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Impacts of waterless toilet & urinals to smart facility operations (Eco-housing framework)

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This thesis project is conducted based on the eco-city framework to encourage the use of waterless toilets and urinals. A waterless toilet or urinal is an environmental friendly technology designated for both rural and urban communities and to promote sustainable practices in facilities management. This project also intends to demonstrate how waterless applications such as toilets and urinals contribute to smart operations of facilities especially in delivering social, environmental and cost-saving impacts.

Facility Management operations must understand how to factor in corporate strategies and a long term facility management goals. Misalignment forces Facility Managers to a reactive role which could diminish customer experience within a facility. In order to fully exhaust the case subject, a mixed methods approach was used, incorporating benchmarking of similar ideas in Finland and the user perspective from the interview sections and questionnaires which was done via electronic email and got response from 44 respondent. The interviews were conducted with 20 respondents which recorded in video format for transcription and analysis purpose. Ultimately, facility managers should be able to measure and reconcile any defects in their daily facility operations.

The problem affecting the use of the waterless toilet and urinals is common in both the developed and developing countries, namely the knowledge gap in the use of water saving technologies and the lack and lack of facility management initiatives to drive the acceptance of this technology. Thus it is pertinent that the competence in water saving technologies is required where the sewage toilet (old fashioned) system is not efficient. While in consideration of a possible innovative product solution, Mivisions International Limited as a progenitor of the project topic has also offered frameworks to help draw up conclusions based on the observations made during the data collection phase of the project.

The research results show that there is a knowledge gap among the target customers and potential user of the product in the adoption of waterless applications. Moreover, the social and economic impact of the use of such technology is not easily recognized by inexperienced users but the environmental impact can be felt. Therefore, the researchers have converted these findings into action by creating effective processes that will draw the attention of the users through activities such as webinars, seminars, creation of social media awareness campaign and product display, and development of network of facility professionals to support the development of stronger and functional frameworks.

Keywords: Sustainability, smart facility operations, waterless toilet system and urinals, explanatory design, mixed method triple bottom line

Table of Contents

1. Introduction	5
1.1 The Project	6
1.2 Company Background	7
1.3. Research Question	8
2 Conceptual Framework - Waterless Toilet and Urinals	9
2.1 Eco-Housing Systems	9
2.2. Facility Managers Critical Success Factors	10
2.3 Facility Manager’s Strategy and Rating Tools	11
2.4 Role of Facility Managers in Delivering of Smart Facility Operations.....	12
2.5 Value Chain and Value Creation.....	14
3. Methodology.....	15
3.1 Mixed method design.....	15
3.2 Research Problems.....	19
3.3 Research Process.....	21
3.4 Research Design	22
4. Results	23
4.1 Survey Analysis	23
4.2 Interviews Analysis	25
5. Solutions - Value Propositions	28
5.1 Environmental Strategies.....	29
5.2 Facility Managers Operational Plan.....	30
6. Conclusion and Further Research	31
References.....	33
Illustrations.....	35
Figures.....	36
Tables.....	37
Appendixes	38

1. Introduction

Sustainable practices in facility management are the new ways used by facility professionals to deliver social, economic and environmental benefits within a facility. In pursuant of this initiative many facility managers across the globe are leaning into the use of waterless toilet or urinal systems in order to align their corporate strategies to practices which can contribute to their overall growth and productivity whether in short term or long term.

This functional thesis has been requested by Mivisions International Limited, a service consulting company currently operating in Estonia. Part of the project goal is to demonstrate how waterless product contributes to smart operations of facilities especially in delivering social, environmental and cost saving impacts. Among the strategies needed to lead the change in facility operations, business owner's wants to be affiliated with the best asset management strategies, expected to wade the effect of competitors. 71 percent of the Earth's surface is water but only about four (4) percent of those is freshwater falling from the sky, streams, lakes and undergrounds, can be used in everyday life of human. The determination of this case study is to encourage the sustainable practices in facilities management through the use of waterless toilets and urinals (Separett, 2016).

Another factor of determination is to find a solution is: As population growth and demands increasing, with nearly 60 percent of global people becoming urban dwellers, challenges related to water are affecting the development of human urban sustainability. Lack of access to safe water and sanitation increases the chance for water-related disasters such as floods and droughts which poses bad impacts on human health and well-being, the environment, economic growth and social development. Those who suffer the most from lack of water are the urban poor in developing countries. One of the problematic challenges related to water is water scarcity, which is happening in almost every continent. Water use has been growing at more than two times the rate of population increase in the last century, along with a great amount of water is wasted, polluted and unsustainably managed. When the water supplies every year drop below 1,700 m³/citizen, that area is experiencing stress water, if they drop below 1,000 m³/ citizen, the continent faces water scarcity, and below the level of 500 m³, it's "absolute scarcity" (Urimat Eco, 2017).

The Composting toilet technology "aims to combine the effects of the proper amount of heat and moisture with naturally occurring microbes to decompose waste materials into safe, usable fertilizers. It is a cost-efficient waterless sanitation that uses aerobic decompositions to remove pathogens from human waste" (Balzer 2012, 4). It has a unique

ecological idea which means if food brings about waste, waste should bring about food (Balzer 2012, 5).

1.1 The Project

The sustainable way of managing facilities is becoming a high priority in most of the management discussions because of the diminishing resources and looming economic crisis that is affecting facility management sector. The core of the facilities management sector is resting on the asset management, architecture, engineering and service innovation concepts; however facilities management is more connected to rendering services which improves performance of the built environment as a whole. The innovate component of a facility manager's duty causes them to develop an out of the box strategies on how to manage the properties and deliver added value to the system.

Sustainability issues have been on the rise lately and has created need for smart actions like turning waste into wealth, moving from a traditional method of household appliance to a more cost saving and environmental friendly technologies. This brings about the need for not just only saving water through using the waterless toilets and urinals but also to create byproducts from the sewage waste produced from using these waterless products into useful agricultural sewage sludge and fertilizers thereby benefiting the environment. Water-less toilets and urinals helps organizations to deliver efficient use of water, sustainable image enhancement, hygiene and waste management, these among others are some of the required features of an eco-city, sustainable housing concepts (Green, 2010).

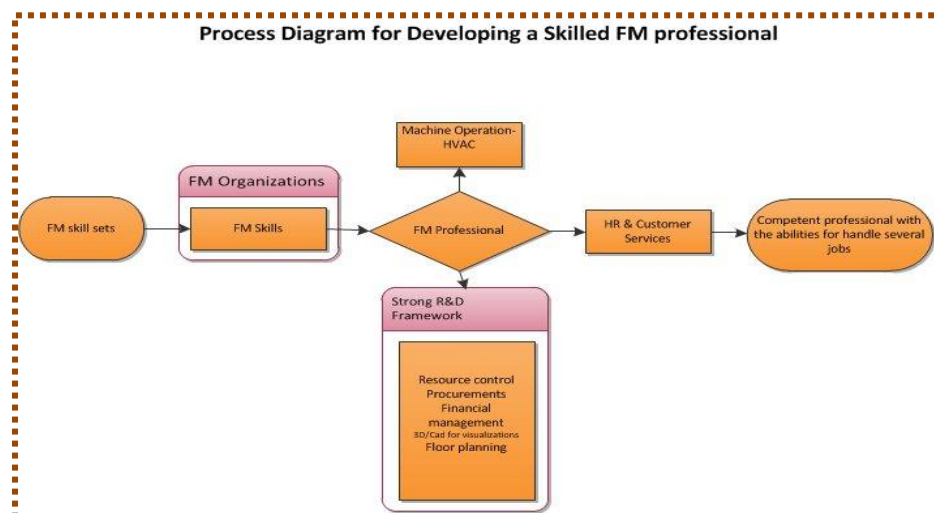
With certain products like VILLA 9000 and Urimat Eco Plus it is now possible to attain sustainable advantages and smart facility operations (Separett, 2016). We know that one the core duties of a facility manager, is to help his organization to reach the triple bottom line effect which is financial impact for his organization, environmental impacts and of course positive impact on the social people (Novosan, 2015).

These skills are not so generic or easy to develop. Managing a working environment where the need for these skills are eminent, requires a strategic pattern on how to organize an effective work pattern to achieve efficiency. In general facility management organizations in Europe are slowly recovering from the effect of the economic recession. This is amongst the reason why the properties built in most location in Finland are mostly over crowded or over used, and this makes the job of a facility manager even more challenging. The subsection below will discuss the issues of sustainable facilities in Europe and issues affecting its performance.

1.2 Company Background

Mivisions International Limited is a service business and consultancy company offering value adding solutions to companies and individuals. The company specializes in a number of specialty growth and expansion services. First and foremost, it creates valuable partner networks and compare their products and services to the existing competition in the region. The company's consultation and professional services are offered to clients and businesses to help them develop the knowledge their careers and businesses requires to perform well in a competitive market. The company promotes asset management and facilities service training to organizations to enable them manage their facilities effectively. The company's diversity management team integrates different nationality experts with different skills and experience together to achieve business' common target. This leads to the potential of innovative, vibrant and dynamic ideas to build the strategy and methodology for their services.

Mivisions International business education services provides strategic supports which bridges the knowledge gap within students and graduates in sustainable practices in Facility Management. As a result, the company can be proud of itself to be the pioneer of supportive education program for degree student all over the world. The company recognizes consumer's demands for quality, innovative and sustainable solutions. Therefore, the company is poised to move the company's services in that direction. One of the ways we do it is to develop new models that can audit the entire phases of our operations by rating, reporting and recommending best practices in the facility. The diagram below show the company's process plan for developing facility managers who are knowledgeable in sustainability.



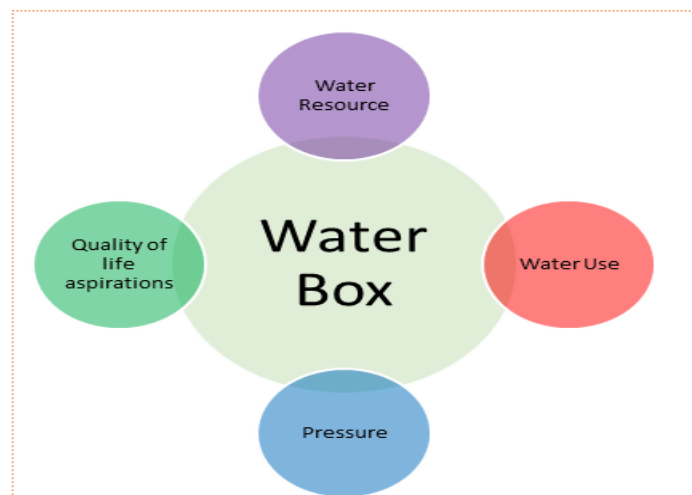
Source: (Mivisions International, 2012).

Figure 1 : Process Flow for Developing a Skilled FM Professional

According to the diagram (figure 1), the activities in a facility management organization have a direction correlation with research and development. Every facet of the activities in this system emphasizes the need to deepen findings in the entire aspects, in order to effectively harness all the potentials. Therefore be able to support the growth rates, manage change constructively and diversify the customer relationship approach, so as to increase the performance of the industry.

1.3. Research Question

This research questions aims to draw attention on facilities managers to diversify their operations strategy by considering efficient water use and also how to transfer this mindset into a long term cost saving strategy for their organization. In view of this expectation: How can waterless toilets and urinals generate added value to an organizations core business process? Studies reveals that increasing level of water consumption can place a burden on the natural hydrological balance and nearly one billion people living in the more arid parts of the globe have limited or no access to water resources (IFMA SFP, 2011). Answering the research question require an observation in the following areas. Firstly, the importance operating a building through efficient water, secondly how limited access to adequate water supplies can affect economic performance of a facility and lastly how shortage of water affects quality of life and expectations.



(IFMA SFP, 2011)

Figure 2: Goals for sustainable Water Use

Figure 2 above shows the relationship between water use and the quality of life of the consumer because nutrition increases with irrigated agriculture, and disease declines with greater availability of clean drinking water. Therefore Facility managers with competence in sustainability can ensure water assessment and converting the data acquired to innovations that will attract environmental and social impacts. Therefore it is much easier

to understand the profit indices by growth and operating strategies directly connected to water supplies, prices and regulations. The information in this case study with alleviates the pressure caused by limited water resources and help to foster creative ways of tackling water related challenges Global water partnership (UN Water statistics,2017).

2 Conceptual Framework - Waterless Toilet and Urinals

Waterless application is a concept that has emerged to become a global phenomenon, with the objective minimizing the impact of industrial growth on the environment across the continent. Waterless devices is not new concept all together but the ideas of sustainability is growing therefore companies are required to align their strategies to fit into this development life cycle. According to recent IBM surveys, it is stated that two-thirds of companies see sustainability as a revenue driver and half of them consider green initiatives will create their competitive advantage. As a result of growing awareness, environmental responsibility can be a platform for both growth and differentiation (IBM CR report, 2014).

An accentuate strategy involves evaluating products in the company's current portfolio. As green competitions emerged and as customer demanded more environmentally friendly products, the companies can now use their sustainability strategy to reposition its business and draw a new customer pool. However, many companies now lack their sustainability heritage because their products were developed long time ago. From the perspectives of customers, this issue can strongly affect to the company legitimate sustainability claims. Therefore, facility managers should step in to help companies find a direction with their sustainability strategies (IBM CR report, 2014).

2.1 Eco-Housing Systems

An eco-house or an environmentally friendly house is designed to functions in a sustainable way. It can save residents a considerable amount of money, energy, water and other natural resources. Facility Managers can convert a home or place of work into eco-house by creating management strategies which aim to achieve protecting the environment, conserving resources and contribute to economic growths. The starting point, is to create an educate-type campaign led by experts to enlighten people on the importance of environmentally safe practices (VTT's Eco-city Concept, 2014).

Encouraging sustainable practices in facilities management does not only bring out smarter way of operating the buildings but it bears in itself developmental consciousness such as in green cities sustainable land use, energy efficiency at neighborhood and city scale. Green

infrastructure brings benefits like low carbon energy and renewable energy systems, waste management including waste to energy, water supply, public transport solutions, smart traffic management guidelines for sustainable infrastructure (VTT's Eco-city Concept, 2014). A functional eco housing system should have the following:

- Energy plan
- Water plan
- Waste plan
- Social plan
- Human service and culture assesment

Within the scope of this thesis, however water applications will suffice. VILLA 9000 toilets are odorless, easy to install and provides great capacity storage which makes it very beneficial for homes. The waste collected is also converted to organic fertilizer for use in gardens, trees and flowers. (VTT's Eco-city Concept, 2014).

2.2. Facility Managers Critical Success Factors

According to Parmenter, (2010,) he stated that “critical success factors (CSFs) are the list of issues or aspects of organizational performance that determine ongoing health, vitality and wellbeing. Normally there are between five and eight CSFs in any organization”. In order to build profitable position in a given ecosystem, there are 5 critical success factors that facility manager needs to take into consideration are:

- Sufficient knowledge of sustainability practices
- How to develop sustainability strategies
- How to use sustainability rating tools
- How to benchmark development practices
- How to develop research framework to support innovative solutions

It is obvious that the first important step for a facility manager as effort to develop and deploy frameworks to support smart facility operations is having sufficient knowledge of sustainability practices and how to interpret its impacts on built environment because of its connection to business performance and new potential customers. Additionally, local cultures are greatly impacted as well. Besides the impact it has on local business and cultures, facility managers however, are now expected to diversify their skills in order to deliver this success factor to the organization

Facility Managers can facilitate partner's process or even a bid for merger and acquisition. With this strategy in place a facility manager is able to provide expertise developmental processes, benchmarking and innovation to support its operations target in any new market. In view of the case product- waterless toilets and urinals solutions should be supported by qualified personnel to drive the entry process and to generate sustainable values. After the internal process, distributors of water applications need to expand their network, especially with logistics companies in order to reduce the cost of transportation.

2.3 Facility Manager's Strategy and Rating Tools

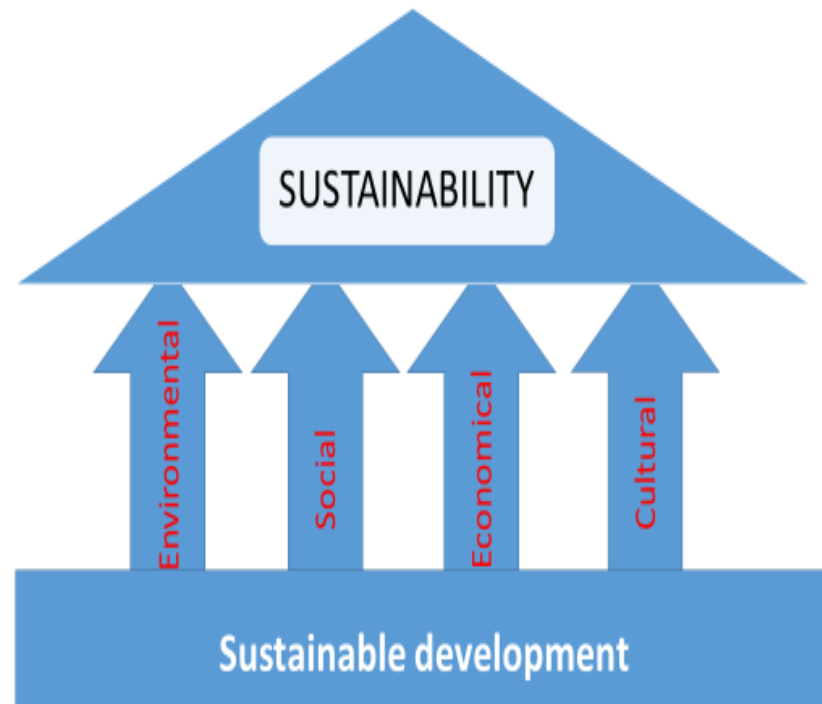
Nowadays, many organizations rank companies on their performance in corporate social responsibility (CSR) and despite some questionable methodologies, these ranking seems to attract considerable public views. Hence, CSR has become one of the most inescapable priorities in business strategy for many leaders around the world. Furthermore, CSR is an essential forerunner in understanding why companies need to integrate sustainable business practices more effectively into their core business operations and strategy. (IBM CR report, 2014).

Nowadays, many businesses face higher raw material and energy costs while governments are trying to place more cost on non-environmental-friendly products. Furthermore, consumers also consider company's environmental record before making purchase decision. There are more and more environmental disasters happening in recent years; hence, even the most skeptical people know about the danger of global warming are recognizing the importance of protecting their living environment. Organizations are taken to curb the menace of water resource utilization and how it affects business.

Technically, it is easy to identify the impact of sustainable facility management practices on the people, planet and profit margin of the organization. Companies usually manage their environmental risk as a problem of regulatory compliance, potential liability from industrial accidents and pollutant release mitigation. However, the impact of sustainable practices in terms of organizations is global and if any problem emerges from the process, it could also be there for a long-term.

In order, to identify and evaluate what impacts a house is crucial to the use of the facility. Hence, rating tools were designed to evaluate not only environmental aspect but also cultural, social and economic development. A number of rating tools have been used all over the world, most of them have a lot in common, some are free on the internet as a basic level, some need to be purchased to get more advances. One rating tool from Global Network for Sustainable Housing is designed to evaluate the house from constructing stage to the final phase or maintenance, with 12 different sustainability criteria to score. The

figure 3 below demonstrates the pillars of sustainable development. It can be seen that there are four criteria to be fulfilled in order to achieve a sustainable project. The goal of these 4 strong pillars of sustainability is achieving a sustainable result/project, therefore if any of the pillar is weak, then the whole system is not sustainable (Olanrewaju, 2015).



Source: (thwink.org 2014)

Figure 3 : Pillars of sustainable development

Sustainability rating tools Using indicators that measure the sustainability of this project of waterless toilets. This we measure at all stages of the waterless toilets from the Design phase to Installation/use Phase and maintenance phase. Waterless toilets offer a remarkable solution to the problems arising due to waste disposal as it does not only curb the problem of pollution due to the discharge of wastewater into water bodies but they also reduces the volume of the waste to about 10% of its original volume thereby reducing the footprint. (Olanrewaju, 2015).

2.4 Role of Facility Managers in Delivering of Smart Facility Operations

The Facility Managers understands the principles of sustainable housing especially the constructing and monitoring the progress of building. Therefore the facility manager can

prepare, manage and keep all operating budget records of eco-house. In addition, the manager must review, recommend approvals, is approvals or changes to all proposed improvement expenditure and all other expenditure of the housing construction. Overall, the facilities manager is a correlation between investors, plan-makers and engineers, to make them collaborate accurately and harmoniously. Nevertheless, the table below shows how generic toilets are used, especially when considering foreign companies' financial capabilities (Rubin, 2010).

	Regular toilets	Low-flush toilets
Bowl	Bowl outlet near rear side of the bowl	Bowl outlet near center of bowl and a larger portion of the front of bowl base is immersed in water
Tank	Smaller flush valve in tank base	Larger flush valve in tank base
Flush	More water to assist flushing from the front of the bowl rim	Some may have additional water supply hole near bowl outlet to forcefully move waste

Source: (Brothers Plumbing, 2017).

Table 1: Various Toilet System

However, a low-flush toilet also has its own problems. The main problem is that a low-flush toilet requires upgraded systems for home plumbing because old pipes do not handle low-flow toilets very well, especially when flushing solid waste. In addition, early low-flow toilets requires multiple flushes to get solids down, thus frustrating consumers and not conserving water in the process. However, newer models are much more efficient in solving that issue. Instead of relying on gravity, like older toilets, new low-flow toilets may use pressurized air (Robin, 2010).

A waterless toilet is a toilet that operates without flush water, unlike a flush toilet. The excreta (both urine and feces) falls through a drop hole. The urine and feces can either become mixed at the point of dropping or stay separated, which is called urine diversion. The main advantage of dry toilets is that they require no water, which helps to save fresh water resources, prevent groundwater contaminations and solve many environmental issues. In addition, users can produce valuable humus for making fertilizer (N.P.K) whose value is estimated approximately 10 euro per person per year.

However, people behaviors can be a big issue when selecting to buy a dry toilet. Many people are still reluctant to use their waste for agricultural purposes and to touch or convey own excreta to a new site. Moreover, compost waste could be a health hazard if it is not processed well. Finally, some versions of composting toilets may be too expensive for some people to afford. Many people have recognized the importance of saving water; hence, more and more dry toilets are used nowadays (IFAD, 2017).

2.5 Value Chain and Value Creation

Dry toilets and urinals in general cannot compete with flush toilets in city areas because of many reasons. Firstly, using a dry toilet takes more responsibilities than a flush toilet. Secondly, not all city infrastructure can afford to process naturally many human wastes at the same time except throwing them to the drain. Thirdly, environmental friendly toilets are often more expensive than normal flush toilets.

Talking about infrastructure in city areas, it is possible that dry toilets can be installed in some eco-cities where they have a closed process of handling wastes. Then, the costs of a building and its relevant systems increase. In some countries, even though dry toilets are decided to installed, a building also needs to be equipped with sewer systems for dry toilets in order to meet the regulations. For non-urban areas or areas with limited water supply, dry toilets and urinals is totally acceptable. However, for poor people in the countryside, they cannot afford the dry toilets but they can afford to build their own system. In addition, in order to deliver this products to the countryside, a company needs to have a strong network of logistic otherwise costs for transportation will increase dramatically. Below are some of the values derived from the use of such a system:

- Healthy, durable, secure
- Full supply of clean water, energy, electricity.
- Renewable energy generation and water recycling areas
- Friendly to the environment and not being affected by external pollutions

Therefore, the value chain and value creation, is the fact encouraging the use of waterless toilets and urinals will spark up a culture that will set a place to raise future generations for our universe. To prolong the satisfactory of residences, houses and all the other neighborhood buildings need to be designed and built holistically so that people can work and study effectively. Thus, residence housing is the priority to any project plan in Eco city.

As housing is crucial in developing eco city, slums are challenges for sustainability of any city. Poor sanitation, pollution, hazardous landscapes, overcrowded in population leads to crime, rare diseases, not fully-developed education. This leads to unhealthy and insecure

condition of living, the economy consequently couldn't advance, making the country poorer and poorer. As a result, sustainable housing makes a solution out of every developing country, which has a number of challenges involved in economic, social and cultural development (Parmenter, 2010).

3. Methodology

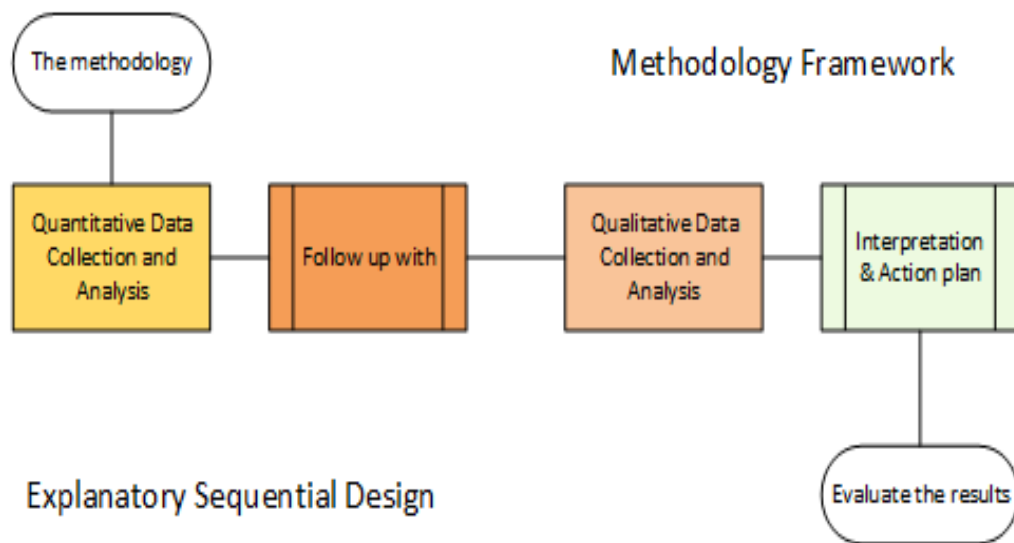
This chapter briefly discusses the research methods and tools used in gathering, analyzing, interpreting, and reporting collected data. In this thesis, the researchers adopted a mixed method research that "incorporates various elements of methods, research processes, philosophy, and research design". (Creswell & Plano Clark 2011, 2). The reason behind this decision was due to the vast data collection needed to validate the research question and to strengthen the authenticity of the findings from the research. As a follow-up plan, benchmarking method was also applied in the research paper during the phase of product benchmarking, this was to enable the researcher to identify potential challenges and competitors related to any (waterless toilets or Urinals) products successful entry into a new market. Though the word "mixed method" is used here as the research method because it already encompasses the quantitative and the qualitative forms of research methodology. This is explained more in the next paragraph.

3.1 Mixed method design

According to Creswell & Plano Clark (2007, 5), Mixed method research was defined both as a method and as a philosophical orientation. As a method, "it focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the combination of a quantitative and qualitative approaches provides better understanding of the research problems than either approach alone". In mixed research methods, "the researchers frames these procedures within philosophical worldviews and theoretical lenses and combines them (the procedures) into specific research designs that directs the plan for conducting the study" (Creswell & Plano Clark 2011, 5). They went further in categorizing this research method into six (6) major designs which are; the convergent parallel design, the explanatory sequential design, the exploratory sequential design, the embedded design, the transformative design and the multiphase design (Creswell & Plano Clark 2011, 69). In this research paper, the researchers have narrowed the research design to incorporate only the explanatory sequential design.

"The explanatory design is a mixed method design in which the researcher begins by conducting a quantitative phase and follows up on specific results with a second phase" (Creswell & Plano Clark 2011, 82). The qualitative phase which is the second phase is

implemented solely for the purpose of elaborating on the initial results gathered from the quantitative phase, and it is due to the essence of this elaboration that the name of the design is being reflected. The researcher collects and analyses the quantitative data which is the main tool for addressing the research question, followed by the justification phase (qualitative data) which could be an interview to go in-depth from the result obtained. The researcher thereby interprets how the qualitative findings assist in explaining the initial quantitative results (Creswell & Plano Clark 2011, 71). The picture below illustrates the explanatory sequential design mixed method.



Source: (Creswell & Plano Clark, 2011)

Picture 1: Explanatory Sequential Design Method

Quantitative Data (Survey)

The Quantitative data for this research paper was generated by critical thinking and brain storming by the researchers thereby producing a survey with the use of a questionnaire that took about five minutes to answer. The Survey featured questions coming from three (3) different categories, which were categorized by the researchers to be; 1) Idea based questions, (2) Knowledge based questions and (3) Expert and experienced based questions. The questionnaire was sent to a total of fifty five (55) people and got response from forty four (44) in total at the end of the survey answering period. This study selected a wide range of target group in terms of profession or category but the overall group of analyzed response was from forty four (44) respondent which some of them were business owners and property managers. The objective of this variety in selection among respondent was to

acquire as much compelling views as possible so as to create an interesting discussion or argument on the case topic.

Idea based questions were created in other to test the awareness of the participants on the basic ideas of waterless applications- urinals and toilet. All the category of respondent were suitable to answer to these question category since it doesn't really need any expertise or prior experience (see Appendix 2 in [Appendixes](#)). Knowledge-based questions was focusing more on people who have read materials, watched relevant programs or attended exhibition etc. related to the waterless urinals and toilets and the water saving technologies in general. People in this categories are students and business men. And the third category which is expert and experienced based questions were coined out for people who are equipped with a substantial prior knowledge and closer experience with various types of waterless applications and technologies, who as well know about their benefits. People in this categories are facility managers, home/property owners, green technology advocates and civil engineers as well as government delegates/ officials (politically inclined individuals both in public and private sector).

The survey was conducted electronically and the questionnaires were sent via the respondents' personal e-mails on 2nd of June 2015. Respondents were given a flexible time frame to return their answers but this was up to a maximum of 4 weeks from the date the questionnaire was sent. After the response were received the researcher put all the data and information collected into research analyzing tools like excel and some other form of "IT" programs to analyze the result and come up with findings and results. These results will be discussed in the next chapter of this paper but before that, let's look into the qualitative phase of this research work and how it was conducted.

Qualitative Strand (Interviews & user perspective)

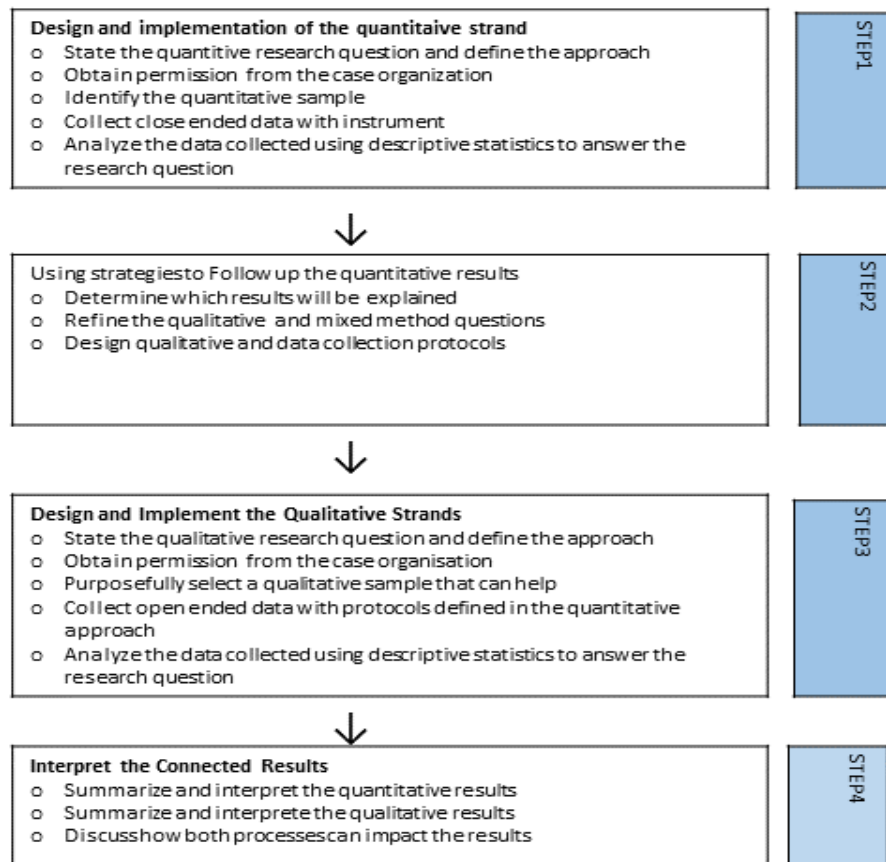
The Qualitative phase of this research paper was conducted using interviews as the major mode of retrieving information. The interviews were all recorded by use of a recording camera of which most of them were done in video format (video recording) while the rest were just voice recordings. There was no rigid or specific order in which the interview were conducted, though the time was always during the day time so as to get good visuals and recording effects. The interview targeted about twenty five (25) respondents but in the end the researchers were able to conduct twenty (20) successful interviews with its respondents. Some of the Interview were conducted as a group by forming groups of maximum three (3) respondents, while others were done individually (one-on-one) with the Authors.

The Locations for the interviews varied as it was arranged to be flexible and at the comfort of the respondents, so some of them preferred their own homes which the researchers had to make the recording instruments ready at their homes while others were neutral and agreed to do it at any location suitable. So some of the location that were used was the “Iso-omena shopping Centre Espoo; Itakeskus Shopping Centre, Helsinki, The researchers’ homes, and public place of gathering like the city library. The times were fixed mostly by the respondents as to enable them participate at their own conducive time. This However posed a huge challenge to the researchers to fit in to their (the respondents) times but it was managed systematically.

The Questions for the interview were derived from the Current state analysis of the waterless toilets and urinals system as well as from the analyzed information obtained from the survey conducted; (See Appendix 1 in the [Appendixes](#) for details). Though it followed same structure of question segmentation like the survey by grouping the questions into Idea-based, knowledge-based and expertise and experience based question, but more open ended and free worded form. Some of the respondent required that the questions be sent to them via electronic mails beforehand so as to enable them get acquainted with the subject matter and help them to be more prepared. The idea of continuing with the interview after the survey was to correspond with the research design method being used in this paper to authenticate the analyzed result from the survey and to further get detailed explanations and in-depth knowledge about behavioral issues that was noticed in the survey (Turner 2010, 753).

Half of the respondent (10) are working in the service sector in various positions which they didn’t want it to be disclosed, four (4) are students in Higher Education institutes, Four (4) are facility/property managers and private business owners and the remaining two (2) are PHD researchers at the University of Helsinki. The Interviews were conducted within the period 21th of December 2016 to 4th of February 2017 which was later retrieved, transcribed, analyzed and interpreted into results which was further used to generate solutions and value propositions .More details of the findings will be discussed in the Result chapter of this research paper.

Implementing an Explanatory Design Framework



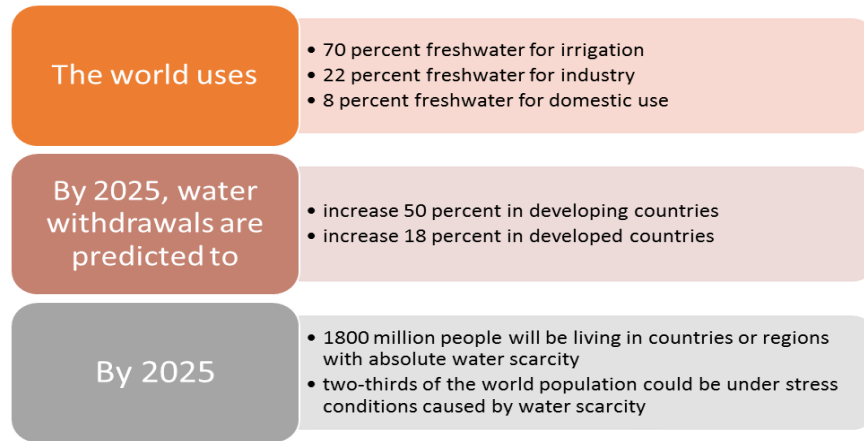
Source: (Creswell & Plano Clark 2011, 84)

Picture 2: Procedures in implementing an explanatory Design framework

The Picture “2” above illustrates how an explanatory design mixed method research is implemented. It gives a detailed information on the step-by step approaching ranging from data and information collection to, data analysis, data interpretation and data reporting, as well as need for additional or backup research and its procedures.

3.2 Research Problems

This research aims to discuss the problem: how to develop a sustainability framework for Facility Manager’s operations by using water saving systems. In the Figure 4; below are some of the compelling reasons for looking in this direction.



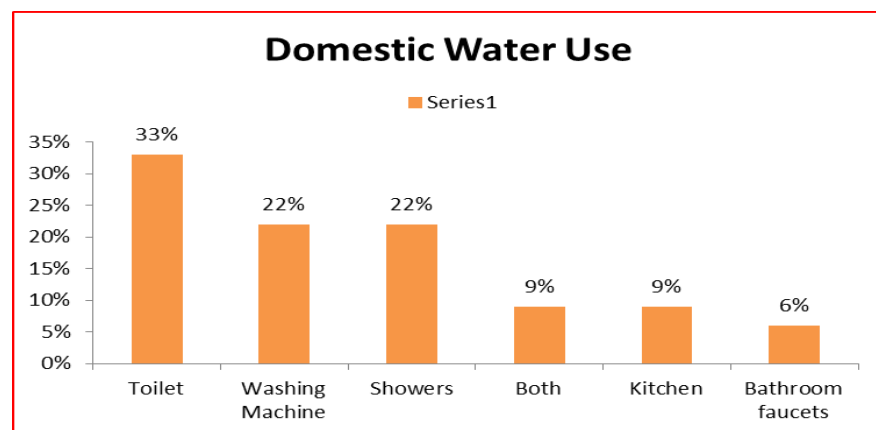
Source: (Hinrichsen & Tacio, 1996).

Figure 4: Research Problems

Water seems to be one of the most precious resources in the world. There are about 70% of the earth's surface is covered with water but just less than 1% of water on earth is "fresh water". The other 97% comes from "salt water" and the remaining of water on earth is "glacier ice" at the North and South poles (IFAD - Investing in Rural People). It is also estimated that:

- The world's six billion people are using 54 percent of all accessible freshwater contained in rivers, lakes and underground aquifers.
- Every day, 2 million tons of human waste are disposed of in water courses.
- Between 1991 and 2000 over 665,000 people died in 2,557 natural disasters of which 90 percent were water-related events.

Additionally, in developing countries, 70 percent of industrial wastes are dumped into waters where they pollute the usable water supply. Therefore, everyone has to make effort to conserve water for 3 reasons. First of all, the less water used or wasted by people, the less clean water will become contaminated. Second reason is that water conservation reduces energy use and can even save households money. Finally, conserving water now allows cities and regions to plan for more efficient use of the water resources in the future.



Source: (Abrashinsky, 2004)

Figure 5 : Indoor water Use

About indoor water consumption of individual households, it is calculated that water usage for toilets makes up the largest percentage (33%) in total, followed is water consumed by washing machines (22%). Older toilets use around five or six gallons of water every time they are flushed. Hence, toilet water conservation is particularly important for household water conservation.

3.3 Research Process

The research process adopted for this thesis combines the mixed method approach with a questionnaire, video interviews, facility manager's event planning and proposals writing. This is shared into three categories, phase one (1) includes concept validation and description, problem definition, research plan. Phase two (2), involves the following process; data collection, data analysis and defining an approach. Finally in phase three (3) has development of an action plan, followed by planning a Facility Management event to promote waterless applications and finally engage stakeholders.

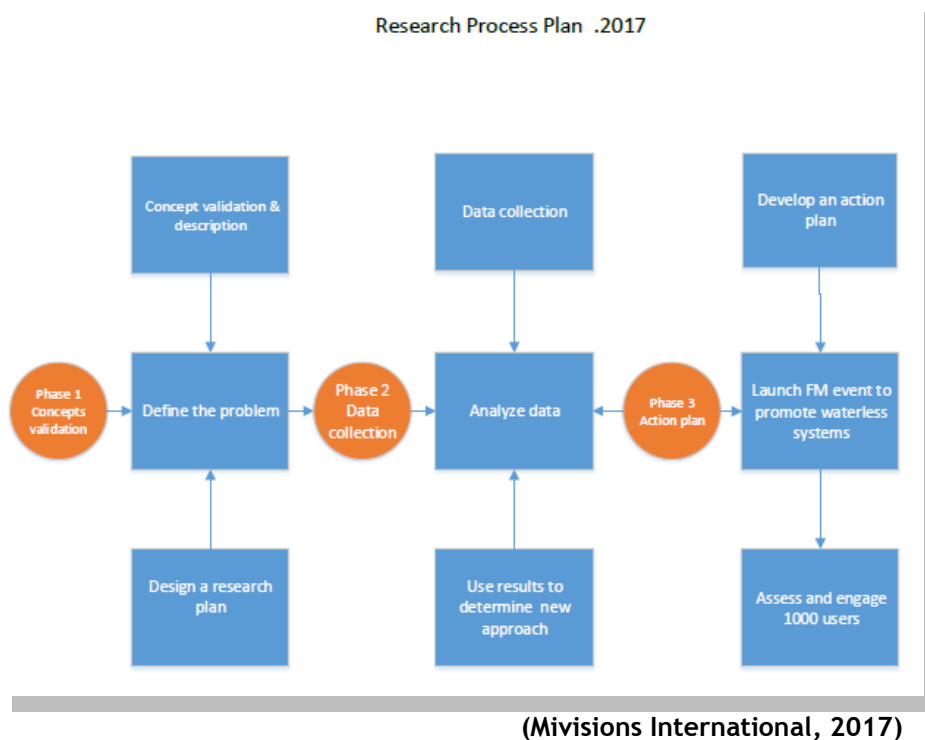


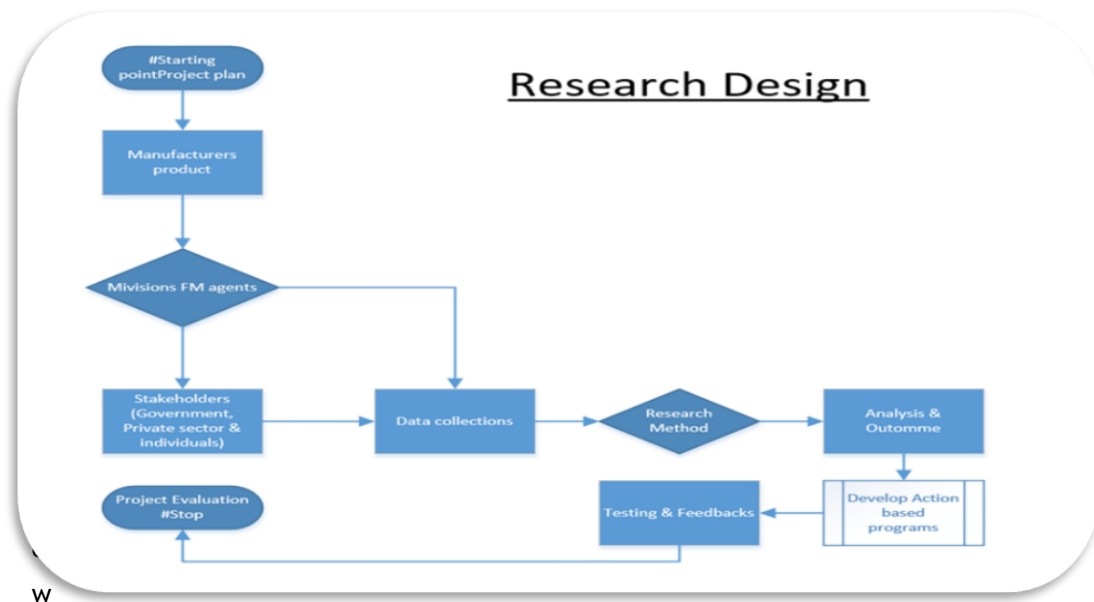
Figure 6 : Three Phase Research Process

Figure 6 above shows the structural pattern of the research process, which shows the three main stages of the process depicted as: concept validation, data collection and an action

plan. This research process also contains several element which is requested by the company as part of the outcome of this thesis. Waterless applications are not very popular especially amongst countries that are so eco-friendly in their business approach and are not necessarily conscious about the environmental sustainability. The sub-section below is set to discuss on the research design and research method considered in this study.

3.4 Research Design

The research design adopted by this case study is specifically drawn to show that there are no alternative to sustainable development because it is the foundation of organizational and technological innovations that yield favorable bottom-lines. It is recognized that sustainable practices creates positively impacts both in business and environmental strategies.



(Mivisions International, 2017)

Figure 7 : Research Design interpretation

Figure 7 above demonstrates the component of the research design and the research method which is intended to prove the importance of sustainable practices in Facilities Management, and the need for Facilities Managers to adopt such frameworks which would enable them operate smartly through use of waterless applications. Organizations which are biased with their sustainability strategies are not able to attain any of the triple bottom target as a result, they stand a chance of eroding their competitiveness.

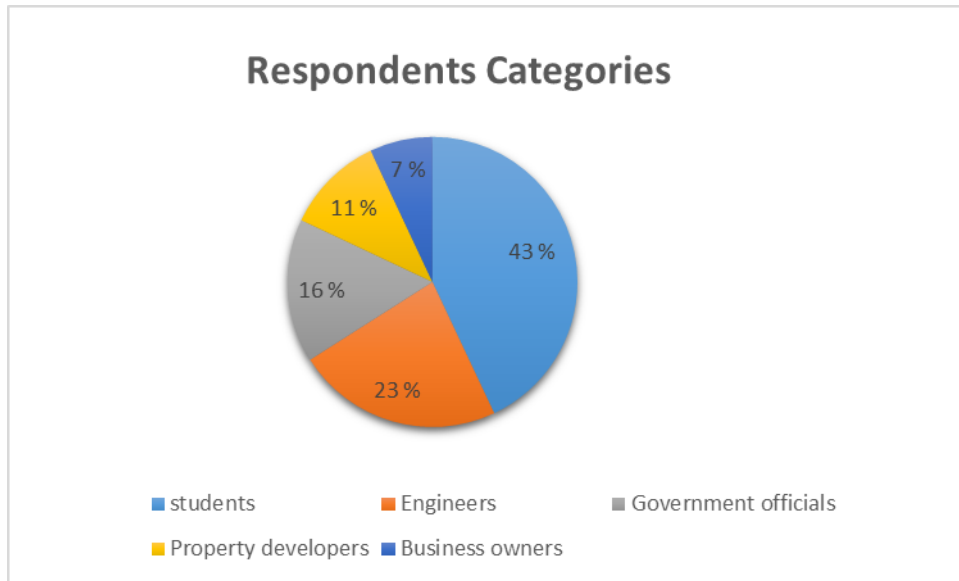
From a financial standpoint, becoming environmental-friendly lowers costs because it help the company to reduce their inputs. In addition, more revenue will be generated from better products and services which enable companies to innovate in order to increase their competitiveness. The research method takes all of the above mentioned into consideration this why, according to the research design above shows the interaction between the Facility managers, manufactures of waterless applications, stakeholders and policy makers. This is in itself is a useful method because we understand that making a drastic change will require a pattern to generalize the problem in order to arouse response. Furthermore, early movers will develop competencies over their competitors. Therefore, this research method will demonstrate that sustainability enables companies to innovate as an integral part of development.

4. Results

The survey is conducted to test user experiences within three categories of users: professional users, idea based users and knowledge based users. The research reveals a trend in customer behavior towards the use of Water-less toilets and urinals. The strongest bargaining chip is the impact it delivers towards social, economic and environmental sustainability. The response from the participants was an eye opener in areas like religious and cultural effect to the compost toilet systems and waterless urinals. In general, the results is a useful tool for facility managers and manufacturers of waterless devices. The sub-section below provides more information about the survey and the surveying results.

4.1 Survey Analysis

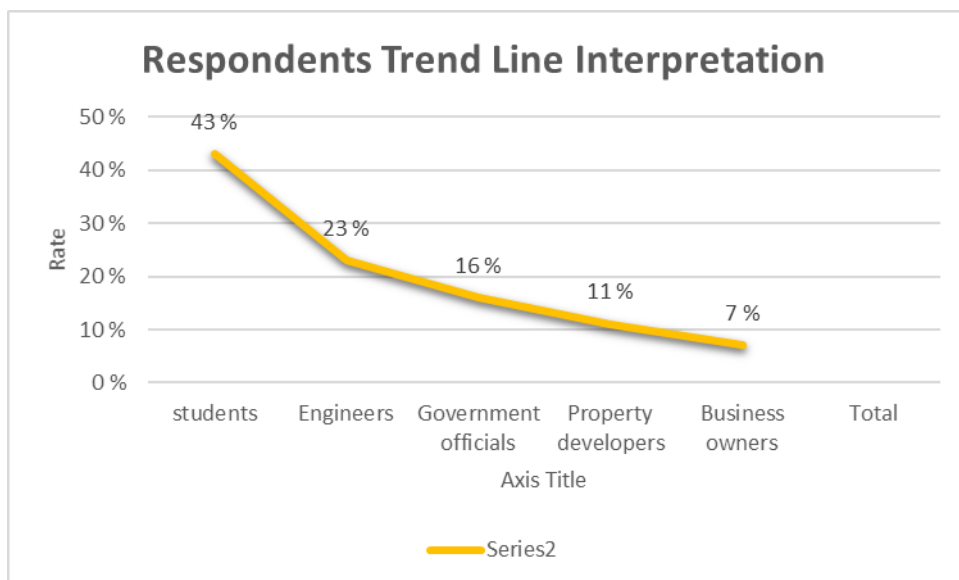
The survey respondent were keen about identity issues so for this reason we excluded any questions that relates to the respondents personal identity. The ages of the respondents varied from twenty one (21) to sixty two (62) of which 75% of them were females and 25% were male. The pie chart below seen as “picture 3” shows the respondents’ category in the way that the researchers have grouped them.



Soucre: (Survey for Thesis, 2017)

Picture 3: Respondents categories

The researchers moved further in creating a trend graph (as can be seen in Picture 4 below), based on the respondents category and participation interest. From the response it was gathered that business owners, property managers and government officials had a low turn up rate of 7%, 11% and 16% respectively in answering the survey and hesitated in giving response to the said research questions. Students on the hand were more proactive and gave good response rate of forty three percent (43%). Engineers and those in the information technology department also gave an encouraging turn-up.



Soucre: (Survey for Thesis, 2017)

Picture 4: Trend Line interpretation of respondents

From the Survey, it was also gathered that half(50%) of the survey sample had little or no knowledge about waterless toilets technology in real life and would be interested in getting more knowledge or taking part in exhibitions that showcases the idea behind the waterless toilets and waterless urines technology.

In addition, no one undertakes the importance of creating social, economic and environmental impacts to attain sustainability. Furthermore, in term of organization, 78% of responses agree waterless toilets such as the VILLA 9000 and other waterless urinals can enhance an organization's connection to green strategies. The importance is that there is just 15% of the respondent saying that there are similar products like VILLA 9000 in their countries.

On the other hand, the survey showed these products will face 3 main problems when entering new markets, especially emerging market. The first one is price problem. Based on the responses, people in emerging market think that the price for Waterless toilets and urinals are too high when considering to the entirely new products and a globally economic downward trend nowadays.

The second problem is about the new system working together with VILLA 9000. Because VILLA 9000 is a new generation of toilet in some areas, especially in emerging market where people rarely access to the latest technology, they still prefer to use the traditional systems. The third problem is the people mindset, many people nowadays do not recognize the importance of saving water. Additionally, they still keep the mindset of "abundant source of water" on the planet; hence, they are not ready to initially invest more money in installing sustainable products for long-term benefits.

4.2 Interviews Analysis

The Researchers have been able to gather numerous findings from the Interviews conducted. The results here will be interpreted with a simple format, categorizing them into six (6) Major Areas of interest that have impacts on the waterless technology system for toilets and urinals; 1) Knowledge gap, 2) Interest, 3) Sustainability Criteria, 4) Geographical effect, 5) Ethical effects, 6) Demographic effect. Most of the female respondent reported that though they haven't used the waterless urinals which are mostly found in the men's toilet but they have little idea about the concept of the urinals. It is more preferred to its traditional counterpart which is the flush urinals. The table below shows the criteria, indicators and assessment of the different scenarios that were built into this thesis.

Criteria	Indicators	Assessments
Knowledge gap	35%	There are significant knowledge biases on the functionality of the waterless toilets and urinals.
Lack of interest	20%	The interest rate are increasing low on issues related to sustainable facility management practices
Sustainability	18%	If waterless application must be adopted by home owners, more should be done to promote the sustainability consciousness
Geographical	5%	Some geographical location do not consider the waterless toilets and urinals important for their homes
Ethical	16%	There are significant ethical issues affecting the acceptance of this technology
Demographical	6%	Younger people are indifferent about the importance of water saving technology , they cannot reconcile the threats

Table 2: Interpretation Criteria

From table 1 above it is visible that of the six 6) interpretation criteria the lowest values are for demographic and geographical effects because age and location plays an active role in the decision and adoption of the waterless technology and system. While knowledge gap, interest rates and sustainability are the highest ranking criteria which reveals the areas that requires urgent input for the technology to be fully accepted. One key interview response was the fact that despite the high intellect level of the participants, there was still some misinformed people out there who actually think that the waterless technology is a failure and cannot be sustained over time.

Forty (40%) percent of the respondents pointed out that thought the technology behind the waterless toilets, waterless urinals and composting systems are great, but it still faces the challenge of being good enough to convince the general public about replacing their traditional flush toilets at home with the waterless toilets. Some of the reason they gave behind this is the fact that one; pricing of the waterless toilets are way higher compared to

its traditional counterpart (flush toilets). Two; the mere image of having in mind that you have to look down after using the toilet and you can see your faces (excrete) is alone very discouraging to them. They prefer that after finishing their business in the toilet they don't want it to be there. It should just go away down into the septic town. Three, the fact that the present day waterless urinals can only be used by males and can be seen mostly in the male toilets in public places as shopping centers and schools, libraries etc.; but this cannot be the same for the female toilets, as those urinals have no way that a female can use them unless there will be a new type in the future that will support female usage and even disabled persons (Laura, interview 6 January, 2017).

Three (3) of the interview respondents who are practicing Islamic religion brought up the issues about ethical effect to the new technology of waterless toilets, and it happens to be that they were focusing more on the religious effect or the adverse effect that can come from one's tribal norms and values. In this they meant that, as Muslims, they are mostly required to wash their organs after using the toilet and when you have to use a waterless toilet then this means that they can't fulfill their religious beliefs by washing since the toilets' technology doesn't allow the use of water. So therefore it will be challenging for people from Islamic countries and the Islamic nation to actually adopt such technology easily. These however then contribute to the next factor which is lack of interest.

Due to some of those religious factors and norm issues, the rate at which some developing countries would show interest in this waterless toilet system will be low. A researcher at the University of Helsinki told the authors that, the waterless toilet system is just like an upgrade of the old and ancient form of pit latrines that were used in mostly African countries in the 19th century. Those toilet system then was just a hole that was dug in the ground maybe at the back of a house and people go there to pass their waste using mostly only tissue paper and the tissue paper have to be put in a separate basket which is kept in the toilet, then when it is full, it will be burnt outside in the bushes. So compared to the recent technology, it now has to be some form of "ash" that can be used to cover the waste after passed onto the toilet bowl, by doing this, it helps as a decomposer to make the waste to decompose faster into solid materials that could be used as a farming supplement for fertilizer. (Alexandra, interview 4 January 2017)

Even though some of the respondent could see clearly some short-comings in the waterless toilet technology, Ninety two (92) percent of them were very positive about the environmental benefit of such technology and commended the system for sustaining such a good way for agriculture. One of our respondents testified that the by-product which he gets from his compost at his summer cottage are being used to help him grow some crops in his farm. "The social and cultural benefits of using a compost toilet system might not be easily felt or seen immediately but the environmental benefit of transforming 'waste' into sewage

sludge as practiced in Sweden and Finland today is a typical example of the success factor in using the waterless toilet system” (kirsi, Interview 12 January 2017).

Conclusively, the researchers were able to analyze all the information gathered and came up with a solution which was presented in the form of a value proposition in the next chapter. It was however discovered that the urban areas like cities and more congested areas might find this waterless toilet system quite difficult to adopt due to its complex form of operation, which is using of ash and compost device. As it will face the challenge of maintenance as well if installed in places like shopping centers. Users might not want to follow the instructions as to how to use the toilet. But in rural areas with maybe less numbers of users, these maintenance factor can be tackled. This is not same for the waterless urinals, as it can and have already been in use both in rural and urban areas with little or no challenges. An example of this can be seen in the public toilet inside the Iso-omena shopping center in Mantikyla, Espoo and the Kamppi shopping center in Helsinki.

5. Solutions - Value Propositions

It is no doubt that waterless toilets and urinals are delivering sustainable impacts toward social, environmental and economic concerns. Social sustainability focus on the people using this product and feeling good about it. Even though, these solutions can easily fulfill customer’s needs as a normal toilet and urinals their special features installed makes it easier to manage without using water thereby preventing the spread of bacteria. This singular functionality amongst others increases human safety and health. Furthermore, eco-farmers can benefits from the type of waste generated in the system as well. Subsequent to the findings from the survey and interviews, the researchers perceived the need to come up with a solution that could tackle the negative effects of the waterless technology, by doing this, it will broaden the scope and knowledge of most people about the waterless toilet systems.

One of the solutions created by the researchers was creating a social media campaign which was aimed at relinquishing the knowledge barriers and create more awareness on the subject matter (waterless toilets and waterless urinals systems). This campaign was not just tailored at combatting the ignorance of the technology noticed during the research but also it will be a medium for FM graduates and students to be more informed about new ideas, developments and trainings that are related to the growth of the FM industry. So in the future, if the case company (Mivision international) permits, the social media pages, (which is done by utilizing the strongest social media platform “Facebook”) will be used as a platform to form stronger bonds among FM practitioners and students. The name of the page on Facebook is labelled “Facility Manager’s Network (FMN)” which is available at

facebook.com/Facility Manager's Network (FMN). As a follow-up for the case company, the researchers will assist in adding more members to the group with time since they are students of the facility management programs and have better contact base. The solution was further expanded into creating online fliers which with the permission of the case company can be distributed via electronic marketing mails and physical distribution during any seminar or product advertisement. (See Appendix 3 in [Appendixes](#) for screenshot page). It is also important to note that, product advertisement could be carried out and promoted on the social media pages of this campaign in order to enable members and general public get more visuals and updated usage information of the waterless toilets and urinals system as well as the composting system in general. The subsection below will discuss the value proposition for the use of waterless application in respect to environmental strategies.

5.1 Environmental Strategies

The value proposition can be looked at in terms of environmental strategies and its long term sustainable impacts. The use of waterless toilets and urinals makes such proposed values possible. Here is how it will happen. Because it is waterless, the device will save a lot of fresh water due to reduction in water use per flush, and this will curtail the depletion of fresh water resources. Another aspect an environmental value proposition is the reduction in the amount of waste water polluting the environment, especially in developing countries where water recycling system still old-fashioned.

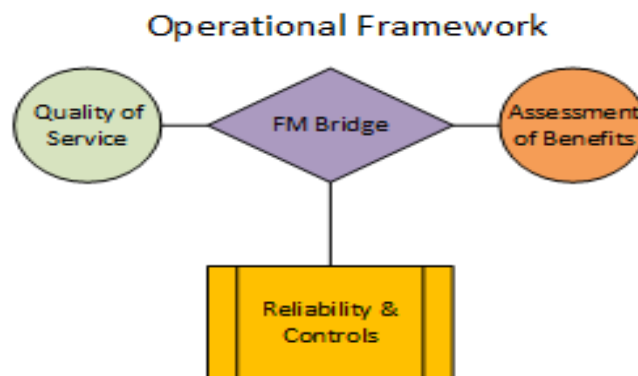
As result of it significant influence on human waste management its benefits to the surrounding areas can be felt through. In the past waste costs money to dispose but waterless toilets and urinals are now making money because most of the compost generated can be used for agricultural applications or packaged as an exports product. Users will be able to reduce their water bill every month which makes up a high percentage in normal household's living expenses. Water saving also enables agricultural system to develop, which contributes to a total economic system and create positive impacts to a society.

Considering sustainability as the driving force of waterless application, its application has spread across every work of human endeavor in many different facets as effort to achieve environmental safety and water resource utilization as a way of protecting the future through sustainable facility management practices. Normally, people prefer to use dry toilets in a cottage or some places where there is lack of water systems. Using dry toilets in urban areas where the population is very crowded will require an upgraded systems in order to handle a lot of wastes. There are still some buildings in USA installing dry toilet systems for all their apartments; however, they also have to install water systems which are used for normal flush toilets.

Hence, it is simply recognized that dry toilets cannot compete with flush toilets in urban areas. The sub-section below will discuss the facility manager's operational plan with consideration to the users of the waterless toilets and urinals. We know that culture change takes times, therefore facility manager who could succeed fast paced economy must consider quality of service and accountability. With accountability it is easy to reconcile measurement parameters to calculate in order to determine how smart the operation strategy is. The facility managers should be able to prove to the customers how much water it could save as well as how much compost it could generate. This will become a driver smart facility operations in both the urban and the rural areas.

5.2 Facility Managers Operational Plan

While in consideration of the solution strategies put out to motivate customers and new breed of facility professionals who are interested in water saving devices, the researchers in this thesis have recognized the following variations. First and foremost, creating a best-fit operational model will help to facilitate three dimensional measurement structure, which combines to form the Facility Managers (FM) Bridge. The purpose of the FM Bridge is to present an innovative way of presenting the operation which is will be focused on high quality, transparency, flexibility and efficiency in order to deliver an experience which appeals to the customer. The main agenda is to motivate new users of waterless applications.



(Mivisions International, 2017)

Figure 8: FM Bridge

The diagram (figure 8) above shows the Facility Managers operation's plan toward a transformative value proposition which can enable the use of environmentally friendly technologies and round up stakeholders support in the adoption process. Requirements like quality of service, measurement of impacts, and reliability and controls are the key elements that will be considered in the value propositions. The section below will present the concluding part of this research. The idea of waterless technologies and its

connection to facility managers operations is quite an ambitious topic with so many connections and therefore we would recommend further development of related topics in order find a list of best practices based latest technological advancement in the field of water saving technologies.

6. Conclusion and Further Research

In conclusion, to smart facility operations means running a facility seamlessly without any water, energy and skilled personnel to maintain the operation. This thesis will consider the water saving part of facility operations. An experienced facility manager with good understanding of environmental sustainability should be able test, observe and rate any aspect of facility operation in order to deliver optimum results and effective customer satisfaction. The development of rating tools, has enabled the appreciation of facility management eco housing projects across developing and developed countries of the world respectively.

In general, waterless toilets and urinals will face a lot challenges when entering into a new a new market because of ethical factors in respect to water use. Even though people in developing countries have a limited access to fresh water, most of them could not reconcile the environmental benefit of the system to the ethical issues surrounding the cultural use of water in most cultures. On the other hand, environmental friendly toilets and urinals has its own competitive advantages in the market such as, dry toilets can be used efficiently in the areas where there are lack of water supply and sewer systems. Waterless toilets and urinals offers both economic and environmental impact respectively. Therefore, with effective sustainability plan, it is totally feasible that waterless toilets and urinals can have a long-term profitable position in the market.

Water is the heart of sustainable development, it has an associated link with social, economic and environmental development and is crucial for human survival itself. For that reason, sustainable housing must go along with reservation and saving water. The structure of an ideal sustainable house meets all the requirement from environment, economic, social and cultural areas. To know more about the importance of water, we have a clearer view on how vital sustainable house is on our planet. The environment plays an important role in developing other aspects of human life: society, economy and culture.

Finally, considering all the different ways to attain smart facility operations through the use of waterless applications which were not mentioned in this thesis because the researchers tried to narrow the scope of the project in order to deliver the anticipated results within the schedule time, we however would use this platform to call for further research on the

following areas: ethical issues affecting the use of waterless toilets and urinals in the developing countries. Developing a maintenance scheme for the waterless toilets and urinals that is strong enough to attract a new pool of users will be a good topic for further research. Lastly, it would also be useful to widen the scope of ergonomics in the design and as a subject of further research this thesis recommends a different types of waterless toilets and urinals which would be more conducive for women and the physically challenged.

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Illustrations

Picture 1: Explanatory Sequential Design Method	16
Picture 2: Procedures in implementing an explanatory Design framework	19
Picture 3: Respondents categories	24
Picture 4: Trend Line interpretation of respondents	24

Figures

Figure 1 : Process Flow for Developing a Skilled FM Professional.....	7
Figure 2: Goals for sustainable Water Use	8
Figure 3 : Pillars of sustainable development	12
Figure 4: Research Problems	20
Figure 5 : Indoor water Use.....	21
Figure 6 : Three Phase Research Process	21
Figure 7 : Research Design interpretation	22
Figure 8: FM Bridge.....	30

Tables

Table 1: Various Toilet System.....	13
Table 2: Interpretation Criteria.....	26

Appendixes

Appendix 1: The story Line of the Video Interview.....	39
Appendix 2: Some Survey questions.....	41
Appendix 3: Social media campaign.....	43

Appendix 1: The story Line of the Video Interview

Story line of the research video.

One of the challenging issues facing the world today is preserving the environment and society through adopting sustainable practices. This has led us to a more critical thinking about how well do the inhabitants of the environment know the steps to take or the things to eliminate in order to achieve the goal of a sustainable world.

About the Video.

In this video we have been able to arrange questions that relates to the society and the environment as well as how people can contribute in their own way to the sustainability project.

Considering the old modelled latrines and holes on the floor in rural areas of African as their own toilet system. This system does not necessarily require the use of water nor plumbing connections as the waste is passed directly into the hole and it stays there until its full and then its covered or evacuated with the help of waste moving companies.

Nowadays, the waterless toilets system and urinals is like an advanced level and a modern design of the then Latrines with added technology to eliminate odor and insects around the waste system.

Questions for the Video Interview.

1. Do you think waterless toilet and urinals have any impact in the running cost or operations of a facility?
2. Have you been engaged or practiced any form of water saving techniques in your home or office? If yes; how?
3. Do you use any waterless toilets or water saving technology in your home or organization?
4. Why do you think the use of water saving systems and technologies like the waterless toilet is (not) important in your home or company?
5. Are you familiar with any waterless toilets system or Urinals? Which?
6. Do you think workers, students and the general public should be trained on water saving techniques? And how best can you advice the training?
7. Would you encourage the use of waterless urinals?
8. Waterless urinals are said to be getting more popular nowadays, how would you describe your experience of a waterless toilets or Urinal?
9. How do you see the use of waterless toilet system and its effect on economic and social wellbeing?
10. How does this influence the environment and the fight against climate change?

11. Which would you prefer to use, a traditional toilet system or a waterless toilet system?
12. What advice do you have to the people out there with regards to practicing sustainability and water saving exercise?

Participants/ Respondent group.

The video interview is mainly targeting the working class Adult in various work sectors of the economy between the age group of 18 -60 but not limited to these group only. It also extends to Students of different discipline and age more especially the university students and graduates.

Producers

The production of the video was done by the researchers of the waterless toilet project, who are students of the facility management degree programme at Laurea University of applied sciences Leppavaara Espoo.

Locations

Some of the locations for the video interview were the homes of the respondent who felt more comfortable to give answers to the research questions from home.

Other locations like the Itakeskus shopping mall (IT IS) in Helsinki, and the kamppi shopping mall in the center of Helsinki were used in making the video.

Script by: Phineese Ihuoma
Edmund Uboegbulam

Appendix 2: Some Survey questions

This questionnaire is for business owners, builders, engineers, facility managers and students and anyone who deems it fit to answer to questions pertaining to sustainability.

The word “products” in this survey is referring to waterless toilets and urinals.

An analyst in charge of Sustainable housing (Eco-city) project is interested in buying a Waterless Toilet for the local community project. His aim to save money, improve the image of his company by demonstrating green strategy and supporting effective waste management mechanisms. This survey takes only 5 mins to answer only few questions. Thank you for your considerations!

What is your career path?

Business owners

Building and architecture

Engineers

Facility and property manager

Students

Government office

Other

What is your Gender?

a. Male

b. Female

What is your Age group?

a. 18-25

b. 26-40

c. 41-65

d. 65 above.

Resource Utilization (TBL frameworks)

1. Do you like the concept of a water saving toilet?

a. Yes

b. No

c. not sure

2. Does water saving equal to saving money

a. Yes

b. No

c. not sure

Competition management (Benchmark model)

1. Are there similar products in your city?

a. Yes

- b. No
 - c. Not sure
2. What are the most important feature for you to consider before investing in this product?
- a. Price
 - b. Quality
 - c. Ease of use
 - d. need

Understanding of the product (KPI)

In what order of priority do you consider the Water-Less Toilet

1. using this product could help my organization to:

- A. be more hygienic
- B. be more customer friendly
- C. Save more in facility operational cost

Clarifying the value propositions

1. In locations with poor water management policies, do you think these waterless product can be recommended? A. yes b. no c. not sure
2. Creating social, economic and environmental impacts. Are these important to attain sustain inability?

Impact questions

Do you think owning a product like this could enhance an organization's connection to green strategies?

How will a green initiative impact quality of life?

Owing to sustainability describe any of your experience with waterless toilets or urinals?

Appendix 3: Social media campaign

https://www.facebook.com/groups/113456386666206/

Manager's Network (FMN)



PRESENTS

FACILITIES MANAGER'S NETWORKING

Facility Manager's Network (FMN)

Public Group Joined ▾ Share ✓ Notifications ⋮

Discussion Members Photos Search this group 🔍

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 something...

FIXED POST

 updated the description. ▾

at 11:05pm

This group is created for students and young facility management professionals to discuss issues related to water use, sustainable facility management practices, water saving innovations and many more.

Seen by 2

ADD MEMBERS

Enter name or email address...

MEMBERS 3 Members




DESCRIPTION

This group is created for students and young facility manage... See More

GROUP CHATS

No group chats, start one now

[Start New Chat](#)