of how the various factors interact with each other is the presence in four companies of a structure and processes aimed at managing environmental dynamics that

proved to be useful when new State laws were introduced for sustainability: these organizations have not undergone a major change in internal procedures as internal environmental culture and knowledge were already developed and tested. These procedures simply had to be adapted without excessive effort of resources. The same thing happened to individuals: the employees were motivated, there was good internal communication, and the managers were sensitive to environmental aspects. Consequently, the adoption of an EMS has been largely influenced by this knowledge and past factors (Essid & Berland, 2018).

The link between the antecedents and the dynamic capabilities is represented by routines. Each routine is set so that it can manage a particular antecedent, such as the use of strategic monitoring in order to react to external changes. In case of a company operating in a highly unstable market, routines on which the dynamic capabilities are based are extremely simple because they must be able to be promptly adapted and changed according to the new situations and the new knowledge that has been created to face the new challenges (Eisenhardt and Martin 2000). The combination of routines in response to antecedents develops dynamic capabilities. The strategic monitoring mentioned before, in fact, develops the sensing capabilities (Essid & Berland, 2018).

The development of dynamic capabilities then leads to the concept of technical and evolutionary fitness (Essid & Berland, 2018). The technical fitness derives from ordinary capabilities and concerns their efficiency in performing a specific activity, while the evolutionary fitness derives from the dynamic capabilities and concerns how well the capability enables a firm to make a living. Therefore, with ordinary capabilities, basic and everyday activities are carried out, while with dynamic ones companies are proactive in responding to specific needs by modifying their resources and adapting them to the best (Helfat, 2007). In particular, the ability to reconfigure resources allows the organization to avoid having to drastically change the corporate structure thanks to the adaptation of already implemented routines (Teece, 2007).

Companies characterized by the presence of external antecedents and only one internal antecedent seem to reach only technical fitness in the integration of an EMS; organizations that present both the structure, processes and individuals prepared to deal with environmental aspects reach evolutionary fitness (and present the use of integrated management systems) (Essid & Berland, 2018).

The competitive advantage of companies is based not only on resources difficult to replicate but also on these dynamic capabilities which are difficult to develop (Teece, 2007). They represent intangible assets which are based on knowledge that is not easily acquired on the market and therefore cannot be recreated. Companies must be aware of this and encourage the creation and internal exchange of such knowledge through structure, processes and behaviours aimed at this purpose (Teece, 2007).

2.5. From theory to practice

In conclusion, the purpose of this chapter was to analyse how knowledge integration can influence the process of an EMS integration. Taken as a separate subject, knowledge integration influences countless aspects of the company. In relation to the integration of an EMS, the research carried out until now on knowledge integration in companies can help to understand how knowledge can be used to implement the system (which specifically needs environmental knowledge).

Environmental knowledge must be shared within the company to ensure the employees involvement, they play a key role in the implementation of the Environmental Management System. The environmental knowledge has several sources: external consultants, buyers, and suppliers with which the company relates. It is not enough to rely on their feedback and adapt to their indications to integrate an EMS: their knowledge must be integrated within the company to be exploited in the long-term. Therefore, it is necessary to know how to deal with knowledge integration within an organization: in integrating an EMS the information regarding environmental aspects must be free to move within the company in every direction (both from the top to the bottom, and vice versa and horizontally).

Knowledge integration goes beyond the company in its entirety, it concerns also organizational groups. In these organizational groups a common knowledge is developed (through the learning process). Once this common knowledge is created, information can be exchanged and, therefore, communication between different individuals becomes possible. This aspect is fundamental for the integration of an EMS: as has emerged several times in the literature, the involvement of the entire company's individuals is strictly necessary to avoid a superficial implementation of the EMS. To

integrate EMSs, companies need to identify the activities and environmental factors to control, decide how to monitor environmental performance, find solutions to problems that had not been treated before (all this process is made through knowledge integration).

Consequently, the purpose of this thesis is to analyse how companies integrate environmental knowledge to integrate Environmental Management Systems.

RESEARCH METHODOLOGY AND ANALYSIS

It is not possible through a survey to understand which are the processes that improve the integration of an EMS in a company (both at the level of new routines and at the level of employee involvement) in response to external changes that need proactive reactions (Testa et al., 2018). There is a need to understand complexity, the obstacles, and the different methods of developing strategies regarding the integration of an Environmental Management System and an in-depth study of the experiences of managers can clarify what are the approaches to the environmental management of a company (Boiral, 2011). Despite the high number of companies adopting an EMS, the entire integration process of these systems is largely unexplored (Boiral, 2011). EMSs require specific environmental knowledge to understand their usefulness, and this knowledge should be integrated with the business activities, involving most employees (Boiral, 2011). Consequently, qualitative analysis is better suited to understand and deepen the actions carried out in order to integrate EMSs in companies, keeping into account the necessary knowledge for it to be managed efficiently (Boiral, 2011).

An exploratory approach based on a qualitative methodology was used to investigate how ISO 14001 and EMAS certified companies overcome barriers to the EMS integration process through knowledge integration. The research is based on case studies because the aim was to deeply understand a contemporary phenomenon and its context (Yin & Davis, 2007). The research was based on theoretical framework (Yin, 2009), because the aim was to test the validity of existing theory on barriers to the EMSs integration in relation to knowledge integration. The study has used a multiple-case design: the first step was theory development, then case selection and data collection (Yin, 2009). Each case study was analysed individually and then, each case's report was used to find differences/similarities between cases.

Specifically, the research was conducted through interviews. The interviews were semi-structured: the topic was predetermined; the main questions had already been developed but adaptable during the interviews. The questions asked are summarised in the next paragraph in Table 10. The questions required open answers. The aim was to investigate who was involved in decisions regarding the adoption of the EMS, and how knowledge was integrated.

3.1. Sample and data collection procedure

The selected companies have obtained an ISO 14001 or EMAS certification at most two years ago. The choice of this criterion is due to the fact of wanting to avoid retrospective bias. Talking about a process that took place too many years ago could have complicated the memory of the various phases of the EMS integration.

The companies were chosen with a non-probabilistic sampling: convenience sampling. Organizations were contacted via email and subsequently interviewed via video call (except in one case, where responses were sent via email). For each company there was only one interview.

To contact companies based on the criterion (therefore, an ISO 14001 or EMAS certification obtained no more than 2 years ago) I used three resources. The first resource was the list of EMAS certified organizations indicated by the Higher Institute for Environmental Protection and Research (ISPRA), which is an Italian public research body. The second source, used to search for ISO 14001 certified companies, is the Accredia database (the only accreditation body in Italy). The last resource used is an online platform created to connect university students and companies: Thesis 4u.

Table 8: Firms interviewed.

Firm	Sector
Air Dolomiti S.p.A.	Aviation
ETC Engineering S.r.l.	Health and environmental engineering
Paneco Ambiente S.r.l.	Ecological services
SICET - Società Italiana Centrali Elettrotermiche S.r.l.	Energy
Siram Veolia S.p.A.	Environmental services
S.A.Ba.R. Servizi S.r.l.	Waste management

Table 9: Role of the interviewees.

Firm	Role in the company of the interviewee	Role in the EMS integration
Air Dolomiti S.p.A.	Passenger satisfaction and environment Director	Manager
ETC Engineering S.r.l.	Co-founder / Director of operations	He is part of the top management that decided to adopt the EMS and appointed the project supervisor
Paneco Ambiente S.r.l.	R&D System Specialist*	
SICET - Società Italiana Centrali Elettrotermiche S.r.l.	Plants Director / special attorney	Manager
Siram Veolia S.p.A.	QHSE Manager	Manager
S.A.Ba.R. Servizi S.r.l.	integrated management system Manager (for the part of environment and quality)	Manager

*The answers were sent through e-mail by the R&D System Specialist who asked his colleagues for information because the integration of the EMS took place before his recruitment into the company.

3.2. Description of findings

The interviews were semi-structured, therefore, for each company there were some specific questions related to the characteristics of each organization (to clarify, for example, on which sites the certifications were obtained). All interviews were made in December 2021. The pre-set questions are listed in Table 10.

Table 10: Questions asked.

Questions
Can you tell me about the process of integrating the environmental management system? (From whom was born the idea of adopting such a system and how it was integrated into the company)
Who was involved in the integration process?

What difficulties have been encountered in the integration process? How have they been addressed?
Do you think the system is well integrated in the company? If so, what was fundamental to the success of such integration?
What was the biggest change within the company?
What are the activities put in place for the continuous improvement of environmental performance?

From the questions listed above, in Table 10, six main topics related to the integration process of an EMS were found. The topics are:

- the adoption and integration process of the EMS,
- environmental knowledge within employees
- difficulties encountered in the integration process
- perceptions of the EMS integration
- the key to successful integration
- changes within the company after the EMS integration.

Below, case by case, the information that has been collected for each topic.

3.2.1 Air Dolomiti S.p.A.

Air Dolomiti S.p.A. is an Italian airline, founded in 1989 and owned by Deutsche Lufthansa A.G. The head office is located in Villafranca di Verona (Italy), and it operates from several Italian cities to and from Munich and Frankfurt (Germany). In 2020 the number of employees was 752 and the company closed 2021 with 112,798,842 Euro of revenues.

The company is ISO 14001 certified since the end of 2020 and is the first Italian airline to be EMAS certified since April 2021. The interview was conducted with the passenger satisfaction and environment Director.

The adoption and integration process of the EMS

The drive to adopt an EMS came from the parent company Deutsche Lufthansa A.G., that is certified ISO 14001 and EMAS for longer than Air Dolomiti S.p.A. The Italian

airline was already certified ISO 9001 (for quality) and 27001 (for information security) before the adoption of the EMS, so they were used to evaluate activities concerning a management system and thinking in procedural terms.

The organization decided to acquire both ISO 14001 and EMAS certifications. In order to be EMAS certified, an environmental analysis must be carried out and an environmental declaration must be prepared (which must be validated by a certifying body). Therefore, as these steps are a prerequisite for EMAS, the company decided to also certify ISO 14001.

The first step for the EMS integration was the environmental analysis. The environmental analysis was managed by the Passenger satisfaction and environment Director. She had the task of managing and coordinating the activities necessary for the effective integration and maintenance of the EMS. In addition, Air Dolomiti S.p.A. relied on an external consultant because no one in the company had the necessary skills to evaluate environmental processes. They were all new to an environmental audit.

For the environmental analysis, meetings were held with the various departments; therefore, the departments that could be more involved at an environmental level were selected by the Passenger satisfaction and environment Director. These departments were chosen both for the actions carried out and to collect information, because the first step is to carry out an environmental analysis that involves the whole company.

The environmental analysis consists of a document (of about 80 pages) in which are described the aeronautical context of the company, and the territorial entities (ENAC, ENAV) and world bodies (ICAO). Within the environmental analysis it is also necessary to carry out the risk assessment. The company analysed who are the stakeholders (entities, Deutsche Lufthansa A.G., employees). Then, the environmental impact and the importance of these impacts for each stakeholder and the risks in environmental terms were evaluated (linked to non-compliance with legislation or suppliers who do not dispose the waste correctly). The risk of image loss is also assessed in the case, for example, of suppliers who do not properly dispose of waste relating to Air Dolomiti S.p.A.

After the environmental analysis, internal audits were carried out. Therefore, the Controlling & Internal Auditing Director chatted with the departments' managers. Once all the information was collected, it was decided with the managers and the Passenger satisfaction and environment Director which were the most sensitive areas to be reported in the environmental declaration. Furthermore, they decided the improvement objectives, which must be measurable, and they have to be updated every year. For example: there are no more plastic bottles in the on-board service and those that are put back in the trolleys to return to the catering are thrown away according to the separate collection. Another example is that from January 2022, the aircraft's seats became

lighter and, consequently, the entire airplane will consume less fuel (the index to keep under control this saving is translated into hours of flight, the more they fly the more they will save fuel).

Environmental knowledge within employees

The attention to the environment had already been addressed mainly by flight attendants. Flight attendants have always had the opportunity, at the end of every flight, to send a report in which they had already reported some ideas regarding the environmental aspects and the same thing for passengers.

After the choice to certify EMAS and ISO 14001, the company was informed: the President sent a communication to all employees indicating that the Passenger satisfaction and environment Director would oversee the certification so that when they were contacted by the manager, they knew what information was required and for what purpose.

During the next steps of the certification, communications were always sent to the employees but there were no courses, the organization assessed that the environmental awareness within the company was already sufficient.

To get employees more involved, the Passenger satisfaction and environment Director created a group called "ENviron Promoters" (EN is Air Dolomiti S.p.A. 's flying acronym). This group would help the Director to collect information from the departments and raise awareness among employees. Participation in the group was free and voluntary. Sixteen colleagues signed up and get together once a month and did a series of activities. The activities concerned:

- the collection of operational procedures and data collection;
- the identification and evaluation of the significance of environmental aspects;
- the drafting of the EMS' documents;
- the definition of the contents of the environmental declaration;
- the proposal of actions to improve and monitor the objectives set.

The members of the "ENviron Promoters" group came from departments less involved in environmental aspects like the PR or general office. The members' feedback was positive because, coming from departments less exposed to the environment, these employees felt involved. In the beginning they helped with the aspects necessary to obtain the certification and subsequently, with the environment Director, they evaluated new projects for the next years to raise awareness among employees. The group also carried out activities related to days dedicated, for example, to the collection of used clothes to donate to associations. So, in addition to sending communications to all employees regarding environmental activities, there is this group that helps raise awareness among colleagues on environmental aspects. The group had the idea of

creating the "environmental tips of the month". These tips appear on the home screen of the company's informatic system (used daily by employees) and every month they give advice on certain environmental aspects (for example, in December there were advice concerning the heating of buildings).

Difficulties encountered in the integration process

The certification was planned for April 2020, but the activity was reduced due to the COVID-19 situation. Consequently, the process was postponed, hoping to be able to do it in person and not remotely. It was postponed to October / November 2020: the first step was the documentary analysis of the various technical aspects, and the second part was done online because it was done during the second wave of COVID-19. Therefore, for the Passenger satisfaction and environment Director, it was difficult to manage and obtain the certification working remotely: it was necessary to organize the work according to the work shifts of colleagues and it was difficult to find each other. However, the colleagues were very helpful and in case of doubts there was always the possibility to ask the consultant.

Perceptions of the EMS integration

According to the Passenger satisfaction and environment Director, there has always been good willingness on the part of employees to provide information and data. Therefore, she considered successful the integration of the EMS because there were no obstacles on the part of colleagues and, indeed they seemed to agree on the choice of certifying the company on an environmental level. In the organization, some individuals were more sensitive to the environmental aspect than others but, in general, there was good involvement. That was proven by the fact that the Director received reports (on some aspects to be improved) without the need for the President to send communications in which he invites employees to report any waste.

The key to successful integration of the EMS

For the Passenger satisfaction and environment Director, the key to the successful integration of the EMS was the fact that the certification was not perceived as a forced thing. On the contrary, it was presented as an opportunity, for all employees, to evaluate their actions and to be able to communicate all the activities that outsiders were not aware of (through the environmental declaration).

Another key factor was the establishment of better relationships with the various colleagues by speaking in a very transparent way about the certification and the different steps. The employees have known each other for a long time so, for the Passenger satisfaction and environment Director, this made a lot of difference in communicating with each other (she did not struggle to find information).

Changes within the company after the EMS integration

The biggest changes noted by the respondent were: (1) the setting process of the environmental goals for the next years, and (2) the checking of the improvement objectives to be achieved (why and how). The Passenger satisfaction and environment Director must set achievable objectives in which they believe and, consequently, raise awareness among colleagues about the importance of the objectives set and the possibility of achieving them. In the organization's context, in which there is not a production department (where it is easier to evaluate the environmental aspect) it is more difficult to communicate objectives to the outside actors avoiding misunderstandings, so they try to set achievable and communicable objectives.

If the objectives set do not entirely depend on the company, the Passenger satisfaction and environment Director tries to adjust the required years to achieve the goal. For example, regarding the snacks' packaging that they buy from other companies, Air Dolomiti S.p.A. decided to have them in recycled paper by 2025, hoping that suppliers will be able to meet the deadlines.

A few months after setting objectives, the Passenger satisfaction and environment Director has a meeting with the managers to understand where they are with the achievement of the targets (which are not perceived as an obligation, but they are recognized as important). In this way, the managers feel involved throughout the year and not only at the end of the year when the Passenger satisfaction and environment Director requests data.

3.2.2. ETC Engineering S.r.l.

ETC Engineering S.r.l. is specialized in the design and management of plants for the treatment of primary water, wastewater, solid waste, and contaminated sites in all areas of health and environmental engineering. In addition, it provides technical and scientific support in the choice of solutions for saving, resource recovery and the minimization of management costs.

It was founded in 2003. The main office is in Trento, while the other offices are in Bologna and Bari. The operating structure of the organization, at the end of 2021, consisted of 51 employees, including the three shareholders and 36 environmental engineers. At the end of 2020, the company reported revenues between 1,500,000 and 3,000,000 Euro.

ETC Engineering S.r.l. is certified ISO 14001 since the beginning of 2020. The interview was conducted with the Director of operations (who is also co-founder of the company).

The adoption and integration process of the EMS

The EMS was the third in a certification that started with ISO 9001 and 45001 (for quality and safety). Consequently, the ISO 14001 was perceived as part of a natural process.

The idea to adopt an EMS came from the fact that the company operates in the environmental field. The aim was also to have an internal logic of consistency with what the company deals in the market, since ETC Engineering S.r.l. proposes environmental projects and solutions. Even though it is a small service company with a relatively low environmental problem, the company decided to manage this certification challenge more than anything else as an issue of internal know-how, to avoid any internal inefficiency.

As highlighted by the Director of operations, ISO 14001 has entered the firm's policy. In all the procedures it gives the organization the opportunity to keep under control its waste production, consumptions but also to develop some policies (for example, the policy on the use of company cars, what kind of car to buy, and the management policy of remote customers' interventions).

On an existing system (for quality and safety), the environmental part was integrated by appointing an employee (indicated by the administration) as manager of the whole system (including quality, safety, and environment) and identifying a group of people within the company who would have helped for the quality part, for the safety part and for the environment part (for example, with environmental controls).

Process of environmental analysis

By doing an internal analysis with the people who voluntarily made themselves available for this environmental part (mainly two people) came up that the production of waste was mainly linked to what people do. These two volunteers helped in the choice of the environmental aspects to keep under control by asking the employees about the environmental impacts they thought they were causing. For example, the two volunteer and the integrated system manager estimated that the greatest impact was related to the fact that they moved a lot with the car to reach their customers.

The waste they produce was mainly due to lunch: there are 50 people who eat every day (therefore residues) and buy lunch (producing light packaging). Furthermore, they had also the typical refusal of the service company: the paper.

Subsequently, it was decided what actions to take to improve the environmental aspects that they had identified. It was also nominated by the administration a responsible, among the employees, for the maintenance and control of the EMS.

External consultants

External consultants from a management consultancy firm were involved for the drafting of all procedures, for the drafting of the entire plan, the integration of policy, models, and collection of various records. Before going to the end-of-year audit, ETC Engineering S.r.l. did the internal audit with the consultants.

Environmental knowledge within employees

Since most of the employee had above-average environmental knowledge (36 employees out of 51 were environmental engineers), training was linked to the management system and not to environmental aspects.

An internal project related to car sharing was also done, in which the groups that managed to reduce emissions the most received a prize. People left home and made groups to come to the office and the company bought electric bicycles for some employees.

Difficulties encountered in the integration process

According to the Director of operations, there were no difficulties. The main issue was to have the real and active participation of people.

The only integration that was a bit more out of the standard was linked to the environmental emergency team that was created by the administration to manage the unlikely environmental problems (concerning the analysis related to small quantities of chemicals in the office). The identification of environmental risks is part of the initial environmental analysis. It was a bit out of the ordinary because the risk evaluation had to deal with extremely unlikely problems. They had to predict accidents with a very small impact (because the volumes of chemicals were limited).

The key to successful integration of the EMS

As a key to the successful integration of the EMS was highlighted the fact that the employees were all involved. The management evaluated the adoption of the EMS, after which they appointed a manager who would then follow the project because otherwise it would not have worked. For example, in the company's office they have plants, so a plant management group was created in which people took care of the plants constantly.

It was also appointed that the disposal of separate collection can work only if there is a self-control of people. If it were something decided by the management and imposed on the employees, it would not work because afterwards there is almost a reaction to an imposition.

Employees' involvement

Meetings are held periodically (not monthly) because the issues related to the EMS do not create particular problems. In correspondence with the quarterly checks of the

activities, the environmental one is also carried out, which usually does not have major problems.

For example, the last environmental issue was linked to the internal redistribution of separate collection bins because in winter people do not go out to eat and stay in the office a lot: they had to strengthen separate collection because there was more waste and there was more packaging.

Actions taken to pursue the continuous improvement of the environmental performance

Every year, during the audits, they have an environmental improvement plan. The objectives identified were linked to the reduction of emissions during travel (because of the several kilometres) and to the consumption of paper. They inserted counters related to the production of paper, the same goes for what concerns the disposal of toners. In addition, the remote management of customers' meetings has been proposed and the transfer of people now is monitored, trying to understand how many kilometres they travel per month. Where possible, invoices are monitored (consumption) and emissions are monitored with internal meters (trying to keep the check on the goal achieved quarterly or even every six months).

Furthermore, they have an audit plan, so there are indicators that they establish annually. However, the Director of operations noted that it is not easy to pursue the environmental goals because for people, in general, it is hard to realize how much waste they produce (and their environmental impacts are mainly related to what people do).

For example, for what concerns safety, it is easier for the employees to understand which are the risks, because they are more tangible. Consequently, the environmental goal is uncomfortable, because by now there are high volumes of packaging, labels that are inside, the instruction booklet, the guarantee, and eventually is generated a lot of waste. All this issue, in the company, is multiplied by 51 people, and by 200 working days a year: the volume of garbage is huge.

3.2.3. Paneco Ambiente S.r.l.

Paneco Ambiente S.r.l. is an Italian company based in Cuneo. The company offers products and services related to ecology, green economy, and micro biodiversity. It has over 40 years of experience in biotechnology. The company, for example, deals with the production of biotechnological products for:

- occupational sanitation in public and industrial spaces;

- neutralisation of odour emissions in industrial environments;

- elimination of algae in water bodies;

- air purification of domestic and public spaces.

In 2020 it recorded revenues of 469,414 Euro and a number of employees between 11 and 50.

Paneco Ambiente S.r.l.'s EMS is certified ISO 14001 since the end of 2019. The interview was conducted through e-mail with the R&D system Specialist.

The adoption and integration process of the EMS

The adoption of the EMS came upon the will of the Legal Representative. The adoption the EMS was a strategic decision because the aim was to sustain the improvement of the company's overall performance and build a solid foundation for sustainable development initiatives.

The potential benefits for the organization, deriving from the implementation of an environmental management system based on the international standards ISO 14001, were:

- the ability to regularly supply products and services that meet the customer's requirements and the applicable mandatory ones;

- facilitate opportunities to increase customer satisfaction;

- addressing risks and opportunities associated with its context and objectives.

Environmental knowledge within employees

From joining the company, the policy adopted for each employee concerns spreading the culture of environmental protection at the various levels of the organization through awareness-raising, empowerment, and continuous training of employees. Furthermore, the company communicates its policy to all suppliers and those who work for the organization.

All company personnel were involved in the EMS integration process.

Difficulties encountered in the integration process

No significant difficulties arose.

The key to successful integration of the EMS

The EMS is perceived as well integrated into the company. As successful keys to the integration were highlighted:

- the identification of the requirements of customers, users, local authorities, and interested parties;

- the evaluation of the significant environmental impacts;

- the improvement of the quality of services with regard to the environment by identifying and assessing the related risks, in the awareness that this improves the effectiveness and efficiency of the services provided;

- the continuous improvement processes;

- the fulfilment of the requirements that the company has decided to adopt;

- the awareness, empowerment and continuous training of employees;

- the communication of its policy to all suppliers and those who work for the organization;

- the maintenance of the integrated management system adequate, efficient, and effective in order to be able to adapt quickly to changing circumstances and / or constraints external to the organization.

Changes within the company after the EMS integration

The change caused by the integration of the EMS was addressing both risks and opportunities. The result of facing these challenges was a basis for increasing the effectiveness of the environmental management system, achieving better results, and preventing negative effects.

3.2.4. SICET - Società Italiana Centrali Elettrotermiche S.r.l.

SICET S.r.l. is an Italian company that supplies electricity based in Bolzano. The core business is the production of electricity from renewable sources (thermoelectric plants). In 2020 it had revenues for 4,597,399 Euro and 30 employees.

The company has several plants, two of these are EMAS certified. One of these two plants that are EMAS certified, was acquired in 2019 and was already EMAS certified since 2013. Anyway, by changing the ownership of the plant, it was not possible to keep the certification, so they had to get it again. The main plant has been certified ISO 14001 since 2004.

The interview was conducted with the plants Director / special attorney of the company for all environmental aspects.

The adoption and integration process of the EMS

The idea of adopting an EMS comes from the fact that thermoelectric plants have a potential impact on the environment (the core business, on renewable energy, has the coal cycle and they burn wood). The ISO 14001 certification was an almost natural process for the company's emissions management.

After that, when SICET S.r.l. also acquired the new plant, the decision taken by the administration was to maintain a line of performance continuity with the old ownership. Therefore, SICET S.r.l. implemented the EMAS certification process also in the main plant.

Employees' involvement and people involved in the EMS integration process

In the EMS integration process were involved all front lines and all employees. According to the plants Director, being certified means having a management system that must be implemented by the individual worker: there must be a training process on the procedures. In addition, annually all employees are reminded of the objectives that must be achieved from an environmental point of view and the good practices to be maintained.

Through a letterbox, employees can always suggest improvements or report events regarding the environment that they have become aware of. Through this type of communication, which can be anonymous, non-virtuous behaviours can be reported or suggestions for improvement can be noted.

The company also relies on an external consultant expert in regulations and environmental management systems. The consultant was involved when the EMS was integrated, but also after its integration to continuously guarantee its maintenance.

Environmental knowledge within employees

On an annual basis, the company do internal courses (regarding the EMS) to the employees.

Difficulties encountered in the integration process

The interviewee highlighted the need to convince the front lines and the operators to act virtuously according to certain procedures as the main difficulty. To overcome this issue, supervision is continuously carried out and training is considered very important. The EMS to keep functioning needs a supervisory system that allows for continuous feedback.

Perceptions of the EMS integration

The EMS is considered well integrated because all the employees were induced to respect the rules. Therefore, a common environmental conscience has been created within the company.

The key to successful integration of the EMS

As keys to the successful integration of the EMS were highlighted the managerial commitment, and the ability to communicate (through the hierarchical scale) the importance of the KPIs set.

Changes within the company after the EMS integration

The main change within the company was a cultural change because these plants operate based on stringent rules. Small details of emissions or incorrect waste management can escape.

In addition, despite having authorization limits, the process is managed by keeping emissions below these authorization limits, just as a virtue, as an added value for the organization.

Actions taken to pursue the continuous improvement of the environmental performance

To continuously improve the environmental performance, the main actions concern process analysis activities, data analysis, predictive maintenance activities (an environmental event could arise due to a lack of maintenance).

Therefore, there are a series of reports that are drawn up every shift, processed daily by the maintenance / production manager and all the activities necessary to maintain performance within the established objectives are immediately activated. The goals are on an hourly basis. The training that is given to the employees annually is focused on maintaining performance levels and on improvement activities.

3.2.5. Siram Veolia S.p.A.

Siram Veolia S.p.A., the Italian subsidiary of the Veolia Group, is the leading specialist in water treatment. The company designs and supplies drinking water or wastewater treatment plants, as well as standardized smaller water treatment equipment for industrial or municipal customers. It also offers a range of services (audit, maintenance, digital, ...) to support all water treatment plant management needs.

The head office is in Milan and the secondary office in Pordenone. The company closed 2020 with 29,483,698 Euro of revenues and 163 employees.

The company has both ISO 14001 (since 2006) and EMAS certifications (on the Politecnico di Milano site since February 2021). The interview was conducted with the QHSE Manager for the North-West region of the company.

The adoption and integration process of the EMS

The choice to adopt the EMS was made years before the QHSE Manager joined the company. He followed the certification on the Politecnico di Milano site (in February 2021). However, the choice to adopt an EMS was due to the fact that it is necessary to participate in tenders.

According to the interviewee, when dealing with energy and plant management, it is quite natural that, having important environmental impacts, there is also an awareness of environmental issues and the need to have a management system. The EMS was necessary also due to the complexity of the company's structure. The firm is scattered throughout the national territory, the contracts basically go to all the Italian regions, contracts are mainly public, and it is historically specialized in the hospital sector. Consequently, compliance in procedures is needed and without a management system it becomes difficult. There is a need to give a certain order to management and to be able to have uniform reporting.

The EMAS certification was concerning only one site because it was more demanding than the ISO 14001 certification. The ISO 14001 must be on all company activities and compliance with the requirements is complicated by geographic extension. As a service company, for the company it is quite complicated to keep everything under control because they manage thousands of plants all over the world.

Environmental knowledge within employees

For many years now, the company has no longer benefited from consultancy in environmental area because the internal EMS managers have a consolidated experience and the skills to set up a management system and certify it. In particular, the interviewee, has a consolidated background in ISO standards.

In the latest site where the EMS was integrated, the contract manager and the technicians inside the plant have undergone a training process for environmental and legal compliance.

People involved in the EMS integration process

To integrate the EMS in the latest site (the Politecnico of Milano), the QHSE manager, a colleague and the people who manage the plant on site were involved. For the

environmental analysis, all employees were involved, both those who work on the site and those who dealt with support operations (mission trading, technical office, etc.). In particular, when more technically knowledge was needed, the QHSE Manager searched for the necessary skills among the employees.

Difficulties encountered in the integration process

In general, the main issues in the EMS integration, was making sure that the people involved follow the rules and procedures of the environmental management system. According to the QHSE manager, it is a continuous and patient process because it cannot be assumed that everyone knows everything and that everyone respects the rules. Also, because the figure of technicians has had a rather tumultuous evolution in the last 10 years: now there is a different environmental awareness and more severe and stringent regulations. There must be continuous work to raise awareness, verify and help. The company has also internally developed tools to monitor environmental obligations on contracts. They must always keep up to date and have an internal editorial staff that produces a regulatory newsletter on a bimonthly basis that is disseminated to all staff.

The awareness of employees takes place on environmental legislation. In addition, non-technical knowledge related to environmental issues comes from the parent company. The company works a lot on this internal communication because its activities deal with energy, water, and waste so environmental awareness it is important.

In addition to the newsletter, there is environmental training programming at all levels and as needed. Furthermore, when there is news from the regulatory point of view, the company must make sure that people receive the news and explain it to them to ensure that it is integrated into existing procedures.

There is a group of people (composed by the QHSE Managers of each branch of the company's Group) who take care of these environmental issues, and the company has a network at national level to act synchronously in order to exchange skills among themselves (trying to integrate their skills).

Perceptions of the EMS integration

According to the QHSE manager, the EMS is successfully integrated. The company have been certified for 15 years without having any problems. Anyway, it needs constant maintenance. They must continually keep it alive and intervene. For the interviewee, the biggest risk is to assume that, once the system is set up and certified, it will go ahead on its own.

The key to successful integration of the EMS

The key to successful integration of the EMS is doing a daily job with patience and never forgetting the EMS. There is a joint effort on the part of many people who contribute to

do not let things go because, otherwise, the deterioration is very rapid. Audits and trainings are fundamental for the maintenance of the EMS.

Changes within the company after the EMS integration

Since the last EMS integration had to deal with a single site, the company has not undergone any particular changes. It had a lot of impact on the people who worked on it because they realized it is a bit more challenging than ISO 14001 certification since no non-conformities are allowed.

Actions taken to pursue the continuous improvement of the environmental performance

The activities are established annually based on the objectives required by the parent company. The objectives are set by the parent company and through the hierarchical structure they are elaborated in detail and established on a case-by-case basis. So, the parent company communicates every year the objectives to the QHSE Manager who then adapt them to the firm (together with the plant managers). These objectives are communicated on an annual basis. These actions are set in terms of reducing emissions and energy consumption.

3.2.6. S.A.Ba.R. Servizi S.r.l.

S.A.Ba.R. S.p.A. was founded in 1982 by the will of eight municipalities in Reggio Emilia (Italy). The company deals with waste management in a timely and intelligent manner and represents a choice of transparency towards citizens and maximum cooperation with local authorities and supervisory bodies.

In 2011 the S.A.Ba.R. S.p.A. was divided into 2 companies:

- S.A.Ba.R. S.p.A. that operates in the private waste management sector
- S.A.Ba.R. Servizi S.r.l. that takes over the business branch of the collection, services, and management of the Collection Centres

S.A.Ba.R. S.p.A. in 2020 had revenues for 10,935,806 Euro and 34 employees while S.A.Ba.R. Servizi S.r.l. have revenues for 16,970,437 Euro and 81 employees. However, many employees work both for S.A.Ba.R. S.p.A. and for S.A.Ba.R. Servizi S.r.l.

There is an integrated management system (for the environment, safety, and quality) and it is also integrated between the two companies (so there is a single manual and a single management system then divided into the two companies) even if each one has its own

certifications. S.A.Ba.R. S.p.A. has been certified both ISO 14001 and EMAS since 2004, while S.A.Ba.R. Servizi S.r.l. since April 2020.

The interview was conducted with the manager of the integrated management system of S.A.Ba.R. S.p.A. and S.A.Ba.R. Servizi S.r.l. regarding the environment management system and quality management system.

The adoption and integration process of the EMS

The interviewee has been in the company for two years, therefore, was hard to get to the history of the early 2000s, when S.A.Ba.R. S.p.A. had the first EMAS registration. He couldn't tell exactly what the process was for S.A.Ba.R. S.p.A. but there were two main reasons. The first was purely economic: EMAS certified companies are entitled to a 50% reduction in the sureties (therefore an economic advantage).

The other advantage was that since S.A.Ba.R. S.p.A. had a landfill and, therefore, an integrated environmental authorization. This authorization is the highest level of environmental authorization to manage waste and provides for a whole series of checks, monitoring and obligations. Consequently, to manage deadlines, environmental compliance and regulatory updating, an EMS allowed the continuous consistency with both the requirements of the environmental authorization and with the environmental legislation. For the same reasons, in 2019 the manager of the integrated management system of S.A.Ba.R. S.p.A. decided to integrate the EMS also in S.A.Ba.R. Servizi S.r.l.

Being certified and, therefore, having a third-party body (there are several entities in Italy, so it is decided voluntarily by each company) that once a year checks the whole company is a stimulus to always be up to date and always attentive to changes in both regulations and the context.

The two companies are both certified ISO 14001 and EMAS. This is because an EMS to be EMAS certified must meet requirements that are equal to ISO 14001 regulations. Furthermore, ISO 14001 is a globally recognized certification while EMAS certification only at European level and is a little more stringent. Furthermore, it is needed a single audit: the certifier of the third-party body comes to the companies and audits for both certifications.

People involved in the EMS integration process

In the latest integration of the EMS in S.A.Ba.R. Servizi S.r.l. were involved the interviewee (the manager of the integrated management system for the environment and quality) and his colleague that is responsible for the safety management system. They follow the certifications' requirements, the certifiers, and build the EMS. For example, if the company starts a new waste management plant, the interviewee from his environmental point of view and his colleague from the point of view of safety, write

the procedure and operating instructions for how the EMS will be managed, what will be the impacts and what checks will be needed.

The integrated system is managed daily. In addition, there is a safety-environment-quality team that takes decisions, and it is made up of the interviewee, his colleague for the part on safety, the general director and the various section managers. There are various sections, for example the collection section, the plant section, the landfill section, and the recycling points section. A meeting is held, with the section managers, every time that decisions concerning environmental impacts are needed. After the decision is taken, the manager of the integrated system (the interviewee) adapts the system according to the new indications.

External consultants were also involved in the EMS integration process and subsequently on a continuous basis. This happens because once a year the company does an external audit, therefore, a consulting company comes a couple of months before having the certification audit to have the opportunity to fix what emerges from this internal audit.

However, since S.A.Ba.R. S.p.A. has been certified for years, for all the involved people it has become normal to work according to the standards required. According to the interviewee, it has become a way of working, which is why the EMS was born.

Environmental knowledge within employees

The interviewee, that is the EMS manager, has been in S.A.Ba.R. S.p.A. for two years and he is an environmental technician. He has a whole university and post-university environmental education. In addition, he worked as an environmental consultant for 10 years. At the beginning of his carrier in the company, he was not involved in environmental management (although he had done training courses on ISO 14001 and on how to implement a management system). Then, as a consultant, he followed companies and waste management plants (in particular, EMAS certified companies), so he had an experience in the field.

His job is that of environmental manager. He prepares all the technical reports and the applications to obtain the authorizations to manage waste. He is also the manager of the management system, and his role includes continuous training. He is always under training because environmental training and environmental legislation are constantly evolving.

The company manages waste, so it is in a particularly delicate sector. The EMS manager must train continuously regarding both the environment and the EMS. For example, in 2020 the new EMAS guidelines on waste management systems came out so, he had to take a training course to understand what they are, how to adapt them and how to apply them to the company’s reality.

Training is continuous and the firm also rely on a consultancy firm that provides regulatory updates and external audits. These external audits are made to improve the management system with a point of view that is different from that of the certifier.

Employees' involvement in the EMS integration process

Employees are not involved in strategic choices. They are involved, at least once a year, in an EMS related training. These trainings concern what it means to be an ISO 14001 and EMAS certified company, what it entails, what are the responsibilities and what are the procedures.

Every time someone is hired or there is a change in environmental procedures, they are informed and, therefore, they are involved in directly. In addition, employees are involved whenever the EMS manager visits a new site where the system needs to be integrated. The manager exchanges opinions with them to understand what the environmental problem might arise.

Employees are involved everyday with the EMS. For example, the recycling points manager goes daily around all the points and checks whether they are managed correctly. If he sees that there are non-compliances, he reports them to the EMS manager. Subsequently, the EMS manager makes a report goes to the recycling point to explain again how employees must behave.

In the end, employees are actually very involved. The employees manage the environmental impact from an operational point of view. They are the ones who can intervene and must know how to handle the matter. It is important that they are all trained from the point of view of environmental compliance.

Difficulties encountered in the integration process

The difficulty was to unify, under the same management system, very different activities such as the management of a recycling point and a cemetery because rules are very general: the ISO 14001 management system can be applied for an office of 5 people or for a company of 500.

According to the EMS manager, another difficulty was the initial environmental analysis. The company have various sites with different activities. Therefore, a lot of time was wasted to be able to clarify and get a general picture of what S.A.Ba.R. Servizi S.r.l. can cause at the environmental level. The environmental analysis was the most difficult part of in the EMS integration because there were many different environmental factors and for each of them, they had to calculate a risk index. Subsequently, on each impact it was determined whether it had a significant impact for the business or not and how to manage/mitigate it. This analysis required a lot of effort, but it was needed to be able to make the basis of the management system on S.A.Ba.R. Servizi S.r.l.

The integration of the EMS to the whole waste collection system was complicated because, for example, they had to find all the emissions of all the cars and of all the means of collection and make the calculations on how it could be improved. That was a much more paper-based activity.

Perceptions of the EMS integration

According to the EMS manager, surely the system is well integrated for S.A.Ba.R. S.p.A., which has been certified for almost 15 years. The EMS is managed daily, and it is in constant evolution.

As for S.A.Ba.R. Servizi S.r.l., the EMS is new and therefore there are more aspects to adapt during the year to be able to calibrate well on how to operate the system.

The key to successful integration of the EMS

According to the EMS manager, the key to a successful integration of the EMS was the involvement of the whole structure was fundamental. In addition, the EMS must be updated daily and become a way of working. Otherwise, if the system is considered just as a tool to have an environmental certification it becomes a waste of time and money.

Actions taken to pursue the continuous improvement of the environmental performance

The EMAS certification requires to report all the indicators of environmental improvement and all the interventions of the next three years. So, every year, when the environmental declaration is prepared, an environmental program of the next three years is presented. The environmental program concerns interventions to improve environmental processes and they must be quantified with an investment, with a percentage of completion and with a goal.

The objectives must be measurable and well defined: the objective cannot be too general. So, at the end of the year, the group that manages the EMS meet and set the objectives. After the objectives are set, employees are trained on what needs to be improved.

3.3. Analysis and discussion

The analysis of the findings was made using a deductive approach. My theory was that barriers to EMS integration can be overcome through knowledge integration. To address internal validity, the analysis was based on pattern matching (Yin, 2009). To analyse the interviews, I used Excel.

In chapter "Conceptual background", at the end of the literature review, several barriers have been deduced that may arise in the process of an EMS integration.

These barriers were:

- Lack of strict requirements to obtain ISO 14001/EMAS certification.
- Lack of managers commitment.
- Lack of employee awareness and environmental knowledge.
- Lack of complementary capabilities.
- Challenge in accessing diverse information.
- Lack of dynamic capabilities.

Analysing the case studies included in this thesis, my final aim was to understand how these organizations have overcome the barriers to EMS integration through knowledge integration.

3.3.1. Successful integration of the EMS and main barriers

First of all, it is important to understand what the successful integration concept was for the respondents and what the barriers to integration were for them.

In Air Dolomiti S.p.A. case, the idea of a successful integration seemed to be based on the involvement of the employees. Difficulties were in fact related to a consequence of the COVID-19 situation: the Passenger satisfaction and environment Director had to organize her work according to the work shifts of colleagues. These colleagues were necessary to obtain the environmental information needed to integrate the EMS within the company. So, the indicated key to successful integration of the EMS was the good relationship and communication with the colleagues because this has made possible their continuous availability to give information.

For both Paneco Ambiente S.r.l. and ETC Engineering S.r.l. were not indicated any particular difficulties. The only issues highlighted by ETC Engineering S.r.l. were to ensure the active participation of employees and to assess environmental risks that were highly unlikely. The perception of a successful EMS integration in Paneco Ambiente S.r.l. was mainly related to satisfy customer's requirements and address risks/opportunities related to environmental aspects. In ETC Engineering S.r.l. the EMS was considered successfully integrated because there was a common realization among employees of what was their environmental impact.

Anyway, in ETC Engineering S.r.l. the important factor for the EMS integration process was employees' involvement because the adoption of the system was decided by the top management, but it can work only with the participation of all the organization. For Paneco Ambiente S.r.l. the key to successful integration of the EMS was a combination

of the consideration of stakeholders' requirements, employees' involvement (through training) and communication of its policy within the company and to suppliers.

In SICET S.r.l. the EMS is considered successfully integrated because the attention on the respect of the environmental rules is high and a common environmental consciousness has been created within the organization. This attention to rules, in fact, was highlighted as the main obstacle during the EMS integration: to overcome this barrier, supervision is continuously carried out. As important factors for the success were indicated the managerial commitment and the communication of the objectives through the hierarchical scale.

In Siram Veolia S.p.A. and S.A.Ba.R. S.p.A. the success of the EMS is represented by the fact that the two companies has been certified for more than a decade without having any problem. The EMS has become a way of working, it is managed daily and in continuous evolution.

The main barrier to the EMS integration in Siram Veolia S.p.A. was, as for SICET S.r.l., the respect of the environmental rules by all people involved. In addition, as regulations are very severe, in the company there is continuous work to raise awareness and verify the respect of the rules. To overcome these difficulties, environmental training is fundamental, and every time legislation changes the employees involved are informed and trained. Furthermore, the company has a national network to integrate skills among colleagues in different sites of the organization.

For Siram Veolia S.p.A., to the successful integration of the EMS were highlighted the daily job on the system, training, and audits. The EMS must be considered daily otherwise it would deteriorate.

In S.A.Ba.R. S.p.A. the EMS is considered well-integrated for the same reasons of Siram Veolia S.p.A. but the barriers to the integration were different. In fact, the main difficulty highlighted was the unification under the same system of different activities. Furthermore, for each of this activity, there were needed information on their environmental risk and, subsequently, a solution to manage them. Consequently, the integration process took a lot of time and a lot of paper-based activity.

The key to successful integration of the EMS in S.A.Ba.R. S.p.A. were the involvement of the entire organization and, as for Siram Veolia S.p.A., its daily consideration.

Table 11: Perceptions of a successful EMS integration.

Firm	Why was the integration of the EMS perceived successful?
Air Dolomiti S.p.A.	Employees were willing to share the information needed
ETC Engineering S.r.l.	Employees realized what was their environmental impact
Paneco Ambiente S.r.l.	Customer satisfaction Risks and opportunities addressed
SICET S.r.l.	Employees were induced to respect the rules
Siram Veolia S.p.A.	The system was already integrated for 15 years in other sites of the company without difficulties The EMS is continuously under control
S.A.Ba.R. Servizi S.r.l.	Employees were actually involved The system was already integrated for 15 years in the other company's site The EMS is managed daily and in constant evolution

Table 12: Difficulties in the EMS integration process and key to success.

Firm	Difficulties in the EMS integration process	Key to successful integration of the EMS
Air Dolomiti S.p.A.	Remote working and collection of information (due to the COVID-19 situation)	Perceived as an opportunity by the employees Good relationships within colleagues Transparent communication
ETC Engineering S.r.l.	To ensure active participation of the employees Environmental risk assessment of unlikely events	Employees' involvement It was not perceived by the employees as an imposition
Paneco Ambiente S.r.l.	No difficulties	Analysis of stakeholders' requirements Continuous employees' training Policy communication to the company's network
SICET S.r.l.	To convince the front lines and the operators to act virtuously	Continuous supervision of employees' Employees' training Managerial commitment Communication of the KPIs through the hierarchical scale
Siram Veolia S.p.A.	To ensure employees' involvement and awareness Keep up to date on environmental regulation	Consistent maintenance during the year Employees' training Internal audits

S.A.Ba.R. Servizi S.r.l.	To unify under the EMS different activities The initial environmental analysis was time consuming The risk assessment of each environmental factor	Employees' involvement and continuous training The EMS became a way of working The EMS is not considered just as a tool to obtain a certification

3.3.2. Lack of strict requirements to obtain ISO 14001/EMAS certification

Since the ISO 14001 and EMAS certifications do not provide defined environmental objectives, the success of an EMS does not depend on the standard itself but on how the system is integrated and implemented (Boiral, 2011). Each company sets its own environmental objectives and control them through the chosen indicators (Pranugrahaning et al., 2021). Consequently, EMS integration strategies are different for all organizations (Aragon-Correa et al., 2020). Furthermore, in the literature there is a knowledge gap on the process of selecting indicators: it not known how they are developed and who is involved in the decision (Boiral et al., 2018).

In the cases studied for this thesis, it seems that to overcome this barrier was necessary a process of knowledge integration. In all cases, to integrate the EMS communication between different departments and individuals was needed. Overall, the process of the EMS integration can be analysed by steps as for the knowledge integration. The steps of knowledge integration are:

- knowledge acquisition so the collection of the necessary knowledge deriving from different sources (Inkpen & Tsang, 2005)
- knowledge valuation (Cohen & Levinthal, 1990) so what information is useful and select the knowledge to integrate (Zahra & George, 2002)
- knowledge transfer where is needed (Mitchell, 2006)

For all cases, expect for Paneco Ambiente S.r.l., a pattern of the knowledge integration process can be found.

In the first step of knowledge acquisition were involved many sources. Knowledge about technical procedures of the EMS was acquired from external consultants (except in S.A.Ba.R. Servizi S.r.l. and Siram Veolia S.p.A.). For what concerns information needed for the initial environmental analysis, it came principally from the employees and from meeting with the various departments managers. Employees had the possibility to report

environmental issues and advice to the EMS manager. In one case, for Siram Veolia S.p.A., there was another external source of information: the parent company.

Subsequently, the information collected was evaluated to select the departments more involved at the environmental level. The activities and the factors to check at the environmental level were selected. To check the environmental improvement of the activities were set environmental objectives. These objectives were set with the participation of the department managers.

At the end, knowledge about the environmental objective set was transferred to the involved employees to raise awareness about their importance. To ensure the achievement of the objectives, the necessary environmental knowledge has been shared with employees working in the departments affected by the EMS. Courses were held on environmental aspects, except in the case of ETC Engineering S.r.l. in which the course was linked to knowledge on the EMS and in Air Dolomiti S.p.A. where the company considered environmental knowledge already sufficient.

In Table 13, is summarized how knowledge was integrated during the choice of integrating an EMS and during the main step of the EMS integration process: the environmental analysis.

Table 13: Knowledge integration in the first steps of EMS integration process.

Firm	First knowledge about the EMS	Knowledge for the environmental analysis
Air Dolomiti S.p.A.	The EMS was requested by the parent company Similar procedures of ISO 9001 and ISO 45001	External consultant for environmental knowledge The Passenger satisfaction and environment director did meetings with managers' departments Reports came from flights attendants and passengers "ENviron Promoters" group that helped during the information collection Internal audits with the Controlling & Internal Auditing Director

ETC Engineering S.r.l.	The need of integrating an EMS came from the firm's field Similar procedures of ISO 9001 and ISO 27001	External consultants for internal audits It was nominated an EMS manager and two employees that voluntarily helped during the information collection (through chats with colleagues) Meetings with employees every three months to check improvements and issues
Paneco Ambiente S.r.l.	Similar procedures of ISO 9001	
SICET S.r.l.	The need of integrating an EMS came from the firm's field The EMS was already integrated in other firm's plants	External consultants for knowledge about regulations Voluntarily suggestions from employees Daily reports from production managers
Siram Veolia S.p.A.	The need of integrating an EMS came from the firm's field The EMS was already integrated in other firm's sites	No external consultants, the QHSE had high knowledge and experience about EMSs and environmental issues Meetings with employees to identify environmental issues
S.A.Ba.R. Servizi S.r.l.	The EMS was already integrated in the other part of the company	The integrated management system manager had high knowledge and experience about EMSs and environmental issues Meetings with section managers to collect information Daily report from recycling points manager

		Audits with external consultants (to have a different point of view and acquire more knowledge)

3.3.3. Lack of managers commitment

Managers must be aware of the opportunities linked to the integration of an EMS (Testa et al., 2018). If managers lack environmental and EMS knowledge, they perceive the EMS integration process as a bureaucratic matter and will not share knowledge with the employees (Boiral, 2011).

Looking at the information available from the interviews, it can be noticed that in three cases the EMS managers were highly educated on environmental matters. In ETC Engineering S.r.l. 36 employees out of 51 were environmental engineers and the only lack was on EMS technical knowledge (and in fact courses were made). In Siram Veolia S.p.A. the EMS manager had consolidated knowledge and experience on ISO standards. The EMS manager for S.A.Ba.R. Servizi S.r.l. had environmental education and experience as environmental consultant for 10 years before joining the company.

Furthermore, for the successful integration of an EMS is essential that at least one manager for each department is involved, especially if the activities they manage have a high environmental impact (Ghisellini & Thurston, 2005). For Nonaka (1988), the ideal model for knowledge management is middle-up-down management: the role of middle managers is fundamental. Information should circulate in all directions within a firm. Middle managers act as intermediaries between the goals decided by top management and the information to achieve those goals that are held by employees (Nonaka, 1988).

The importance of middle managers is highlighted in Air Dolomiti S.p.A. where they share information on their activities and, subsequently, participate in the objectives' development. From the interview was clear the importance of involving middle managers. They are involved several times during the year, even after the goals are set. They inform the environment Director about progress in environmental activities. The same role of middle managers was highlighted in Siram Veolia S.p.A. and S.A.Ba.R. Servizi S.r.l. Also in these two companies, middle managers support the integration of the EMS and its continuous improvement.

3.3.4. Lack of employees' awareness and environmental knowledge

Daily activities are carried out by the employees, consequently, for a successful integration of an EMS their involvement must be ensured (Rebelo et al., 2014). In the literature, the need for training within the employees was already noted by Perez et al. (2007) because it allows the participation of the entire organization and, therefore, the sharing of information. Employees, in fact, are a key part of the information sharing system (Florida & Davison, 2001). In addition, employees become resistant to changes if they lack knowledge (Teece, 2007).

In all cases, employees were fundamental during the initial environmental analysis. The selection of the environmental activities to control and the objectives set were based on information that came from the employees.

In each company there was a training for employees, except in the case of Air Dolomiti S.p.A. where the present knowledge was considered sufficient. Anyway, their involvement was guaranteed by the constant communication during the EMS integration process. Furthermore, a group was created where employees can voluntarily join to develop activities. These activities aim to share information about the environment and increase employee awareness.

In all other cases, training courses were held to create a common knowledge base. Generally, knowledge was linked both to the environmental aspect and to the functioning of the EMS. The courses are continuous because the employees must be informed at every change of legislation.

A particular way to involve the employees was adopted by ETC Engineering S.r.l. To reduce the emissions related to cars, they implemented a project in which the groups that managed to reduce emission the most received a prize.

The different activities to ensure employees' involvement and, as a consequence, knowledge sharing methods are summarized in Table 14.

Table 14: Knowledge sharing methods.

Firm	Knowledge sharing methods
Air Dolomiti S.p.A.	Reports from employees and passengers Communication from the President to employees

	"ENviron Promoters" group composed by employees to collect environmental information and raise awareness within the company Environmental tips to employees through informatic system
ETC Engineering S.r.l.	Chats with employees for the identification of environmental issues Employees' training on the EMS Internal car sharing project (to raise awareness) Meetings with employees every three months to monitor progress of the EMS
Paneco Ambiente S.r.l.	Continuous employees' training
SICET S.r.l.	Employees' training Communication of environmental objectives to the employees Letterbox for employees' suggestions Daily reports (made by production managers)
Siram Veolia S.p.A.	Employees' training Bimonthly newsletter on environmental regulations Parent company's communication on environmental issues Company's network of QHSE managers (coming from different branches)

S.A.Ba.R. Servizi S.r.l.	Meetings with section managers when environmental decisions are needed Employees' training Chats with employees to identify environmental issues Daily report on EMS procedures (made by the recycling points manager)

3.3.5. Lack of complementary capabilities

Complementary capabilities are resources and capabilities (Christmann, 2000) that allow limited use of resources for the integration of the EMS and continuous environmental improvement (Darnall & Edwards Jr, 2006). As noted by the literature, excessive costs during an EMS integration can be avoided by exploiting knowledge on other management systems that are already integrated in the company (Darnall & Edwards Jr, 2006). The exploitation of knowledge on other systems, in fact, was part of the integration of the EMS in all the interviews made for this thesis.

All companies had already developed skills to manage the EMS either from the integration of other ISO standards or from past EMS integrations. For past EMS integrations I mean the cases of SICET S.r.l., Siram Veolia S.p.A. and S.A.Ba.R. Servizi S.r.l. where the last certification, and therefore the last integration of the EMS, was tied to a specific location of the enterprise. However, the two companies were already certified for years in their main plants.

Instead, Air Dolomiti S.p.A., ETC Engineering S.r.l., and Paneco Ambiente S.r.l. already had a structure and a culture aimed at improving business efficiency. These companies were already used to a management system's procedure because they were certified ISO for quality and safety.

Table 15: Firms and their complementary capabilities.

Firm	Complementary capabilities
Air Dolomiti S.p.A.	ISO 9001 and ISO 27001

ETC Engineering S.r.l.	ISO 9001 and ISO 45001
Paneco Ambiente S.r.l.	ISO 9001
SICET - Società Italiana Centrali Elettrotermiche S.r.l.	Other plants had already been certified ISO 14001 and EMAS before the acquisition of the new electrothermal power plant (that is here the object of study for the EMS process integration)
Siram Veolia S.p.A.	The firm had already been certified ISO 14001 (and here the object of study was the site of the Politecnico di Milano in which the EMS was integrated to obtain the EMAS certification)
S.A.Ba.R. Servizi S.r.l.	The other part of the company (S.A.Ba.R. S.p.A.) had already been certified ISO 14001 and EMAS

Anyway, in each case, the presence of the developed skills is important because they allow the continuous improvement of the EMS (Darnall & Edwards Jr, 2006). In fact, one of the threats in an EMS integration is too much knowledge entrusted only to external consultants. For example, in Air Dolomiti S.p.A., for the initial environmental analysis a consultant was involved because no one had the necessary skills. Anyway, it is not clear if his/her knowledge was in some way integrated in the company to avoid the continuous reliance on consultancy firms.

External consultants can also be involved to have a different point of view: this happened in S.A.Ba.R. Servizi S.r.l. where the knowledge of the external consultant has been used to make additional improvements.

3.3.6. Challenge in accessing diverse information

Part of this barrier is linked to the first obstacle previously treated, namely, the lack of strict requirements to obtain ISO/EMAS certification. The EMS managers must deal with different sources of information and different type of knowledge to plan and integrate the EMS. In the EMS integration process are involved different disciplines and activities. That is why middle managers are important: they are the key to integrate specific knowledge (related to daily activities and departments) with the top

management knowledge. Furthermore, within an organization it is necessary that the members are aware of who holds certain information useful for the creation of new knowledge (Lewis, 2003).

The access to diverse information can be put in order with knowledge repository systems (transactive repository systems and routines). Transactive memory systems are developed through training and shared experiences within employees (Ren & Argote, 2011). As already discussed, all companies, except Air Dolomiti S.p.A. have made courses. For the organizations that have created a transactive repository systems, the benefit is the ability to access the necessary information easily and quickly (Heavey & Simsek, 2017). Furthermore, the concept of absorptive capacity leads to the conclusion that if a company does not invest in creating an initial knowledge on fundamental fields of its activities, in the future this same company will not be able to capture the opportunities and will not be able to respond proactively when necessary, therefore stopping to grow or doing it very slowly (Cohen & Levinthal, 1990).

It must be added that, the access to diverse information is related to learning behaviour in groups. Learning behaviour in work teams is based on exchanging information and this happen only if the members of the group feel free to share their information. There is the need to create a team psychological safety environment in which participants feel safe in interpersonal relationships (Edmondson, 1999).

Psychological safety seems present in the employees' involvement process of Air Dolomiti S.p.A. and ETC Engineering S.r.l. In these two companies there is the possibility to voluntarily participate in the EMS integration process. Furthermore, the environment Director of Air Dolomiti S.p.A. highlighted the importance of good relationships with her colleagues. These relationships are based on transparent communication about the EMS integration process.

3.3.7. Lack of dynamic capabilities

The information collected through the interviews are not sufficient to analyse how the companies overcame the lack of dynamic capabilities (and if they were really lacking dynamic capabilities). Further research is needed to understand how dynamic capabilities can be developed through knowledge integration and how they affect the EMS integration process. It must be understood which are the capabilities related to sensing and exploiting opportunities/threats in the EMS process and how firms reconfigure resources to integrate knowledge. Furthermore, a deepen knowledge on the technical changes on routines that had been affected by the EMS integration is required.

3.4. Implications for Research and Limitations

The findings that the perception of a successful EMS integration differ across firms has important implications for future research on EMS integration strategies. The success is related to internal factors, mainly the perception of the employees' involvement. The employees' involvement is reached through trainings and environmental projects within the company.

So far, most studies on EMS have focused on the motivations, results, and costs of an EMS adoption, giving for granted the EMS integration process. Furthermore, these studies represent the managers perceptions. From the research made in this thesis, it seems important an extension of the research also considering the employees' perceptions. Analysing the responses of the employees involved in the EMS integration process, it would be possible to identify the best strategy for integrating knowledge during the EMS integration process.

Furthermore, all companies in this thesis had complementary capabilities that made the EMS integration process easier. Further research must include companies without complementary capabilities to analyse how the EMS integration process may differ and how the lack of pre-existing knowledge on management systems is overcome.

CONLUSIONS

The aim of this thesis was to deepen the research on the process of EMSs integration because, so far, the literature is focused on the motivations and costs of adopting an EMS. Furthermore, from the available literature it can be noticed that the main barriers to a successful EMS integration are related to a lack of environmental and technical knowledge. These main barriers to a successful EMS integration are:

- Lack of strict requirements to obtain ISO 14001/EMAS certification.
- Lack of managers commitment.
- Lack of employee awareness and environmental knowledge.
- Lack of complementary capabilities.
- Challenge in accessing diverse information.
- Lack of dynamic capabilities.

Anyway, from the case studied in this thesis, it seems clear that it does not exist a clear definition for success when dealing with EMS integration. The perception of success from the managers' point of view highlights the need for employees' involvement. In general, employees' involvement is reached though common knowledge on the EMS and environmental aspects. So, in this thesis, the managers' perceptions on successful EMS integration were related to employees' involvement and they structured their strategies considering the need to involve the whole organization's structure. Managers exploited knowledge integration within employees to overcome the barriers to EMS integration.

So, the reasoning here was: the success of an EMS integration is linked to the level of employees' participation because the barriers to EMS integration are overcome mainly through employees' involvement. Employees' involvement is achieved through the integration of the knowledge necessary for the integration of the EMS, that is, the environmental knowledge and knowledge related to the EMS' requirements.

In the companies involved in this thesis, the lack of strict requirements to obtain ISO 14001/EMAS certification was overcome following the process of knowledge integration: knowledge acquisition from the employees and from external sources, knowledge valuation to understand which environmental factors were important to check and knowledge transfer to employees to guarantee their involvement and achieve the objectives set.

Lack of managers commitment was overcome by entrusting the integration of the EMS to an employee who had, at least in part, the knowledge necessary to integrate the EMS. Subsequently, these selected managers involved the heads of the various departments

because it was necessary to collect information on the activities carried out in order to complete the environmental analysis.

In all cases, employees were fundamental during the initial environmental analysis. The lack of employees' awareness and environmental knowledge was overcome through specific trainings and involvement in projects aimed to raise their participation. These activities were fundamental to the collection of information on which the objectives for the integration of the EMS were then based and to communicate the importance of these same objectives to the employees.

The companies involved in this research were not lacking complementary capabilities: they had already developed skills to manage the EMS either from the integration of other ISO standards or from past EMS integrations (in different sites of the firm). The organizations were already used to management systems procedures, so knowledge integration here was the key to further develop past stocks of knowledge and exploit it to easily integrate the EMS.

In the end, all the discussed barriers were related to the challenge in accessing diverse information. During the whole process of the EMS integration, the EMS managers had to collect and integrate knowledge deriving from different departments within the company, different individuals, and even external consultants. Knowledge integration was an important key to overcome the difficulties related to the management of high amount of information coming from various sources. Middle managers were fundamental because they integrated the top-management knowledge with the employees' knowledge (related to daily activities that must be checked for the EMS). Furthermore, to guarantee the possibility to continuously access environmental information, the EMS managers developed transactive memory systems through training and shared experiences within the employees. The aim of these transactive memory systems was to benefit from the opportunity to easily and quickly access information because employees had a common knowledge on EMS issues and, consequently, communication was simplified. The knowledge integration process simplified the communication within employees because the EMS managers could avoid misunderstanding when collecting environmental information.

In conclusion, this thesis highlights the need to extend qualitative research on the integration process of EMSs in order to understand the different strategies that firms develop. The comparison between perceived success of the EMS managers is not possible as there is no clear definition for success in the integration process of an EMS. The success of the EMS integration strategy passes through the perception of managers and seems to focus on employees' involvement. Anyway, so far, the point of view of the employees has not yet been considered in the literature on the EMS process integration. The employees' point of view is also important to understand how knowledge can be

integrated effectively throughout the company's structure. Furthermore, the research must be extended to companies that lack complementary capabilities. It should be analysed how the lack of pre-existing knowledge on management systems is overcome and how knowledge is integrated.

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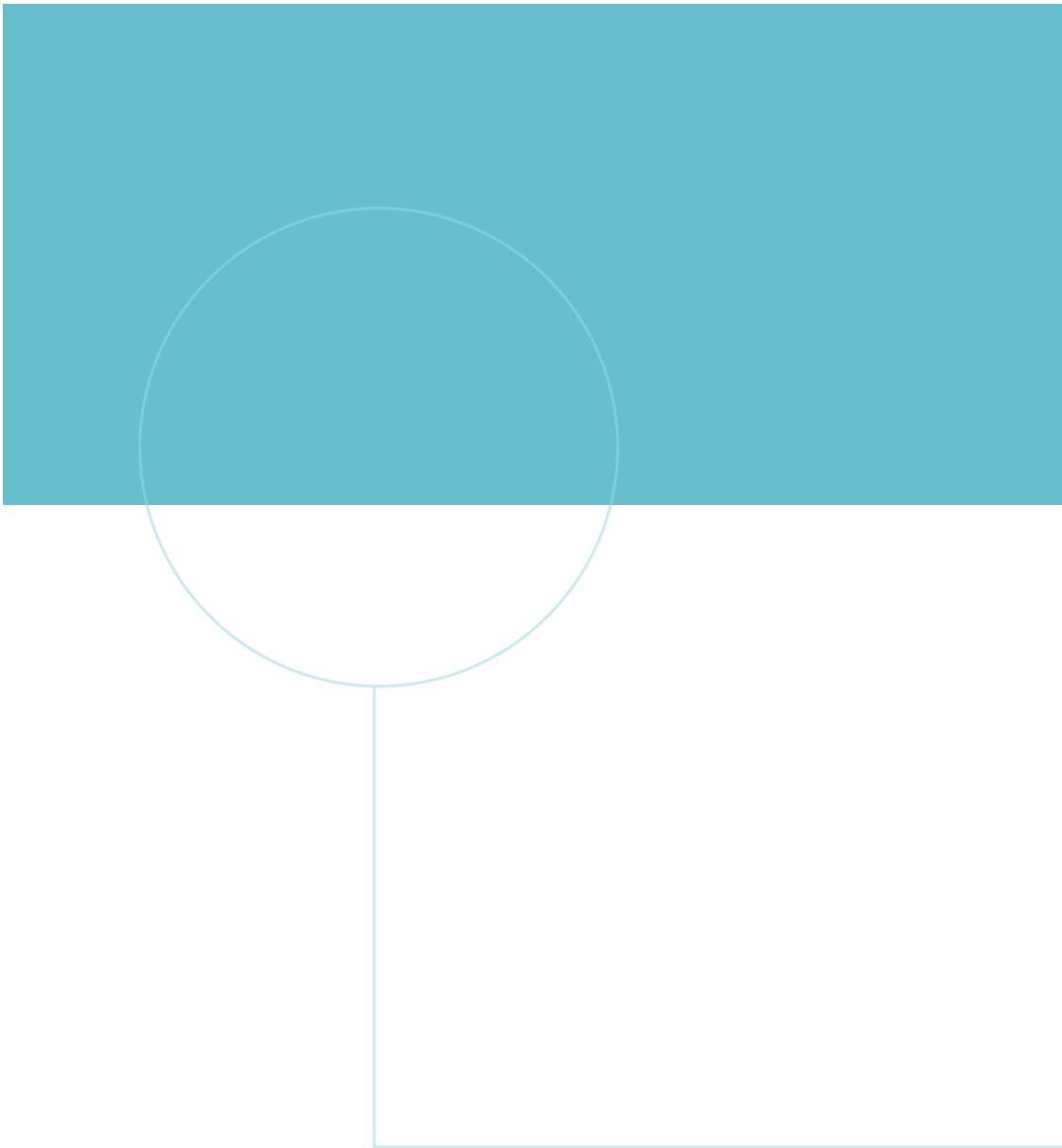

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