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Master thesis

Challenges and opportunities for SMEs to adopt GHG calculation tools

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Abstract

This study is made to understand the opportunities and challenges SMEs have to adopt GHG calculation tools. Adoption of GHG calculation tools are common by large organizations and have proven as a consequence to lower their GHG emissions, motivate their employees and establish sustainability goals. Even thou a large amount of large organizations have adopted GHG calculation tools, this is very rare in SMEs. Using the theoretical framework called Rogers diffusion of innovation theory and a survey, the factors behind why or why not SMEs have adopted GHG calculation tools were studied. The results showed that only 9% of SMEs have adopted GHG calculation tools and the reason for this is lack of resources, competence and data. The analysis showed that the characteristics of an organization that affects this the most are leadership, education and regulations. In order to overcome the challenges, organizations should prioritize to have a leadership that motivates employees to engage in sustainability actions. Organizations should enable skill development in the field of sustainability to increase the competence. This would enable more organization to adopt GHG calculation tools and most likely lower their GHG emissions.

Keywords: Greenhouse gasses, SMEs, emissions, adoption, challenges, opportunities.

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Content list

1. Introduction

1.1 Background

Climate change is undeniably the biggest threat to humankind in our life at this moment and moving forward. Human actions in the form of combustion of fossil fuels, agriculture and deforestation releases greenhouse gasses (GHGs) in the atmosphere and especially carbon dioxide which has the highest impact today. Consequently, this changes the climate and has catastrophic consequences by affecting the rate of extreme weather, melting the glaciers, and raising the sea levels. This increases the risks that the planet starts going in a negative spiral because of our actions and the result could be that our actions to mitigate this have no effect. Actions today change the balance in nature and consequently even more in the future (WWF 2019).

The knowledge of how humans affect the earth is not something new, but the changes needed to abrupt the ongoing negative trend is not easy and includes sacrifices. Our actions today change the balance in nature and consequently even more in the future. In order to create a change and have the right mindset and plan moving forward, the United Nations together with the member states decided on 17 goals that should be fulfilled by the year 2030 with focus on a social, economic and sustainable future for everyone. The overall purpose with the 17 goals is to limit global warming to 2 degrees Celsius and aim for 1.5 (UN n.d).

In 2017, Sweden established an internal climate policy framework with the long-term goal of net zero GHGs released into the atmosphere by 2045. The purpose with the framework is to give conditions for business and society in Sweden to adjust and make the necessary changes in order to reach the climate goal. The framework has also made it possible to create some regulations with climate in focus. There are not only regulations on organizations but also on the Swedish government to each year report on the work towards the goals and what has been done. The government should also each year make reviews if more actions are needed (Swedish Environmental Protection Agency, n.da).

For Sweden to reach the climate goals, different actors in society (individuals, organizations and government) need to do their part. Organizations are one of the key parts in making this change, and a lot of regulations and responsibilities has been put on them, particularly the large organizations (Levin et al., 2018). However, there is a lack of research regarding small and medium sized organizations (SME) and low carbon emissions (Conway, 2015). SMEs are defined by the European Union as organizations that have less than 250 employees or a turnover of less than 50 million euros or a balance sheet of less than 43 million euros (European Union n.d). In this thesis the used definition

of SME will be according to the staff count. The current regulations that are in place regarding GHG emissions are directed towards larger organizations and SME are not obligated to follow them. In Sweden, SME make up 99.9% of the total number of organizations and therefore, more focus should be on these organizations (Svenskt Näringsliv n.d). SMEs in the world affect the livelihoods of over 2 billion people (SME climatehub, 2022). According to a study made by Tillväxtverket (Swedish Agency for Economic and Regional Growth, 2018), only 46% of SME works actively with environmental questions. The reason for this is according to Conway (2015) that the SMEs lack knowledge of what actions are best to take to reduce environmental impact. Larger organizations are often slower to make changes, SME organizations are often faster to react, more flexible and have a lower level of hierarchies. This shows that there are opportunities for SME organizations to take a more active role in reducing climate change.

In order for SMEs to change to a more sustainable business model they need to understand their emission sources and quantify their GHG emissions in order to take appropriate actions to reduce emissions. This enables the organization to track and follow up, also have goals connected to sustainability that can be (Swedish Environmental Protection Agency n.d b). According to the greenhouse gas protocol (n.d), organizations need to track their greenhouse gas emissions for them to be successful and prepared for national and regional climate policies in the future. Therefore, calculating carbon emissions in SME organizations should be the first step towards a sustainable change in the business. The tools and methods exist, but the diffusion of these tools is the challenge.

1.2 Purpose and objectives

The purpose of this study is to analyze the challenges and opportunities to adopt GHG estimation tools in Swedish small and medium size organizations (SMEs) in order to address the global and Swedish climate related goals.
The specific objectives are:
- To present and analyze the different GHG estimation tools available for SMEs.
- To understand the internal and external factors that affect why these tools are being used or not used by SMEs.
- To suggest strategies to overcome the challenges hindering SMEs to measure their GHG emissions.

1.3 Limitations

This study has limitations that may affect the results. The main limitation of this study is that the study is based on a limited number of SMEs, which means the result may not be robust. Other limitations are mostly connected to the data collection method of survey. The limitations are as followed:

- Response frequency: The number of respondents on the survey was low, only 22 SMEs were able to participate in the survey. The consequence of this is that relevant analyses could not be done to verify the significance of the results. Hence results are of indicative in nature.
- Response biased: Most of the respondents to the survey were working in the manufacturing sector. This limits the results to this sector and a general result of all sectors could not be made. Since the survey topic was sustainability and it was a free choice to respond to it, arguments could be made that organizations that are interested in sustainability might have been more willing to respond to the survey.
- Response understanding: As with all questions, the survey questions might have been misunderstood by the participants, and answers have the risk of not reflecting the reality. The answers from the organization is very much linked to the knowledge of the participant answering the survey. If the participant did not have the correct knowledge regarding the organizations sustainability actions, result could be wrong.
- The theoretical framework includes several variables found in the literature, but there might be other variables that were unintentionally not included. The study is also limited to that the independent variables affecting an organization are not linked to eachother.

2. Literature review

2.1 Carbon footprint and GHG

According to Gao, Liu and Wang (2013), carbon footprint can be used to calculate how much we as humans can consume in order to not extract more out of planet earth than what it produces. The reason that these calculations are possible is because carbon footprint is defined as "the measure of the total amount of carbon dioxide emissions directly and indirectly caused by an activity or accumulated over the life stages of a product". These calculations can be performed on a personal level or on an organizational level where the GHG emissions are addressed on all spheres, e.g., energy use, production of products, use of vehicles etc.

Even though the definition of carbon footprint includes the words carbon dioxide emissions the concept of carbon footprint in most cases also includes all types of GHGs, for example methane, nitrous oxide and chlorofluorocarbons (Selin, 2020). These GHGs trap heat in the earth's atmosphere by absorbing the energy that enters the atmosphere and the energy that emits from the earth. From this, the term greenhouse originates in this instance as it works in the same way as a traditional greenhouse. In order to compare and analyze the effect of these GHGSs, each gas was given a value in Global Warming Potential (GWP), which is based on the gas ability to absorb energy and how long they stay in the atmosphere. To set a base, the primary greenhouse gas Carbon Dioxide CO_2 which in 2019 was equivalent to 80% of all the GHGS released in the US, was set as a base with the GWP of one (EPA n.d a). This means that every other gas will be compared through how much amount of energy the emissions from exactly one ton of gas will be absorbed over a period in comparison to the emissions that occur from 1 ton of carbon dioxide (EPA n.d b). This enables comparison between the gasses and therefore, the severeness can be analyzed for each gas. Methane has a GWP of 28-36 over a time period of 100 years. This time period is shorter than what carbon dioxide has but the amount of energy it absorbs is much higher and therefore a higher GWP. The gas that has an even higher amount GWP is nitrous oxide which has a GWP of 265-298. This shows that it is much more environmentally hazardous to release nitrous oxide in the atmosphere than carbon dioxide (EPA n.d a). To summarize the emissions from all GHGs a common metric measure is carbon dioxide equivalent (CO2eq) which multiples the amount of gas released and the corresponding GWP (EU glossary, 2017).

The energy absorption contributes to a rise of the global temperature, which in the last 35 years has grown. The rising temperature comes with severe consequences to many levels of the environment, some of them are rising sea levels, longer warmer seasons, floods and storms. Continuing in the same way as we are now, the effects will grow and lead to catastrophic consequences (Muthu 2021). This is acknowledged by the UN and

the member states, consequently the sustainable development goals were set and the goal of limiting global warming to 2 degrees (UN n.d).

2.2 Mitigation and assessment of GHG

To change the disastrous business as usual path, mitigation needs to be a key thing moving forward. As Muthu (2021) writes that it could seem easy to mitigate by undoing what we as humans have done to get to the place where we are now, but it is impossible to undo everything we have done for years. This applies that both mitigation and adaptation are needed and scientists together with the UN set out goals for 2030 which is based on the 4-R formulae: Reduce, Reuse, Recycle and Refuse. These goals and targets can be overwhelming but they can be broken down into easily understandable components:

- Use less fossil fueled powered transportation
- Use less air-conditioning and heating
- Increase forestation and reduce deforestation
- Utilize and maximize the use of renewable energy sources
- Recycle more, both materials and heat
- Create sustainable cities
- Refuse to produce any waste
- Create technology that are sustainable and contribute to a more sustainable lifestyle
- Return what we take from the wilderness

These are not everything that needs to be done, but they are some of the major actions to reduce our carbon footprint. They can be followed by individuals, organizations and also governments.

For an individual, organization or a government to know what actions to take and what will have the biggest impact, GHG assessment is necessary. GHG assessment or estimation is an understanding of the situation in response to GHG emissions and can be done for the situation now or in the future. The assessment should not be mixed up with mitigation actions to reduce the carbon footprint, the assessment is solely mapping the studied system. The mapping shows the relevant aspects that contribute to the GHG emissions and the amount in the selected parameters that will be investigated (Muthu 2021). As the greenhouse gas protocol (n.d) explains, organizations need to assess their carbon footprint in order to have a successful process of mitigating their GHGS emissions. Otherwise, resources and knowledge could be allocated to aspects which seem to have a high impact but actually do not contribute to that extent to the overall carbon footprint creating a false narrative of sustainable work that overshadows the actions that are actually needed to take.

Study made by the Boston Consulting Group (2021) shows that 85% of organizations are interested in reducing their emissions but only 9% are able to measure their emissions

comprehensively. The study shows that 57% of the organizations that track all of their GHG emissions are able to significantly reduce these emissions. The most common reasons to why organizations have not calculated their GHG emissions are because of lack of time, resources, and relevant data.

SMEs who have lack of resources could take loans to finance investments to improve their business. This is often the case when investing in machines or R&D when the payback is almost certain. Sustainability practices are more challenging to see the payback, the investment is often in the form of an investment with payback long in the future. This together with the high cost and interest rates makes it challenging for SMEs to take loans to overcome the lack of resources in the field of sustainability (Marinkovic, n.d). In Sweden, the Swedish environmental protection agency (n.d,c) have adressed this and created funds for actions that lowers GHG emissions.

In order to help organizations, governments are creating policies and instruments on emissions to get organizations to lower their climate impact. According to Plan A (2020) 57 carbon pricing systems exist and these are in the form of 28 emission trading systems and 29 carbon taxes. Emission Trading systems (ETS) are regulations set on the number of tonnes of GHG an organization can emit. These can be seen as allowances and therefore can be sold and bought by other companies. This works as an example if one company has lower carbon emissions than what they are allowed to, they can sell the remaining to another company that might have more emissions than allowed. Consequently, mitigating and assessing your carbon footprint is not only a legal obligation, but also a competitive advantage.

Creating sustainability practices based on GHG emission calculation may improve many aspects in an organization, which were not expected. Such aspects include access to new markets and competitive advantage, increased customer base, and a more positive brand image, and better internal relation with employees (Tsvetkova, Bengtsson & Durst, 2020). In order for an organization to create positive and long-lasting sustainability practices there are many strategies that could be implemented. These strategies do not work for every organization and should be analyzed individually. SMEs often lack the knowledge on sustainability due to scarce resources, and therefore, a strategy to expand such knowledge among them is to connect with networks and other businesses in the sector. Exchanging ideas and data knowledge benefits both parties. All sustainability practices should have the goal to be long-term instead of short-term since the short-term goals could contradict the practices in the long run, resulting in a negative spiral (Tsvetkova, Bengtsson & Durst, 2020).

2.3 Standards to calculate GHG emissions in organizations

There are many different tools that exist today to calculate GHG emissions in an organization, but they are often not used. Swedish Environmental Protection Agency

(n.d a) mentions two methods, namely GHG protocol and ISO 14064-1. Accordingly, these methods have proven to be most common and well researched (UK Government, 2019 & Issel, 2021).

2.3.1 GHG protocol

The greenhouse gas protocol (n.d) is a standard developed by the World Resource Institute (WRI) and the World Business Council on sustainable development together with some large corporations. The standard is made for businesses developing a GHG inventory, who has either direct or indirect GHG emissions. The GHG accounting is based on a set of 5 principles which are:

Relevance
The GHGS inventory assessment should reflect the GHG emissions appropriately in the company in order to work as a decision-making tool.

Completeness
The GHGS inventory should report on all the GHG emissions that are in the set inventory boundary.

Consistency
Use consistent methodologies and report changes in order to allow for comparisons between emission data.

Transparency
Disclose all relevant issues and assumptions in order to show full transparency.

Accuracy
The result of the GHG emissions reflects the actual emissions and uncertainties should be reduced as far as possible in order to make the best decisions.

The standard is based around the activity of identifying and classifying the emissions from the sources in the system boundaries. The GHG protocol sets the organizational boundaries by dividing the GHG emissions into three scopes in order to classify the direct and indirect emissions. These three scopes are:
Scope 1, Direct GHG emissions
Scope 2, GHG emissions generated from purchased electricity
Scope 3, Emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company

The emission data that is identified and measured can be converted into the correct amount each emission is multiplied by the corresponding emission factor. In order to follow and track the development of GHGS emissions, a base year should be set that will

be used as a comprehensive year to analyze change from. This base year needs to have verifiable data on emissions and the organization has to disclose the reasons for choosing that particular year as the base year.

2.3.2 ISO 14064-1

The standard ISO 14064-1 is developed by the international standards organization (2018) and is a part of the ISO 14000 series of standards focused on environmental management. The standard is developed for the same reason as the GHG protocol to guide organizations to quantify and report greenhouse gas emissions. The information in the ISO standard is often consistent with the information in the GHG protocol and sometimes it is even derived from it. The difference between the two standards is that the ISO 14064 tells the organization what to do and what is the absolute minimum, the GHG protocol explains how and why the organization should quantify and report the emission.

The ISO standard is also based on the 5 principles: relevance, completeness, consistency, accuracy and transparency. The standard has similar organizational boundaries as the GHG protocol but does not define them into three scopes. Still the emissions are divided into direct emissions, emissions generated by purchased electricity and indirect emissions. The verification of the emissions consist of three assessment steps which are: review of the GHG information system where the data is analyzed in order to eliminate misstatements, evaluation of the GHG data to analyze if misstatements occur and their effect on the overall accuracy on the result, lastly the result is compared against verification criteria to see the consistency with standards or program requirements that are obligated to follow.

3. Theory

3.1 Existing theory

3.1.1 Characteristics of an innovative organization

To quantify and report GHG emissions in an organization is a choice and therefore comes down to a decision made by the organization. In order to analyze why or why not organizations calculate their greenhouse gas emissions, a theoretical framework on decision making and the factors influencing decision making has to be developed. Calculating GHG emissions in an organization for the first time is something that is new for the organization and therefore can be seen as adopting an innovation. Methods to calculate GHG emissions have been developed and are available for use by organizations, but it is up to the organization to decide to adopt the method or not. To understand the theory behind adopting an innovation, the theory developed by Rogers (2003) can be used.

Roger (2003) has developed the theory of adopting an innovation in the form of an idea, product or a service by an individual or an organization. According to Roger, innovations in organizations spread between and from companies much in the same way as innovation is spread between individuals.

Bumane-Vitolina et al. describes how organization innovation has been found to increase the use and success of new technologies and processes in the organization. It often increases the coordination and cooperation between leadership and employees, and external relations. Consequently, an organization with a high degree of organization innovation affects the adoption of innovations (Bumane-Vitolina et al., 2022). The organizational characteristics identified and analyzed as either positive or negative towards innovativeness are centralization, complexity, formalization, interconnectedness, organizational slack, size, attitude towards change and system openness (Rogers, 2003). Since these characteristics have a direct impact on the organizational innovativeness, they should also affect if an organization has calculated their carbon footprint.

Centralization

Centralization is connected to the leadership of the organization and how centralized it is. Centralized in the terms of a few individuals who make the decisions in the organization. This has been studied and seen as a negative effect towards innovativeness in organizations. Having a wider leadership in an organization with more people having the opportunity to make decisions has been seen to have a positive influence on innovativeness. Contradictory, a more centralized organization has proven to have an advantage when it comes to implementing innovations (Roger, 2003). Studies have

shown that the centralized leadership's attitude towards the specific innovation has a large influence on the likelihood of implementation. A centralized leadership in an organization limits the innovation to the extent to which the leadership has a positive relationship (Kozioł-Nadolna and Beyer 2021). Involving all the stakeholders in the decision-making process makes the process more collaborative and efficient (Ali, Zwetsloot & Nada, 2019).

Complexity

Complexity is the degree of which the people in the organization have knowledge and expertise in the field. A higher degree of knowledge and expertise towards a particular subject will increase the innovativeness of the organization. Especially, increase the success rate of innovations. Organizations that consist of people with high knowledge in a field such as sustainability are more likely to develop and adapt innovations related to sustainability and the success rate of these innovations is often high (Rogers 2003). The employee´s knowledge and skills to adopt and create new processes are affecting the rate of adoption of new innovations (Ali, Zwetsloot & Nada, 2019).

Formalization

Formalization focuses on how the members of the organization follow rules and regulations. What can be seen according to Rogers (2003) is that a more formal organization is less likely to be innovative but have an advantage in implementing innovations. Studies made by Shanker et al. (2017) further proves this concept that an organization with more freedom with less rules and regulations lets the employees act freely and come up with innovative ideas more often. This can also be related to how the external regulations set on the organization affects the innovations. External regulations can force organizations to come up with new innovations.

Interconnectedness

The connections between members of the organization are called interconnectedness. Having a higher degree of interconnectedness affects the innovativeness of the organization positively. Sharing values and having great communication between members have a great effect on the innovativeness in the organization, both at the first phases and implementation (Rogers, 2003). This is further proved in a study made by Watson (2021) where having common values and a mission is creating an innovative environment.

Organizational slack

Organizational slack is the available resources that are left outside the budget. These resources are then available to spend on new innovations and ideas for the organization. Consequently, a high degree of organizational slack gives more resources towards establishing new linnæations. Larger organizations often have more slack resources; therefore size is a factor connected to innovativeness (Roger, 2003).

Attitude towards change

In order for an organization to be innovative the organization's members both from the leadership and employees need to have a positive attitude towards change. Innovations are something that is new for the organization and will therefore result in change, either when developing innovations or implementing innovations. If the members of the organization are unwilling to change and path dependence is a common phenomenon, the innovativeness of the organization is seen from studies to be lower (Rogers, 2003). People development in the sense of attitude towards change is linked to innovation and a positive relationship between those instances has been found (Ali, Zwetsloot & Nada, 2019). Other studies have shown that the workforce agility is also connected to the innovativeness of the organization where the employees are able to adapt and react to changes in a positive manner to influence innovation (Franco & Landini, 2022).

System openness

System openness is the degree to which the organization is connected to external systems and members of the society. The focus is also on how open the organization is in terms of information flows between people in the organization and external connections. An organization with a high degree of openness is proven to have an advantage in innovation decision making and implementation (Rogers, 2003). Studies made by Petrou el al. (2020) shows that the external environment has a high degree of influence on the organization. If the organization is able process information efficiently the external environment can have a positive impact on the innovation process at the organization.

3.2 Proposed theoretical framework for this thesis

From the existing theory reported in chapter 3.1, a framework can be developed to understand the factors influencing if an organization has or has not adopted GHG calculation tool (Figure 1).
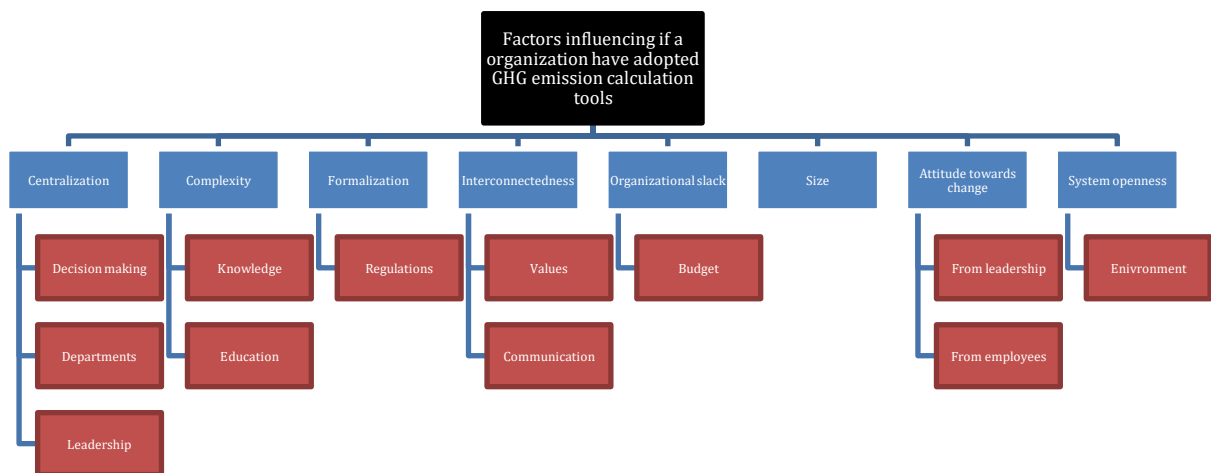
Figure 1: Possible factors influencing whether an organization has adopted or not adopted a GHG calculation tool

The theory uses the 8 characteristics of an innovative organization and each characteristic has their own more detailed characteristics. Since all these characteristics have an influence on the innovativeness of an organization, all should contribute to the decision adopting GHG emission calculation tools. According to this theory, an organization that fulfills all characteristics, or most of the characteristics are likely to be innovative and as a consequence, are more likely to have adopted GHG emission calculation tools. Each characteristic can be evaluated further.

Centralization is the first characteristic with the underlying characteristics of decision making, departments and leadership. If an organization has decentralized decision making with each department having the availability to make decisions the organization is more likely to have adopted GHG emission calculation tools. If the leadership allows more decision making to each individual it is also more likely that the organization has adopted GHG emission calculation tools.

Complexity has a strong influence on if the organization has adopted GHG emission calculation tools or not. If the members in the organization are well educated in the field of sustainability and have the correct knowledge the organization is more likely to have adopted GHG emission calculation tools. If an organization lacks competence in sustainability, they are not likely to have adopted GHG emission calculation tools.

Formalization is about the regulations and formality of the organization. The theory is that if the organization is affected with regulations connected to sustainability, the organization is more likely to have adopted GHG emission calculation tools. If the organization does not have a clear understanding of what regulations that affect them this lowers the chance of them adopted GHG emission calculation tools.

The interconnectedness of the organization is related to the values and communication at the organization. The theory is that, if the organization has values with sustainability as a role in them, the organization is more likely to have adopted GHG emission calculation tools. In order to calculate the GHG emissions of an organization, good communication is necessary, therefore the communication has to be good in the organization for it to have adopted GHG emission calculation tools.

The size of the organization affects the level of innovativeness of the organization and therefore also its likelihood of adopted GHG emission calculation tools. The theory is that a larger organization is more likely to have adopted GHG emission calculation tools because the organization has more resources.

The attitude towards change affects the likelihood that the organization has adopted GHG emission calculation tools. The more positive attitude the leadership and the employees have towards change, the more likely the organization is to have adopted GHG emission calculation tools according to this theory.

The last characteristic is system openness and with that the environment around the organization. The theory is that if the organization has customers, stakeholders or other external factors that value sustainability, the organization is more likely to have adopted GHG emission calculation tools. If the organization feels that the external environment has no interest in sustainability, the organization are less likely to have adopted GHG emission calculation tools.

4. Method

4.1 Research approach

In order to conduct a research study, a research approach has to be chosen and well developed. A research approach can be described as the general plan for the study and the approach varies depending on the hypothesis. There are three categories of research approach (Bryman and Bell, 2015):

- Deductive
- Inductive
- Abductive

When conducting research with a deductive approach the theory comes before the data collection and the testing. The hypothesis of the study is formulated from the available theory and later tested in the study to confirm its validity. This means that if the study is new so that there are no existing theories in that topic, a deductive approach cannot be used (Bryman and Bell, 2015).

Inductive approach collects the data first and then develops a theory based on the data gathered. Consequently, an inductive approach contributes to the upbringing of new theories developed from data gathering. This approach needs to be used if there are no developed theories in that topic before (Bryman and Bell, 2015).

The last approach called abductive approach combines the two approaches of deductive and inductive. This approach is often used when the data collection shows results that do not comprehend with the developed theory. In this instance, new theory is developed from the data collected and therefore the research starts out with a deductive approach and later ends in an inductive approach, consequently creating a abductive approach (Bryman and Bell, 2015).

In this study a deductive approach is used as the theoretical framework is developed before gathering the data necessary to prove the theory. The theoretical framework was developed using Rogers diffusion of innovation theory (Rogers, 2003), which was tested using quantitative data collection methods. The cons of using the deductive approach is that other relevant theories could be overlooked.

4.2 Data collection

4.2.1 Qualitative or quantitative data collection

The research study will always have a phase of data collection. Data is needed in order to formulate a theory or to test a theory as written in chapter 4.1. There are many methods to use to collect data, and to divide the methods the focus can be on qualitative or

quantitative data. Qualitative data is data that focuses on a smaller amount of data but more extensive with more emphasis on words rather than numbers. Qualitative data is more common to use when formulating theories as an inductive approach but not always, there are studies using qualitative data in an deductive approach. Examples of methods to collect qualitative data are participant observation, qualitative interviewing and focus groups. These methods use a small sample size of participants and focus to extract more information from each (Bryman and Bell, 2015).

Quantitative data collection is often described as a method to collect numerical data and larger quantities. Quantitative data collection is more commonly used in a deductive approach to test existing theories. Using a large quantity of data, the theory can be examined using numerical data and proven or disproven. Examples of quantitative methods are surveys, structured observation and structured interviews (Bryman and Bell, 2015).

This study uses quantitative data collection methods in order to verify the existing theory and the developed theory. The reason for using quantitative data collection methods is to have a larger sample size with data that can be analyzed in numerical methods. The data collection methods used will be explained in detail in the following chapters.

4.2.2 Survey

An online questionnaire survey was conducted to gather data regarding the percentage of SMEs who have adopted a GHG calculation tool and the factors behind such adoption.

Survey is a method for collecting a large amount of data with a small amount of work for each data gathered. The method can also be called a self-completion questionnaire and has many similarities to a structured interview. The method consists of questions that are asked to people that have the necessary information. The questions in the survey are less open to enable easier answers and analyzing possibilities compared to questions in an structured interview. There are often less questions in a survey compared to a structured interview since people are less likely to answer a survey if it has many questions compared to a structured interview. The advantages of a survey is that there is no variability in questions or in the interviewer, each respondent has the same questions and the answers are easier to analyze. The disadvantages are that the questions can be interpreted differently by the participants and no follow up questions can be asked. In order to use surveys as a reliable method, the questions should be clear and easy to understand, the respondents have to be of interest to the study (Bryman and Bell, 2015).

This study uses the method of survey to prove or disprove the developed theory. Survey was chosen as the data collection method since it is a method often used to gather a large quantity of data in a small amount of time. Other data collection methods that could have

been chosen instead was interviews and observations. Since these methods needs a lot more work from the author and gathers a smaller scope of data, survey was chosen to be superior compared to these. Using the survey, the theory shows how some characteristics of an organization have an effect on if the organization has calculated their greenhouse gas emissions or not. In order to study these characteristics, each characteristic needs to be connected to at least one question in order to see how the respondent's organization is characterized. The questions are developed from the existing literature and theories. All the survey questions with related characteristics and available answers can be seen in table 1. The survey is divided into two parts. The first part is questions regarding the characteristics of the organization and the factors behind the environmental work at the organization. The second part of the survey's aim is to understand if the organization has calculated their greenhouse gas emissions and why or why not. Each question has several possible response options for the respondents to choose, which were developed from interviews with 3 participants.

Table 1: Survey questions

QUESTION NR.	QUESTION	ANSWER:	CHARACTERSTICS (FROM VARIABLES IN FIGURE 1)
1	How many employees are there in your organization?	Ex: 1-10, 11-25….	Size
2	In what sector does your organization act?	Ex: Manufacturing, education…	-
3	Describe how your organization is organized in departments/offices	Free	Departments
4	How possible is it for each department/office to take their own decision connected to environment and sustainability?	No possibility 1 Large possibility 5	Decision making/leadership
5	Do you have a budget to actively reduce your greenhouse gas emissions?	Yes/no	Budget
6	How well do you think the organization's leadership prioritizes to reduce the organization's greenhouse gas emissions?	Not at all 1 Large priority 5	Leadership
7	How willing are the organization's leadership to improve their engagement with reducing the organization's greenhouse gas emissions?	Not at all 1 Very willing 5	Attitude towards change
8	How engaged are the employees in the organization to reduce the organization's greenhouse gas emissions?	Not engaged at all 1 Very engaged 5	Attitude towards change
9	How willing are the employees in the organization to improve their engagement with reducing the organization's greenhouse gas emissions?	Not at all 1 Very willing 5	Attitude towards change
10	Has the organization nominated a person or persons who will work with questions regarding greenhouse gas emissions?	Yes/no	Decision making/communication
11	Does a strategic plan to reduce the organization's greenhouse gas emissions exist?	Yes/no	Communication

12	To what degree do you know as an organization what you can do to lower the organization's greenhouse gas emissions?	We dont know at all 1 We know exactly 5	Knowledge
13	Does the organization work actively to develop and reach sustainability goals for the organization?	Yes/no	Values
14	If you answered yes to question 13, are these goals communicated to the employees at the organization?	Yes/no	Communication
15	If you answered no to question 13, why do you not have goals connected to sustainability?	Free	Decision making
16	If you answered no to question 13, would you like to have goals connected to sustainability?	Yes/no	Values
17	From your defined values, how much is sustainability included?	Not at all 1 Very much 5	Values
18	If your values include sustainability, to what degree are they communicated to the employees at the organization?	Not at all 1 Very much 5	Communication
19	How important is it for you as an organization to reduce your environmental impact?	Not at all 1 Very important 5	Values/knowledge
20	How active do you work with reducing your environmental footprint as an organization?	Not at all 1 Very active 5	Leadership/values
21	To what degree is there a need for education for your employees when it comes to your possibilities as an organization to reduce your greenhouse gas emissions?	Not at all 1 Large need 5	Education/knowledge
22	To what degree do you enable skills development when it comes to your possibilities as an organization to reduce your greenhouse gas emissions?	Not at all 1 Large need 5	Leadership/education
23	To what degree are you as an organization affected by rules and regulations connected to greenhouse gas emissions?	Not at all 1 To a large degree 5	Regulations
24	Do you have an understanding of all the rules and regulations that affects you as an organization connected to greenhouse gas emissions?	Yes/no	Regulations
25	To what degree do your customers/suppliers demand actions from you when it comes to greenhouse gas emissions?	No demands 1 High demands 5	Environment
26	Have you as an organization calculated your greenhouse gas emissions?	Yes/no	
27	If you answered yes on question 26, have you calculated your greenhouse gas emissions yourself or an external actor?	Ourselves/actor	
28	If you answered yes on question 26, how did you calculate your greenhouse gas emissions?	Free	
29	If you answered yes on question 26, why did you calculate your greenhouse gas emissions?	Ex: To lower our emissions, to set goals…	

30	If you answered yes on question 26, when did you calculate your greenhouse gas emissions for the first time?	Ex: less than 1 year ago, 2-3 years ago...
31	If you answered yes on question 26, how often do you calculate your greenhouse gas emissions?	Each year/Every second year/Not regulary
32	If you answered yes on question 26, how has it affected your organization that you calculated your greenhouse gas emissions?	Very negatively 1 Very postively 5
33	If you answered yes on question 26, in what way have it helped you as an organization that you calculated your greenhouse gas emissions?	Ex: Motivaded us, helped us set goals...
34	To what degree would you recommend other companies to calculate their greenhouse gas emissions?	Never 1 Always 5
35	If you answered no on question 26, why haven't you calculated your greenhouse gas emissions?	Ex. Not enough data, No method
36	If you answered no on question 26, how interested are you to calculated your greenhouse gas emissions?	Not at all 1 Very Interested 5
37	If you answered no on question 26, what would you need in order to calculate your greenhouse gas emissions?	Ex. Method, resources...
38	How much more would you like to work with questions regarding sustainability?	Not more 1 Much more 5

The email addresses of the participants of the survey were gathered from the organization Avalon Innovation, which collaborated in this research and has contacts with their customer companies. Other companies were gathered from Växjö municipality websites, where the size of the companies is mentioned (which form the basis to scan the SMEs). The survey was sent to a total of 205 companies. The survey was sent to the environmental specialist at the company if that contact information existed, otherwise the survey was sent to a person in the leadership of the organization. There were a total of 27 responses with 22 of these being SMEs. This shows a total response rate of 13% which is aligning with findings from other surveys sent through email (Fincham, 2008). To validate the result the 13% of respondents need to be evaluated with the 87% that did not respond in order to ascertain that non-response bias did not occur.

Non-response bias is the phenomenon that occurs when the subjects who are not taking part in the study are systematically different from those who did participate in the study. If such phenomenon occurs the results might not correspond to reality. To assess if non-response bias took place, the characteristics and properties of the participants and non-participants can be compared. If the characteristics of the non-participants and participants are similar the participants can be seen to represent the mass (Prince, 2012).

In this study the characteristics that could be evaluated from the participants and non-participants was the size of the organizations and the sectors they operate in. The comparison can be seen in table 2.

Table 2: Composition of respondent's vs non-respondents

Characteristics	Respondents	Non-respondents
1-10 employees	23%	22%
11-25 employees	18%	26%
26-75 employees	40%	32%
76-150 employees	9%	10%
151-250 employees	5%	10%
Manufacturing sector	66.7%	71%
Economy, science and technology sector	18.5%	24%

The numbers are similar between the respondents and the non-respondents. This does not prove to full extent that non-response bias did not occur since only two characteristics was analyzed but it shows that the probability of it occurring in this study was low.

4.3 Analyzing the data

To analyze the data gathered from the survey, statistical equations with mean value are used. In order to see how much each question affects the probability that the organization have calculated their GHG emissions, comparing the answers from the organization that have calculated their GHG emissions and the organizations who have not needs to be done. The mean value shows the mean answer on each question from the group of organizations that have calculated their GHG emissions and the organizations who have not. Using these calculations shows which questions that has the largest difference between organizations that have calculated their GHG emissions and the organizations that have not calculated their GHG emissions. This will consequently show which questions have the highest impact on if an organization have calculated their GHG emissions or not. In order to analyse if the difference is statistically significant, a two sample Mann-Whitney test will be used (Nachar, 2008). A Mann-Whitney test is used to determine statistically if two different groups are different on a variable. This is done by testing if the problability to get a higher value from one group is larger than the other group. The Mann-Whitney test used in this analyse was done with a significance level (p-value) of 0.05, this means that any results over 0.05 is not statisticily significant. The results of the mean values, the differences and the Mann-Whitney test for each question will be displayed in a table as the example shown in table 3.

Table 3: Analyzing of each question from the two groups

Question	Organizations who have adopted GHG calculation tools	Organizations who have not adopted GHG calculation tools			Mann-Whitney test
	Mean value*	Mean value *	Difference	p-value	
4					
5					

4. Results

The result of the survey regarding the characteristics can be seen in table 4. The results show that most organizations that answered the survey has between 26-75 employees and 66.7% of the organizations are working with manufacturing. 73% of the organizations does not have a budget set to reduce the organizations GHG emissions. Still, most organizations have an interest in reducing their GHG emissions as shown in results to question 19. The correspondents feel that the employee's engagement to reduce the organizations GHG emissions is higher than the leaderships engagement. The interest to improve the engagement is similar between leadership and employees. 59.3% of the organizations have nominated a person that is responsible for questions regarding reducing the organizations GHG but 63% of the organizations have not a strategic plan to reduce it. The answers to question 12 regarding the knowledge in the organization, what the organization can do the reduce their GHG, the answers are similar to a normality curve with most answers 40.7% is in the middle and 10 above and 6 below.

Table 4: Survey results from the first part of the survey connected to characteristics

How many employees are there in your organization?				
23% (5)	**18% (4)**	**41% (9)**	**9% (2)**	**5% (1)**
1-10	11-25	26-75	76-150	151-250
In what sector does your organization act?				
66.7% Manufacturing		**18.5% operate in economy, science and technology**		**14.8% other**
Describe how your organization is organized in departments/offices				
Free text				
How possible is it for each department/office to take their own decision connected to environment and sustainability?				
5% (1)	**18% (4)**	**23% (5)**	**14% (3)**	**41% (9)**
1	2	3	4	5
Do you have a budget to actively reduce your greenhouse gas emissions?				
73% (16)			**27% (6)**	
Yes			No	
How well do you think the organization's leadership prioritizes to reduce the organization's greenhouse gas emissions?				
9% (2)	**9% (2)**	**36% (8)**	**23% (5)**	**23% (5)**
1	2	3	4	5
How willing are the organization's leadership to improve their engagement with reducing the organization's greenhouse gas emissions?				
0% (0)	**5% (1)**	**32% (7)**	**18% (4)**	**45% (10)**
1	2	3	4	5

How engaged are the employees in the organization to reduce the organization's greenhouse gas emissions?				
0% (0)	14% (3)	36% (8)	23% (5)	27% (6)
1	2	3	4	5

How willing are the employees in the organization to improve their engagement with reducing the organization's greenhouse gas emissions?				
0% (0)	9% (2)	36% (8)	32% (7)	23% (5)
1	2	3	4	5

Has the organization nominated a person or persons who will work with questions regarding greenhouse gas emissions?	
45% (10)	55% (12)
Yes	No

Does a strategic plan to reduce the organization's greenhouse gas emissions exist?	
68% (15)	32% (7)
Yes	No

To what degree do you know as an organization what you can do to lower the organization's greenhouse gas emissions?				
9% (2)	18% (4)	36% (8)	23% (5)	14% (3)
1	2	3	4	5

Does the organization work actively to develop and reach sustainability goals for the organization?	
41% (9)	59% (13)
Yes	No

If you answered yes to question 13, are these goals communicated to the employees at the organization?	
9% (2)	55% (12)
Yes	No

If you answered no to question 13, why do you not have goals connected to sustainability?
Free text

If you answered no to question 13, would you like to have goals connected to sustainability?	
5% (1)	36% (8)
Yes	No

From your defined values, how much is sustainability included?				
5% (1)	18% (4)	23% (5)	18% (4)	36% (8)
1	2	3	4	5

If your values include sustainability, to what degree are they communicated to the employees at the organization?				
9% (2)	5% (1)	27% (6)	14% (3)	41% (9)
1	2	3	4	5

How important is it for you as an organization to reduce your environmental impact?				
0% (0)	**9% (2)**	**18% (4)**	**32% (7)**	**41% (9)**
1	2	3	4	5
How active do you work with reducing your environmental footprint as an organization?				
9% (2)	**23% (5)**	**18% (4)**	**23% (5)**	**27% (6)**
1	2	3	4	5
To what degree is there a need for education for your employees when it comes to your possibilities as an organization to reduce your greenhouse gas emissions?				
5% (1)	**9% (2)**	**18% (4)**	**27% (6)**	**41% (9)**
1	2	3	4	5
To what degree do you enable skills development when it comes to your possibilities as an organization to reduce your greenhouse gas emissions?				
14% (3)	**27% (6)**	**32% (7)**	**5% (1)**	**23% (5)**
1	2	3	4	5
To what degree are you as an organization affected by rules and regulations connected to greenhouse gas emissions?				
14% (3)	**32% (7)**	**23% (5)**	**14% (3)**	**18% (4)**
1	2	3	4	5
Do you have an understanding of all the rules and regulations that affects you as an organization connected to greenhouse gas emissions?				
41% (9)			**59% (13)**	
Yes			No	
To what degree do your customers/suppliers demand actions from you when it comes to greenhouse gas emissions?				
23% (5)	**14% (3)**	**32% (7)**	**18% (4)**	**9% (2)**
1	2	3	4	5

9 of the 22 organizations have active sustainability goals that they work towards. Of the organizations that does not have sustainability goals, 86% of these would like to have it. The results show that most organizations feel that it is very important to lower their environmental footprint as an organization, but there are not equally many that work very active with it. Of the 22 participants, only 2 of them (9%) have calculated their GHG emissions which can be seen in table 5.

Table 5: Survey results from the second part regarding adoption

Have you as an organization calculated your greenhouse gas emissions?	
9% (2)	**91% (20)**
Yes	No

If you answered yes on question 26, have you calculated your greenhouse gas emissions yourself or an external actor?	
100% (2)	**0% (0)**
Ourselves	Other

If you answered yes on question 26, how did you calculate your greenhouse gas emissions?
Free text

If you answered yes on question 26, why did you calculate your greenhouse gas emissions?
To lower our emissions, to see where we can be better, in marketing standpoint

If you answered yes on question 26, when did you calculate your greenhouse gas emissions for the first time?
4-6 years ago (1), 2-3 years ago (1)

If you answered yes on question 26, how often do you calculate your greenhouse gas emissions?
100% (2) Every year

If you answered yes on question 26, how has it affected your organization that you calculated your greenhouse gas emissions?				
0% (0)	**0% (0)**	**0% (0)**	**0% (0)**	**100% (2)**
1	2	3	4	5

If you answered yes on question 26, in what way have it helped you as an organization that you calculated your greenhouse gas emissions?
Motivaded, lowered our emission, envisioned us, helped us set goals

To what degree would you recommend other companies to calculate their greenhouse gas emissions?				
0% (0)	**0% (0)**	**0% (0)**	**0% (0)**	**100% (2)**
1	2	3	4	5

If you answered no on question 26, why haven't you calculated your greenhouse gas emissions?				
27% (6)	**27% (6)**	**23% (5)**	**23% (5)**	**0% (0)**
Not enough resources	Not enough competence	No data	No method	Other

If you answered no on question 26, how interested are you to calculate your greenhouse gas emissions?				
10% (2)	**14%(3)**	**35% (7)**	**15% (3)**	**25% (5)**
1	2	3	4	5

If you answered no on question 26, what would you need in order to calculate your greenhouse gas emissions?
Method, resources, competence, data and time

How much more would you like to work with questions regarding sustainability?

5% (1)	9% (2)	45% (10)	27% (6)	14% (3)
1	2	3	4	5

The two SMEs who have calculated their GHG emissions have different number of employees, one has between 11-25 and the other 26-75 employees. They do not operate in the same sector either. The similarities between these two organizations are a strong leadership that prioritizes environmental questions, well established plans and sustainability goals who are communicated to their employees. Both organizations have well educated staff in sustainability and have calculated their GHG emissions themselves. Both would highly recommend other to do it since it has helped improve their motivation one of the organizations have been able to reduce their GHG emissions consequently.

The organizations that have not calculated their GHG emissions says the main reason is that they have not got enough time or competence, there is also a lack of data and resources. The results show that there are interested in calculating their GHG emissions and they would need more resources, a method/tool, better competence and data to do it. The results of the survey show that in the end, most organizations would like to work more with questions related to reducing GHG emissions.

5. Analysis

According to literature review, organizations have to take the environmental change serious and perform the right actions in order to reduce its serverness. This is necessary to reach the 2030 sustainable development goals. In order to do so there is a need for GHG emission calculation in all organizations that have any intention to reduce their emissions. The tools and methods exist already with the standards of GHG protocol and ISO 14064-1, the adoption of these methods from organizations and in particular SMEs are the challenge. The organizations must consider the environmental change seriously and there is a wide range of opportunities for SMEs to adopt GHG emission calculations tools. Such adoption could improve the motivation, allow accurate and measurable sustainable goals, and also reduce the organizations GHG emissions.

The literature and former studies show that there are multiple factors influencing the adoption of GHG emission calculation tools. For each question, the Mann-Whitney test of the mean value difference between the organizations that have calculated and not calculated their GHG emissions is presented in Table 6. This test is not entirely robust in our analysis due to the skewed distribution among the two groups of the respondents, two who have adopted the GHG emission tool vs 22 who have not. The analysis can still explain trends in results. The characteristics of an organization that has the highest influence of adoption in this case and corresponds to these questions are budget (question 5), leadership (question 20), education (question 22) and regulation (question 23).

Table 6: Mean value for the two groups and the statistical analysis results

Question	Organizations who have adopted GHG calculation tools	Organizations who have not adopted GHG calculation tools			
	Mean value*	**Mean value ***	**Difference**	**p-value**	**Mann-Whitney test**
4	4.5	3.6	0.9 (25%)	0.437	Not statistically significant
5	1	0.2	0.8 (400%)	0.022	Statistically significant
6	5	3.25	1.75 (54%)	0.055	Not statistically significant
7	5	3.95	1.05 (27%)	0.159	Not statistically significant
8	4.5	3.7	0.8 (22%)	0.311	Not statistically significant
9	4.5	3.65	0.85 (23%)	0.231	Not statistically significant
10	1	0.5	0.5 (100%)	0.208	Not statistically significant
11	1	0.25	0.75 (300%)	0.040	Statistically significant
12	4	3.05	0.95 (31%)	0.344	Not statistically significant
13	1	0.55	0.45 (82%)	0.254	Not statistically significant
14	1	0.83	0.17 (20%)	0.655	Not statistically significant
17	5	3.5	1.5 (43%)	0.109	Not statistically significant
18	5	3.63	1.37 (38%)	0.145	Not statistically significant
19	5	3.95	1.05 (27%)	0.132	Not statistically significant

20	5	3.2	1.8 (56%)	0.069	Not statistically significant
21	4.5	3.45	1.05 (30%)	0.207	Not statistically significant
22	5	2.75	2.25 (82%)	0.051	Not statistically significant
23	5	2.7	2.30 (85%)	0.039	Statistically significant
24	1	0.35	0.65 (186%)	0.094	Not statistically significant
25	4	2.63	1.37 (52%)	0.126	Not statistically significant

The participants that have not calculated their GHG emissions says the reason for this is lack of resources, competence and data. This is similar to the results from earlier studies made by Boston Consulting group (2021) and corresponds accurate to the challenges written in literature. SMEs does not have the same resources to spend on sustainability actions as larger organizations have. The organizations that have an active budget made for reducing GHG emissions are more likely to have calculated their GHG emissions. A reason that data is a lacking and are needed to be improved for SMEs to calculate their GHG emissions is because the data is not obligated to be reported, making it a choice instead of an obligation. Since sustainability is often not a priority in SMEs the competence and education in sustainability is rarer. The analysis shows that there is a will to prioritize sustainability but not as many actions because of these challenges.

Following the challenges, the analysis shows that improving the characteristics of leadership, education and regulation with a more diverse leaderships with focus on sustainability, enabling skills development internally in the field of sustainability and a clear understanding of regulations and how these affect the organization. These are also strategies to tackle the challenges that most SMEs have with lack of resources, competence and data.

6. Discussion

6.1 Opportunities

Many opportunities have been identified for SMEs to adopt GHG emission calculation tools in their business. The methods and tools to calculate GHG emissions exist today and are well established. Using these methods to get an understanding of where the GHG emissions come from at your organization and the size of these emissions should be the first steps of sustainability actions in the organizations. Such decision has shown to increase the motivation internally at the organization, enabled measurable and accurate sustainability goals and even lowered their GHG emissions. Calculating the GHG emissions eliminates the presumption that occurs in organization of where their emissions come from. This lowers the chances of resources spent at wrong places and a false narrative of sustainability work. In order to see results of the environmental work that occurs at the organizations, emissions have to be calculated and communicated to the employees at the organization. A large opportunity the decision of adopting GHG emission calculation tools comes with is that it enables identification of where improvements are to be made. Since the world is changing and sustainability is more important than ever before, calculating the GHG emission at an organization helps the organization stay relevant and improves the brands position compared to others. As with adoption of innovations, early adopters influence others to adopt the innovation also. An organization that adopts the GHG calculation tool could influence other organizations to adopt also and enable a way for others.

6.2 Challenges

As with everything else, there are challenges that exist with adoption of GHG emission calculation tools in SMEs. Such challenges are that it takes resources to calculate GHG emissions, resources in the form of money and time. This is especially true the first time you calculate the GHG emission in an organization since the method are unknown. SMEs do not have the same resources as larger organizations have, often not the same knowledge and education in the field of sustainability and often not the same amount of data. Knowledge is needed to understand how to calculate the GHG emissions, what data that is necessary and what the results mean. Organizations and particular SMEs are viewing the sustainability changes that are necessary as something costly instead of an opportunity (Conway, 2015). This lowers the motivation and adoption of such actions. The challenge is also that SMEs are reluctant to take financial credit loans in order to have resources to apply sustainability practices (Marinkovic, n.d). The reason for this is the high cost and risks involved with taking a loan for sustainability practices. This further expands the challenges of lack of resources in SMEs.

The information and knowledge regarding sustainability opportunities as a consequence of calculating emissions needs to be improved in order for more SMEs to adopt GHG

calculation tools. In line with this the business environment and policy support with the current regulations are challenges that is hindering business to adopt GHG calculation tools. The studies made before having focused on the challenges with sustainability actions instead of opportunities. The organizations that have conducted environmental actions in order to reduce their GHG emissions are competing on the market with organizations that are using false marketing strategies to seem sustainable (Braga Junior et al., 2019). Often called greenwashing, some organizations are using tricks and strategies in marketing to show a sustainable organization that in reality is not. Competing with organizations that are using the same marketing without spending the resources to actually create sustainable actions lowers the motivation to invest in sustainability.

6.3 Strategies

There are many strategies an organization could use in order to enable adoption of GHG calculation tools and using the results successfully. The challenges of adopting GHG calculation tools has been identified and the main reasons why organizations have not adopted yet are lack of resources, competence and data. Most organization are performing some sustainability actions today in order to reduce their GHG emissions, these actions cost resources. Most organizations have not actually calculated their GHG emissions. In order to have resources to adopt and calculate GHG emissions from the organization, sustainability actions should be made firstly after GHG emissions have been calculated. This in order to optimize the resources spent. The GHG emission calculation can show what resources are needed to reduce GHG emissions and where to invest them. Organization could also apply for fundings that governments are offering for actions to reduce GHG emissions.

A full GHG emission calculation according to the GHG protocol standard takes time and a lot of resources. In order for organizations to understand what a such investment could result for them; organizations could cooperate with universities and students. This occurred during this study as the author performed a general GHG emission calculation on Avalon Innovation. This calculation focused on all scopes of emissions and resulted in many applicable actions. The calculation showed that Avalon Innovation lacked data in order to calculate very accurate results. Using the available data showed that 95% of the GHG emissions in Avalon Innovation occurred from transportation in form of business trips. The business trips emissions occurred from 90% car transportation and second from trains. Analyzing the data showed that if Avalon Innovation would switch half of their car trips to trains instead, their overall GHG emissions would be reduced by 25%. The conclusion of the calculation is that Avalon Innovation should focus on reducing their business trips by using digital meetings and when trips are needed to use train instead of cars.

The calculation at Avalon Innovation shows what the results could be when an organization cooperate with students to understand their GHG emissions. This could be a great strategy for many organizations since it is resource efficient.

To tackle the lack of competence in SMEs, the employees and leadership could be educated in the field of sustainability. There are existing companies that offers educations for organization in sustainability. Such education could also lead to a higher motivation for sustainability actions and the results from this study shows that an organization that enables skills development are more likely to have adopted GHG calculation tools. A leadership that offers skills development shows a leadership that prioritizes sustainability which increases the chances of adoption of GHG calculation tools. These strategies correspond to the results of this study which is that leadership, education and regulations are the main characteristics that affects the likelihood of adopting GHG calculation tools.

6.4 Further research

There are multiple options for further research to this study that can be recommended. A larger study with more organizations participating in different sector would establish a more robust result. Such study should include a well-established theoretical framework that documents more characteristics than used in this study. This would enable an analysis showing what characteristics some sectors should prioritize to establish successful sustainability actions.

Recommended further research would be to study larger organizations and how they compare in sustainability questions compared to SMEs. Such study could focus on organizations that have established sustainability actions in their organization to see strategies other organizations should implement.

The data collection method used in this study could be complemented with a qualitative data collection method to see more detailed characteristics of organizations. This would enable a deeper understanding of each organizations and the background to why or why not they have adopted GHG calculation tools.

7. Conclusion

There are multiple opportunities for SMEs to adopt GHG calculation tools. The tools and methods exist today to be used and such adoption could lower the GHG emissions, motivate the employees and establish sustainability goals in the organizations. Still, this study shows that only 9% of SMEs have calculated their GHG emissions. This is due to the challenges of lack of resources, competence and data in SMEs. The study shows that the characteristics of an organization affects the adoption of GHG calculation tools. The characteristics that have the largest impact is leadership, education and regulation. In order to overcome the challenges, organizations should prioritize to have a leadership that motivates employees to engage in sustainability actions. Organizations should enable skill development in the field of sustainability to overcome the challenge of lack of competence. This would enable more organization to adopt GHG calculation tools and most likely lower their GHG emissions.

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