

The background of the cover features a stylized map of Namibia in a golden-yellow color. The map is positioned such that its western and southern borders are visible. Overlaid on the southern part of the map is a photograph of a coastline at sunset or sunrise, with waves breaking and a warm, golden light reflecting on the water. The sky in the photo is a deep orange, matching the map's color. A white circular icon, resembling a location pin or a target, is placed on the western coast of the map, near the middle.

Tekes Business with Impact project

NAMURBAN

URBAN RESOURCE EFFICIENCY
IN DEVELOPING COUNTRIES

Pilot Walvis Bay, Namibia

FINAL REPORT

Tekes Business with Impact project

NAMURBAN

Urban Resource Efficiency in Developing Countries
Pilot Walvis Bay, Namibia

FINAL REPORT

Satakunta University of Applied Sciences
2018

Tekes Business with impact project:

NAMURBAN – Urban Resource Efficiency in Developing Countries Pilot Walvis Bay, Namibia
(Years 2015–2017)

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ABSTRACT

NAMURBAN was a research project on urban development using Namibia as a pilot country. It brought Finnish and Namibian partners together to meet the local needs in Namibia as well as research, technology and capacity building.

The NAMURBAN project was part of BEAM – Business with Impact -programme and it was financed by Tekes – the Finnish Funding Agency for Technology and Innovation – and by the Ministry of Foreign Affairs of Finland, Satakunta University of Applied Sciences and seven Finnish companies (Fimuskraft Ltd., GA90 Recycling Ltd., Naps Solar Systems Inc., Rannan Teollisuuskone Ltd., Riffid Ltd., Sansox Ltd. Oy, SWOcean Ltd.). The project was running from October 2015 until September 2017.

The NAMURBAN project included the sustainable technological concept of urban environments in developing countries. The coastal city of Walvis Bay in Namibia was used as a pilot site for the investigation and developmental activities. The themes of resource efficiency were clean (drinking) water, sanitation, renewable energy production solutions (especially solar and biogas), waste recycling, housing (construction), IoT and ICT.

The project main actions were 1) Operational environment mapping, 2) Technological resource efficient solutions for urban concept, and 3) NAMURBAN Concept and business with impact. A questionnaire was administered to Finnish companies on business opportunities in Namibia. The technological aspects were studied in a city and a pilot fish factory. Strengths, weaknesses, opportunities and threats of the sectors were realized. The social, economical, political, technological, ecological and demographic drivers for cost-benefit analysis were also studied. The capacity building was realized as several face-to-face events in Namibia and Finland. The project was also disseminated in various publications by project personnel as well as other instances.

The NAMURBAN project has successfully identified the needs of Namibia's major industries and made recommendations for meeting those needs, particularly by partnering with SAMK and the Finnish companies. A joint venture between the Finnish company Fimuskraft and a Namibian company is well under way.

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INTRODUCTION

Urban development in Africa

In the next ten years, the population in Africa is expected to grow approximately 25%, and 70% of the growing population will be living in slums appearing around the megacities. Global megatrends – urbanization, megacities, slumming, clean water, CO2 free energy production, digitalization and food production – are a reality in Africa already.

At the moment, the ongoing infrastructure projects for housing, traffic, energy and water correspond to 378 billion USD markets in the sub-Saharan area and 1190 billion USD market in the whole continent. By the year 2020 the number of mobile connections is expected to grow near market saturation point and the number of internet connections will increase 60% from the 2010 level. Furthermore, the discretionary income will grow over 50% compared to present level, creating a 1.4 billion USD mega consumption market.

The NAMURBAN project

The NAMURBAN project studied urban resource efficiency in developing countries by using the city of Walvis Bay in Namibia as a pilot. The project was running from October 2015 until September 2017.

NAMURBAN was part of BEAM – Business with Impact programme and financed by Tekes – the Finnish Funding Agency for Technology and Innovation and the Ministry of Foreign Affairs of Finland, SAMK and seven Finnish companies. The Finnish companies (Fimuskraft Ltd., GA90 Recycling Ltd., Naps Solar Systems Inc., Rannan Teollisuuskone Ltd., Riffid Ltd., Sansox Ltd. Oy, Swocean Ltd.) were actively participating and presenting high know-how and technology about housing, renewable energy, water and sanitation as well as IoT and ICT applications. In addition, external services and co-operation were obtained from Namibia University of Science and Technology (former Polytechnic of Namibia), Aalto University and NHW Market Discovery, Inc.



For the NAMURBAN project, Namibia was chosen as the pilot country for urban resource efficiency in developing countries. Namibia is located in South-Western Africa, and its western border is the Atlantic Ocean. Land borders are shared with Zambia, Angola, Botswana and South Africa. The population is approximately 2.5 million.

In Namibia, the urban development balance is very fragile as the population grows 2.5% per year, and in some cities even 4% per year. Namibia has a challenge, in terms of urban development because of informal settlements, extreme water scarcity, and dependency on imported energy combined with the highly skewed income distribution situation. The social challenges include one of the most unequal income distributions in the world, huge unemployment of young people, low education level and equality of people. There is an existing and growing population of under-educated young people, who enter the job market without skills.

During the NAMURBAN project we studied and promoted development possibilities in Namibia and further in African markets, especially in the Southern African Development Community (SADC) area. The specific solutions of NAMURBAN were based on the analysis of the current situation and needs for urban technology and systems in Namibia. We studied and developed a sustainable technological concept of urban environments in developing countries using the pilot site of the coastal city Walvis Bay in Namibia. The themes were drinking water, sanitation, renewable

energy production solutions (especially solar and biogas), waste recycling, housing (construction), IoT and ICT. Logistics was added as it is the core business on urban development in the pilot city Walvis Bay. In the early phase of the study, it was found that water and energy are the driving forces of urban development in Namibia.

The work was conducted in five work packages (WPs): project management (WP1), operational environment mapping (WP2), technological resource efficient solutions for urban concept (WP3), NAMURBAN concept and business with impact (WP4), and impact and dissemination (WP5). These work packages are presented in this report.



PROJECT MANAGEMENT

The project was managed both thematically and financially by Satakunta University of Applied Sciences (SAMK). A project coordinator with experience in international projects, and expertise in both environmental sciences (Ph.D.) and concept development, was leading the project. A vast number of experts worked at SAMK with the different themes of the project. There were some changes in the project personnel during the project, but the changes had no negative effects on the project outcome.

SAMK researchers had an intensive programme for field visits to Namibia. These field visits were found very suitable for successful implementation of the project. They were the key to obtain commitment of the local stakeholders to the project and its aims. Companies were actively participating in the events in Finland, and Fimuskraft Ltd. took part in the field trip to Namibia in September–October 2016.

A steering committee was organized, which consisted of representatives from SAMK, the funding Finnish companies, and Namibia University of Science and Technology (NUST). The steering committee met both face to face and online using WEBEX HILL online tool before sub-reporting. The steering committee was also informed about the activities of the project via e-mail, phone calls and face to face discussions.

The NAMURBAN project was part of [Developmental evaluation of Business with Impact \(BEAM\) Programme](#), Mid-term Evaluation conducted by 4Front. The project provided information and contacts to evaluators. The evaluators interviewed the project manager as well as several stakeholders in Namibia during their field mission to Namibia in 2017. However, any specific information on evaluation results of the project was not provided in the report as the evaluation considered the whole BEAM programme.



OPERATIONAL ENVIRONMENT MAPPING

When planning new business opportunities in developing countries, knowing one's operational environment and the characteristic features and local nuances is essential. In the second work package, the research question was “*What is the operational environment effect on the creation of a resource efficient technological concept for developing markets using Namibia as a pilot country?*”

Operational environment in Namibia, i.e. regulations, policies, local practices and business environment as well as education, was studied from many aspects: clean water, sanitation, energy, housing, waste management and logistics.

The methods of the study were literature reviews, data collection from the internet, field work in Namibia (data collection, meetings and events) and interviews with several stakeholders. Data was analysed by using the multi-level perspective (MLP) and transition management analysis (Savela 2017 & Savela et al. 2018).

The operational environmental studies formulated the basis for Finnish companies to create new business opportunities in the future. The results were partly reported and discussed also in workshops led by NUST, and published as John et al. (2017).

Regulations and policies affecting resource efficient society

There are regulations, policies, standards and plans in Namibia that have an effect on the resource efficiency of the society. These regulations, policies, standards and plans regarding clean water, sanitation, energy, housing, waste management, IoT and ICT, and logistics, are listed below.

Clean water

- Integrated Water Resources Management Plan (IWRM)
- National Water Policy (NWP) & Water Supply and Sanitation Sector Policy (WASP)
- Water Resource Management Act (WRMA)
- Vision 2030
- Harambee Prosperity Plan
- National Development Plan NDP4 and NDP 5

Sanitation

- Water Supply and Sanitation Sector Policy (WASP)
- Joint Monitoring Programme for Water and Sanitation (UNICEF/WHO)
- National Sanitation Strategy
- Vision 2030
- Water Supply and Sanitation Policy of 2008

Energy

- Electricity Act of 2007
- Renewable Energy Programme Regional Energy Distribution Master Plan (REDMP)
- the Off Grid Energisation
- Master Plan for Namibia (OGEMP)
- Harambee Prosperity Plan
- National Development Plan 4 and NDP 5

Housing

- National Housing Enterprise Act
- National Housing Development Act of 2000
- Local Authorities Act of 1992
- Harambee Prosperity Plan
- Mass Housing Development programme

Waste management

- The Environmental Act of 2007
- The National Waste Management Act
- Pollution Control and Waste Management Bill

IoT and ICT

- Computer Misuse Act of 1988
- Communication Act 2009
- Broadcasting Act of 1991
- Posts and Telecommunications Companies Establishment Act 1992
- Harambee Prosperity Plan
- Vision 2030
- National Development Plan (NDP 4 and NPD 5)

Logistics

- Road Traffic and Transport Regulations
- Road Traffic and Transport Act (22) of 1999
- Logistics Master Plan
- National Development Plan (NDP 4 and NPD 5)
- Harambee Prosperity Plan
- Vision 2030

Local practices and business environment in Namibia within resource efficiency

Namibia is a stable democratic country with stable governance, prudent macroeconomic management and participatory civil society. The business environment is peaceful and secure, however, the country is vulnerable to external shocks, such as drought. In economic freedom ranking, Namibia was ranked 8th of 46 countries in Sub-Saharan Africa.

The local practices and the business environment, including stakeholders and beneficiaries as well as the social aspects, were researched, and these are briefly presented next.



CLEAN WATER

Namibia is the driest country south of the Sahara Desert. It is already facing the lack of fresh water and biomass, but due to climate change, many African countries will face the same issues in the following years. According to most recent studies (conducted in 2010), 85.5% of Namibians were connected to clean water.

However, water resources are unequally distributed in the country, and there are inequalities in access to water resources. In Windhoek, the potable water is produced in water reclamation plant that uses treated municipal wastewater and surface water. Maintaining potable water quality as per standards encourages good health and in sufficient quantities meets the demands, but there are biases and psychological barriers towards the wastewater reuse among the population. Water quality perception varies, and water taste differences caused by treatment activities has caused some people to buy or travel with bottles of water that they feel is of better quality compared to that in that locality.

General public does not know which legislation applies and which ministry or agency is responsible for particular issues in water affairs. Lack of governance, such as institutional fragmentation, lack of coordinated decision making, corruption and poor practices of transparency and accountability, hinders equal access to water.

Local communities and households, industry, farmers, and corporations would benefit from resource efficient clean water solutions.

Stakeholders

- Ministry of Agriculture, Water and Forestry (The Department of Water Affairs, DWA)
- The Namibia Water Corporation Ltd. (NamWater)
- Cities and Municipalities
- Namibia University of Science and Technology (NUST)
- University of Namibia (UNAM)
- Ministry of Defence
- Ministry of Health and Social Services
- Habitat Research & Development Centre

SANITATION

Only 13% of rural and 61% of the urban population in Namibia had adequate sanitation systems. Lack of reliable sanitation is an everyday challenge for health, especially as approximately 15% of the population are HIV positive. Poorly treated wastewater poses a risk to humans and food. Citizens income can be threatened due to sanitation problems and poor sanitation endangers also gender balance.

Local community health, especially the health of women and girls, would highly benefit from improved sanitation facilities, but they benefit also the households, schools, industry and corporations. Not only does the improved sanitation increase the sense of dignity, but it also gives privacy, social prestige and security.

Shared sanitary facilities within the communities provide the quickest and best improvement to informal settlements' needs, but they also bring challenges with maintenance, privacy and hygiene responsibilities.

Stakeholders

- Ministry of Agriculture, Water and Forestry
- Ministry of Health and Social Services (MOHSS)
- The Namibia Water Corporation Ltd. (NamWater)
- Cities and municipalities
- Local Authorities (LAs)
- Red Cross Society of Namibia
- Namibia University of Science and Technology (NUST)
- University of Namibia (UNAM)
- Namibia Standards Institution
- Habitat Research & Development Centre



ENERGY

The energy sector in Namibia consists mainly of petroleum fuels, electricity and local fuel wood supplies. So far, there are no oil or gas reserves nor refineries in Namibia, and therefore all petroleum products are imported. Since the electricity production in Namibia doesn't meet the demand, Namibia currently imports over half of its total electricity demand. The electricity production in Namibia relies on hydropower and the production of hydropower depends, among other things, on hydrological conditions.

All together Namibia is strongly dependent on imported electricity. However, there is offshore natural gas field that is known as Kudu gas field – and Namibia prepares to utilize the gas. The Kudu gas power plant has been delayed and currently is expected to be completed in 2020 (Savela 2017, 80). The natural gas power plant is hoped to be the answer to the electricity shortage of Namibia.

There is a need for education on energy consumption behaviours, since electricity is often taken for granted. Currently, the individual and collective consumption behaviours influence the cost of electricity.

Energy markets are expected to open up for independent power producers focused on renewable energy. At top levels, political and economic elites through conflict of interest and self-enrichment, can capture policy development processes and national investment schemes in energy infrastructure developments, resulting in poor coordination of developments and decisions.



Focusing on renewable energy, the non-renewable natural resources will be sustained and conserved. Increasing the utilization of renewable energy sources, such as solar energy, over non-renewable, such as diesel, leads to enhanced economic benefits.

There are people living without access to electricity, mainly in rural areas. Access to electricity would improve local urban and rural dwellers' living standards.

Stakeholders

- Ministry of Mines and Energy
- NamPower
- Cities and municipalities
- Ministry of Finance
- GIZ Namibia
- University of Namibia (UNAM)
- Namibia University of Science and Technology (NUST)
- Habitat Research & Development Centre
- InnoSun Energy Holdings
- Renewable Energy Industry Association of Namibia (REIAoN)
- The Renewable Energy and Energy Efficiency Institute (REEEI)

HOUSING

In Namibia, there is increasing demand for low cost housing. The legislative systems and procedures, that allow ownership or purchase of homes, are not sufficiently clear, which results in large numbers of people not owning homes and only left with an option of renting.

Local communities, urban dwellers and lower income groups would benefit from affordable and resource efficient housing solutions. Currently, low income households are socially excluded from the formal housing market. Eventually, the growing informal settlements might create social unrest and decrease the health conditions. This might also lead to increased need for schools, hospitals and police stations.

Stakeholders

- Ministry of Works and Transport
- Ministry of Local Government, Housing and Rural Development
- Ministry of Lands and Resettlements
- Shack Dwellers Federation of Namibia
- Build Together Scheme
- National Housing Enterprise
- National Planning Commission (NPC)
- Bank of Namibia
- The Institute for Public Policy Research
- Cities and municipalities



WASTE MANAGEMENT

Most of the waste disposal sites in Namibia are dumpsites and the majority of them are open dumpsites with no control. Large-scale recycling is implemented only in Windhoek with private contractor. Most recyclables are transported to South-Africa. Benefits of waste management and waste separation are not fully understood. People often dispose waste, including fuel and oil, into sewers or anywhere on the ground freely with no fear, which makes it challenging to enforce and monitor illegal dumping. Political entities are the main drivers of development, and have only little interest in waste management. There have not been large investments in waste recycling.

Appropriate disposal of waste can be seen costly, but recycling waste not only saves our natural resources, but also helps save energy. Recycling reduces waste at landfills, and by simply recycling an old item or making a basic fix to it, we can save all the raw materials and energy that would have been consumed in the process of making a new item. Therefore, waste management carries importance for the conservation of the environment.

If waste management was better organized, there would be less contamination in local urban and rural dwellings. Wildlife, flora and fauna would be disturbed less, and non-renewable natural resources would be better sustained through the re-use-approach. Global warming contributors would be reduced and the economic benefits would be increased.

Stakeholders

- Ministry of Fisheries and Marine Resources (MFMR)
- Ministry of Environment and Tourism
- Ministry of Health and Social Services (MHSS)
- Ministry of Regional and Local Government, Housing and Rural Development
- Namibia University of Science and Technology (NUST)
- Cities and municipalities



IOT AND ICT

There are people living without access to electricity, mainly in rural areas, and there are still areas with no mobile phone coverage. Many people have limited access to modern ICT services such as internet and computers, and lack of ICT skills. The telecommunications sector is currently dominated by two majority state-owned operators.

Communities, households and individuals, as well as schools, corporations, industry, and government, would benefit from improved IoT and ICT possibilities.

Stakeholders

- Ministry of Information and Communications Technology
- Communications Regulatory Authority of Namibia (CRAN)
- Namibia University of Science and Technology (NUST)
- University of Namibia (UNAM)



LOGISTICS

Transport and logistics is a strong driver of economic growth and poverty reduction. Poor rural infrastructure, especially transport infrastructure, is one of the biggest obstacles decreasing productivity.

Namibia is a small country with small domestic market, but on the other hand it has great potential for broader markets, thanks to the new expanded Walvis Bay port. Logistical possibilities are affected by the vehicle costs, fuel prices and maintenance costs. People must also consider the value of the cargo – is the transportation cost-effective. However, in Namibia the time required for customs clearance is shorter than in many other African countries. Also the risk of fraud is lower.

Local communities, corporations and industry would benefit from improved logistics. Efficient logistics would also increase the economic benefits.

Stakeholders

- Ministry of Works and Transport
- Ministry of Trade and Industry
- Namibia Logistics Association (NLA)
- Namibian Ports Authority (Namport)
- Walvis Bay Corridor Group (WBCG)
- Namibian–German Centre for Logistics (NGCL)
- Namibia University of Science and Technology (NUST)
- National Planning Commission (NPC)



Case Urban infrastructure governance in Namibia

Savela made her Master's thesis in political sciences on themes "Regulation and policies of Namibia affecting resource efficient society" and "Local practices and business environment in Namibia within resource efficiency". Savela's thesis "Urban infrastructure governance in Namibia – A multi-level analysis of urban system transitions" was published at the University of Turku in 2017. The summary of Savela's thesis goes as follows:

The research in this thesis was conducted as a part of the project NAMURBAN (Urban Resource Efficiency in Developing Countries – a pilot study of Walvis Bay, Namibia), a two-year project of Satakunta University of Applied Sciences in Finland. It focuses on the challenges that rapid urban development imposes in Namibia and the city of Walvis Bay, on urban infrastructure governance and sectors of water, sanitation and energy. It models these sectors in forms of systems and adapts the multi-level perspective (MLP) and transition management (TM) approaches. The systems and their interactions are described in three levels: 1) the landscape level, 2) regime level and 3) technological niche level and situated in a transition model. The thesis describes the regime membership network of these regimes, the capacities of members and their perceptions towards sustainability transitions of the urban systems through adaptive capacity framework. It adapts the critical viewpoint of political ecology and other theories of political science to deepen the theoretical frameworks of transitions and adaptive capacity.

The methodology of the thesis is grounded on a case study and qualitative field research, especially on participant observation method. Most of the material was received during a three-month field visit to Namibia in autumn 2016. This material includes interviews with relevant stakeholders and experts, informal discussions, literature and a questionnaire posed to external experts of the most influential forces in urban development in Namibia.

As a result, the following themes are considered as the most influential forces in urban development: 1) water crisis, 2) land ownership and housing, and 3) structural deficits. Other considerable responses included urban spatial planning, public transportation and economic and social issues. The urban water and sanitation regime is characterized by an unequal distribution of water resources, outdated legislation, various practices between the regime members, varying perceptions of the need and expense of technology and the lack of public domains for discussion, key monitoring institutions and a skilled workforce. The urban energy regime is characterized by a high dependency on imported electricity, ideological division between gas and full renewable energies as means of modern electricity supply, active public debate on renewable energy solutions, the roles of independent power producers (IPPs) and market-dominating state parastatal NamPower, and the shift from a single-buyer model to a modified single-buyer model. The thesis concludes that understanding the water-energy nexus is essential in urban development; the MLP approach would highly benefit from the theoretical field of political science and should be orientated towards a developing country context. As a result, system modelling may further assist in capacity building in urban sectors. (Savela 2017.)

The data from themes “Regulation and policies of Namibia affecting resource efficient society” and “Local practices and business environment in Namibia within resource efficiency” are visualized for water and sanitation in figure 1 as well as for energy in figure 2. Details can be found on scientific paper by Savela et al. (2018, submitted).

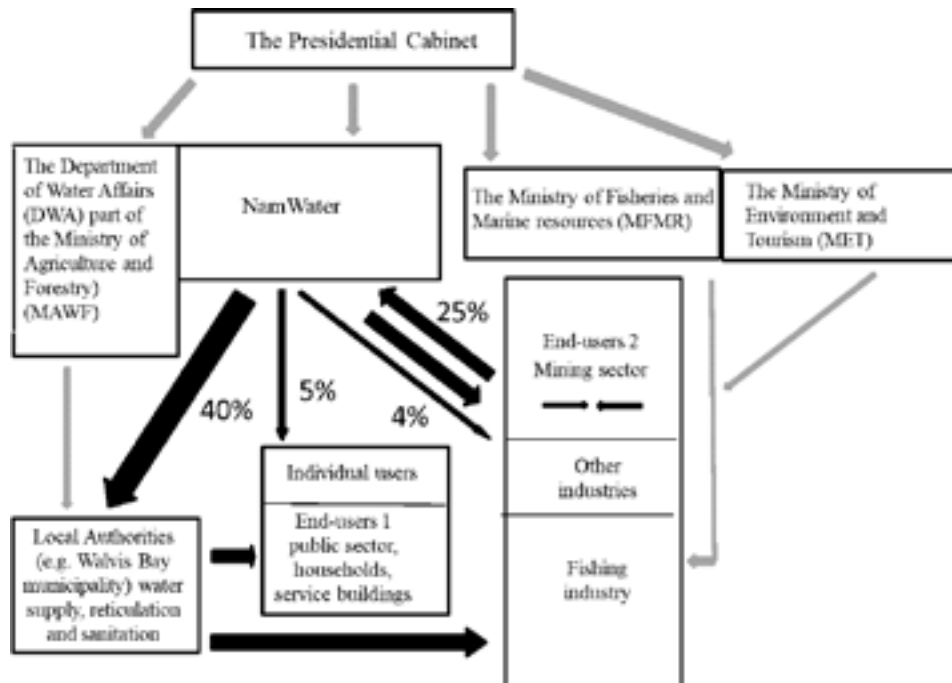


Figure 1. Water and sanitation infrastructure governance in Namibia (Savela et al. 2018).



Figure 2. Energy infrastructure governance in Namibia (Savela et al. 2018).

The educational situation and the need for capacity building

CLEAN WATER

There is a need for accessible potable water (tap water) supplies to all informal communities. To be able to extend the service supplies outwards on the outskirts of towns, the pipelines must be constructed systematically, to prevent complexities in distribution network.

To provide clean water for all communities, more research about water purification, especially practicable water purification methods, is needed. In addition, people need to be trained in proper usage of water purification tablets.

To prepare for the water crisis, more investments need to be done in water research, especially in harvesting, collecting and storing the existing water that might otherwise evaporate or run-off into oceans. Currently the IWRM (Integrated Water Resources Management Plan) issues are not adequately included in curriculums of tertiary institutions. The tertiary institutions are mostly producing engineers and artisans creating a very huge performance gap between water infrastructure development and maintenance. Therefore, the water sector needs skilled local workforce for water management.

There is a need for retrofitting the appliances, consumption restrictions or quotas, and tariffs for water savings. The issues need to be communicated, as well as effectively enforced to the users.

In the city of Windhoek, there have been educational campaigns on water reclamation, but further awareness raising, especially in the cities, is needed.



SANITATION

To limit the emergence of water contamination and water-borne diseases, sanitation needs to be better acknowledged. First of all, the informal communities need a permanent and accepted sanitary facility option, since the options that have already been tested have all been temporary solutions. Adequately accessible sanitary facilities would eliminate acts of open defecation. There is a need for research to find new innovations and technologies, especially in developing affordable dry sanitation systems.

The sanitation and water facilities need to be better maintained. Ignorance of best practices in sanitation exists in communities, and people pay little attention to maintaining hygienic conditions, even when fully aware of the negative impacts it has on them. That is to say, there is a need for basic training on hygiene and sanitation in local communities. Educational institutions should include water and sanitation in all study programs, and there is a need for health schools and health clubs. Training in sanitation should focus on monitoring, record-keeping and giving feedback, to improve sanitation planning, management activities and research. The locals should be encouraged to apply for foreign scholarship and student exchange programs, so that they could learn experientially and adopt new sanitation ideas and programmes.

Knowledge of policies and procedures is limited, and there is no clear understanding of technical options. The construction work and project management are of poor quality, and therefore proper contractor training is needed.

To implement all of the above, information, education and communication material is needed. Corporations between local educational institutions and foreign educational institutions could share knowledge and adopt best applicable solutions for sanitation.



ENERGY

There is a need to raise awareness about energy efficiency. Critical skills sharing is needed, as well as general cultural acceptance of the new consumption patterns.

There is a great need for experts in energy production, since the status of higher education for the renewable energy sector is still very low. At Namibia University of Science and Technology (NUST), there are some Bachelor level programmes in electrical, mechanical and civil engineering and other related studies such as Natural Resource Management. There are also a few Master level programmes available at NUST such as civil engineering, integrated water resources management and sustainable energy. In addition, there is a project called the Southern African Sustainable Energy Initiative (SASEI), for institutional, human resources and system strengthening.

In Namibia, there is a need for new innovations and technologies to replace heavy fuel-oil plants and aging technology. Also spare parts for technology are needed. There is a need to invest in wind power, as several wind farms (with a capacity of generating 20–50 MW) could be built along the coast. The new wind power farms would remove the constraints on the Namibian energy demands in the areas nearby Walvis Bay and Swakopmund. In addition, to procure solar energy technologies, subsidies and reasonable loans to clients need to be offered. Due to the water scarcity, the use of hydro-power stations should be reduced, since currently large amounts of water are lost or polluted in processes during electricity generation.



HOUSING

There is a need for qualified personnel in the field of sustainable housing, such as land surveyors and planners. Currently, informal builders are significant players in the housing delivery process. The managerial and technical skills of the builders need to be enhanced, artisans need to be trained in improved construction techniques, and the small scale entrepreneurs need to be instructed in low-cost building materials production and housing construction. The construction techniques need to be understood comprehensively, and the critical skills must be shared without simply 'copy-pasting' the existing housing formats.

Materials such as Portland cement, steel and construction timber, are not locally available, and this has created a need for new housing construction technologies. There is a lack of appropriate technical know-how in the utilization of locally available environment-friendly building materials. The development of more appropriate and affordable materials and building designs should be researched.

Workforce, especially women, needs to be educated for efficient and sustainable building. At NUST there are three housing related study programmes: Bachelor of Town and Regional Planning, Bachelor of Architecture and Bachelor of Land Administration. Currently, the Habitat Research and Development Centre (HRDC) is lacking in funding and projects.





WASTE MANAGEMENT

Local knowledge of recycling should not be taken for granted, especially people living in informal settlements have a low level of understanding on waste management and separation. Personal safety equipment and more hazardous waste cells are needed. There is also a great need for waste storage facilities to reach all informal settlements. To increase engagement of population, local councils and municipalities arrange mass cleaning campaigns.

Special attention should be paid to training management and collection of hazardous waste. Education and training of waste management authorities and their personnel is a clear target for improving waste management. The training should focus on monitoring, record-keeping and feedback, to improve management. People's access to information needs to be insured at all times.

Namibia lacks environmental health experts. Therefore, the country needs further investments in educating more environmental scientists, especially environmental health scientists, to adequately research and manage solid waste. Evidently, currently there are only 3–4 environmental health scientists per region. At NUST, there is one Bachelor level programme focusing on this field – Bachelor of Environmental Health Sciences.

Investments should be directed to establishing electronic waste reuse projects, where re-assembled electronics, e.g. computers, can be distributed to all schools to aid children that may otherwise never have access to computers.

ICT AND IOT

The relevance of information and communication technology (ICT) or Internet of Things (IoT) is not fully understood. Many people lack of basic ICT skills.

Limited electricity access leads to limited use of ICT services. Not all people have access to computers, and the spare parts originate from foreign countries.

At UNAM and NUST, there are study programmes for information and communication technologies. At UNAM, it is possible to study computer engineering and computer sciences. At the Institute for Open Learning, there are some ICT courses, and a possibility to study an international computer driving license.

LOGISTICS

The transport infrastructure in Namibia needs to be upgraded. There is also a need for skilled labour force in logistics.

At NUST, there is one Bachelor level programme in logistics: Bachelor of Logistics and Supply Chain Management. Also the Business School of Excellence offers qualifications, and the NGCL offers logistic courses.



Business survey analysis

A business survey analysis was conducted in autumn 2016 (the first phase) and spring 2017 (the second phase). The survey focused on the business opportunities of Finnish companies in Africa, especially in Namibia. In the first phase of the study, the research method was a questionnaire form, which was submitted to 51 companies. Altogether 13 answers were received (response rate 25.5%).

In the second phase of the study, companies were interviewed, to receive more detailed information about their interests.

THE PURPOSE AND BACKGROUND OF THE STUDY

The purpose of the business survey analysis was to identify the possible subjects of interest, and challenges companies had already encountered or expected to encounter in the Namibian business environment. A short questionnaire form was sent to companies known to have either already running business activities in Namibia or plans to run such activities in the future.

In the survey, the companies were asked about their fields of industry, previous experience in the Namibian markets, their interests towards future business in the country, the source of information from which they obtained their up-to-date knowledge about the business environment, and what form of business they would be interested in running in Namibia. In addition, the companies were asked to name three (3) most challenging influential factors related to entrepreneurship and business in Namibia. At the end of the questionnaire form, the companies were asked about their willingness to participate in a separate interview (phase 2). During the interview, they were asked about additional information they would like to obtain from the project. The results of the study were used in creating a resource efficient technological concept, which was suited for the needs of the companies and these actors.

QUESTIONNAIRE

QUESTION 1. The field of industry

The companies represented the fields of energy, electricity, water, infrastructure building and sanitation solutions, recycling and waste disposal, agricultural machinery, ICT, logistics, shipbuilding, diving services, professional services, consultation and teaching/education.

QUESTION 2. Does the company have previous experience from the Namibian markets? (yes/no)

Eleven companies out of thirteen replied that they did not have previous experience from the Namibian markets, whereas two had previously been involved in the business activities in Namibia.

QUESTION 3. The company is interested in the business opportunities in Namibia in the future. (yes/no)

All the thirteen respondents showed interest in business opportunities in Namibia also in the future. This implies that the experiences among those who already had gained previous experience from the aforementioned markets, were willing to engage in the activities again.

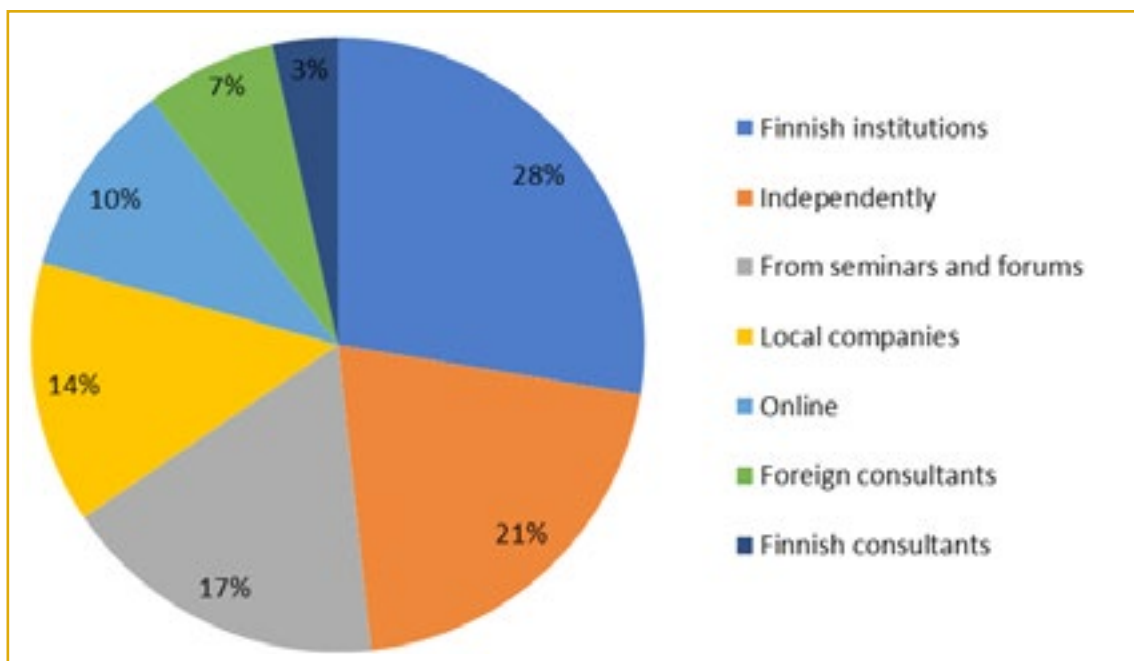


QUESTION 4. The company usually obtains information about Namibian business environment from...

Options: 1) independently, 2) online, 3) Finnish institutions (such as universities), 4) Finnish consultants, 5) Foreign consultants, 6) Local companies, 7) From seminars and forums, 8) From communities in social media, 9) Other.

Most of the information among the respondents was obtained from Finnish institutions (28% of responses), independently (21% of responses), including for example the company's own viable studies and from seminars and forums (17 % of responses).

As can be seen in the graph below, the companies obtain information from various sources. Those companies who already had business experience in Namibia mainly used their local contacts. Finnish institutions continue to have an important role in providing information. Based on the results, there seems to be a need for a more integrated information base for the Finnish companies interested in running business activities in Namibia. Especially more information and studies are needed in mapping the local entrepreneurs and relevant actors.



Sources of information about Namibian business environment.

QUESTION 5. Select from the following options the most challenging influential factors that have an effect on entrepreneurship and business activities in Namibia (name three most important factors scaling 1 (most important), 2 (second important) and 3 (third important))

Options: 1) dissenting working cultures, 2) taxation, 3) the lack of skilled workforce, 4) the lack of transparency, 5) slow decision making process, 6) permits, 7) communicational problems, 8) the cost of materials, 9) the lack of local actors/entrepreneurs, 10) other.

The results of the question were graded as follows: most important equals 3 points, second important equals 2 points and third important equals 1 point. In rare cases, where the respondents had marked the options with “x” (not numbers 1–3), these answers were marked as the “most important” and given three points.

Altogether seven distinguishable factors were discovered from the replies. These included the lack of local actors/entrepreneurs (18 points), slow decision making process (16 points), dissenting working cultures (5 points), lack of skilled workforce (5 points), lack of transparency (4 points), communicational problems (3 points), and permits (1 point). Other noted factors were lack of experience and knowledge (of the company), and corruption.

As most of the respondents were still at the stage of planning business activities in Namibia, the conception of lacking of local actors/entrepreneurs in the sector can also signify the lack of knowledge and information about possible local companies, cooperation partners and entrepreneurs. Other important aspects were cultural factors (related to working habits, decision making and communication) as well as related to the lack of skilled workforce.

**MOST CHALLENGING FACTORS EXPERIENCED
IN BUSINESS ACTIVITIES IN NAMIBIA:**

1. Lack of local actors/entrepreneurs
2. Slow decision making process
3. Dissenting working cultures
4. Lack of skilled workforce
5. Lack of transparency
6. Communicational problems
7. Permits

Question 6. Our main interest in Namibia includes...

Options: 1) consulting, 2) investing, 3) service production, 4) subcontracting networks, 5) manufacturing, 6) service provision, 7) other.

More than half of the respondents (7/13) named service provision as the most interesting field of business. Consultancy was considered as the second interesting field of business, and service production and manufacturing the third interesting field of business. Other fields the respondents were interested in, were subcontractor networks, selling of products (to importer), product marketing and retail relations.

As the companies named their interests to be mostly in services and consultancy, as well as selling and marketing of products, there is a special need for information and good practices from these fields.

**THE FIELDS OF BUSINESS THAT FINNISH COMPANIES
FIND THE MOST INTERESTING IN NAMIBIA:**

1. Service provision
2. Consultancy
3. Service production
4. Manufacturing
5. Subcontractor networks

INTERVIEWS

In the second phase of the survey, the participants were asked about what kind of information they still wanted to obtain from the project. The participants were interested in information concerning up-coming projects in their specific fields – run by the government, private enterprises or municipalities. They were interested in water purification, container terminals and logistics centres, practices in energy and resource efficiency, legislation of these fields, situation among distributors of commercial sector and future development plans.

The respondents wanted more information about the demand of the products and co-operation opportunities with other micro-enterprises or with bigger companies – either Finnish companies or local companies. Some respondents mentioned the need for information about the true opportunities of micro-enterprises in Namibia and especially guidance and information about funding for export promotion. It was mentioned that without proper guidance and possible auxiliary funding it is hard for a micro-enterprise to start building long-term business or take longer trips or multiple visits as there needs to be enough capital to keep the company running.




RESULTS OF THE STUDY

The results of the study can be summarized as follows:

- 1 The companies obtain information about the Namibian business environment from various sources. The most common ways the companies receive information are via institutions (such as universities), independent research and from seminars and forums.
- 2 The respondents found that the most challenging factors in the Namibian business environment were lack of local actors and entrepreneurs, slow decision-making processes, dissenting working cultures, and lack of skilled workforce.
- 3 The respondents were mostly interested in service provision, consultancy, as well as service production and manufacturing.
- 4 More information was required especially in the fields of ongoing projects, cooperation opportunities, funding opportunities and customer demand.

Based on the results, despite the relatively low number of responses, there seems to be a need for a more integrated information platform for the Finnish companies interested in running business activities in Namibia. More information and study is needed in mapping the local entrepreneurs and relevant actors. As the companies named their interests to be mostly in services and consultancy, as well as selling and marketing of products, there is a special need for information and good practices from these fields.

TECHNOLOGICAL RESOURCE EFFICIENT SOLUTIONS FOR URBAN CONCEPT



In the project's third work package, technological resource efficient solutions for urban concept were researched. The research question was: *What Finnish technologies are suitable for creating integrated sustainable solutions to urban societies in developing countries using Walvis Bay, Namibia as a pilot city?*

Suitable resource efficient technologies in a city and in an industrial pilot are presented in this chapter. As a part of capacity building for Finnish companies, information on Namibian permits and licensing was gathered as well as data on the current capacity of the research areas. The capacity building was realized as several face-to-face events.

The feasibility study includes information about the local business environment. SWOT analysis was used as a method, to recognize the strengths, weaknesses, opportunities and threats for each sector.

NASA satellite picture of Walvis Bay, Namibia in 2006.

Suitable resource efficient technologies in a city

In the original research plan the technological resource efficient solutions were planned to be based on basic and detailed engineering of the modular resource efficient housing concept. In an early phase of the project it was noted that the focus of the NAMURBAN technological solution had to be broader to fit the need of the customers in an urban environment, i.e. in municipalities and cities. The customers in Namibia and in other Southern African countries are willing to invest in solutions, not just in specific technologies.

NAMURBAN project Finnish companies provided the following resource efficient technology options:

- Water and sanitation systems from Sansox Ltd. and Rannan Teollisuuskone Ltd.
- Energy systems from NAPS Solar Systems Ltd. (solar energy) and Firmuskraft Ltd. (bioenergy)
- Waste recycling (especially e-waste) from GA90 recycling Ltd.
- System management with IoT and ICT solutions from Riffid Ltd. and Swocean Ltd.

In addition, NUST made an intensive study on housing in Namibia within the same timeline. Another BEAM project, Smart Communities, focuses on developing a community having their pilot in the southern Namibian city of Keetmanshoop.

The needs and environmental issues of the current technologies in use were studied and compared to the potential of the Finnish companies, especially the NAMURBAN companies, that have sustainable and resource efficient technologies in use.

The suitable resource efficient technologies in a city are presented next.

CLEAN WATER AND SANITATION SOLUTIONS

Drought, unpredictable rainfall, and the hydrological cycle, are the most significant environmental issues regarding water supply in Namibia. Populous areas exploit water in the upstream water basins, thus limiting volumes of water reaching the downstream. There is a need for adequate infrastructure to supply all populations with potable water. The old water infrastructure needs to be repaired and replaced to maintain provision of quality water.

In Walvis Bay, the water demand will grow within the next couple of years. There is not enough ground water in Walvis Bay to cover the growth of water demand, and therefore nonconventional water sources, such as desalination and artificial recharge, need to be explored.

Tea Mäkelä (2016) made her Bachelor's thesis in the School of Engineering Science at Lappeenranta University of Technology (LUT) about drinking water treatment methods in Namibia. Currently there are several water purification technologies being used or tested in Namibia. In water reclamations plants several methods are used or tested, such as pre-ozonation, flocculation, dissolved air flotation, rapid sand filtration, ozonation, granular activated carbon, biological activated carbon, membrane filtration, chlorine disinfection and stabilization. In addition, there is the membrane bioreactor (MBR) system and the MICROPUR process. In some communities, water is treated with water purification tablets.

There are limited water and electricity resources in Namibia, which forms challenges in accessing sanitation and ensuring environmental protection. There is a need for a wider range of sanitation systems, and safer and more sanitary toilet facilities, such as a flushing toilet with a hand washing basin, are needed in all informal settlements.

Moreover, there is a high risks of marine pollution around Walvis Bay area originating from harbour, sewage and waste waters from fish processing, and the desalination plant. The wastewater treatment systems are already exceeding the acceptable cleaning capacity. Currently, one third of the treated wastewater is used for irrigation and two thirds are pumped to the Namib Desert. The wastewater area in the desert is very close to the municipality of Walvis Bay, and there is a demand for the land to be used for other purposes. On the other hand, the wetted land dangers the main road infrastructure between the municipality of Walvis Bay and the Walvis Bay airport.

Currently there are some wastewater technologies being used or tested in Namibia. Some of them are wet systems, such as treatment plants, conventional waterborne

sanitation system, vacuum/small bore sewer system, and septic tanks and drain systems. Some of the technologies are dry systems, such as VIP pit toilet and the Ecosan toilet. Also biogas systems, composting toilets and the Environflush system are being tested.

Within the NAMURBAN project we have studied the current water systems in Walvis Bay, and researched new cost-effective technological solutions that could be used in the future. One possibility to treat the wastewater sludge, recycle the nutrients and simultaneously get renewable energy, is to digest the sludge anaerobically. The purified wastewater not used for irrigation, can be discharged to a constructed wetland, where the nutrients can be utilized to grow plants. Later the plants will be harvested and taken into the anaerobic digestion with the excess sludge from the wastewater treatment process. This process produces biogas that can be used for energy production, and wet sludge can be used as fertilizer and irrigation. The water coming out from the constructed wetland is purified enough to recharge groundwater resources. The economic viability of different alternative wastewater treatment methods, together with sludge treatment, are assessed by a cost-benefit analysis and life cycle cost analysis.



RENEWABLE ENERGY SOLUTIONS

As mentioned before, Namibia currently imports over half of its total electricity needs. The energy sector in Namibia is dominated by liquid fuel usage, imported electricity and local wood fuel supplies. There are heavy fuel-oil plants and hydro-electric power stations. High-voltage transmission lines are used to transmit power over long distances. There is a need for new innovations and technologies to increase electricity self-sufficiency, and to decrease electricity costs.

Increase in energy demand, of both industries and the households, puts stress on the limited energy resources. Therefore, the focus needs to be redirected to utilization of renewable, environmental friendly energy resources. Moreover, there is a need for energy recovery. Namibia boasts a coastline of more than 1 600 km, which offers unexplored wave and tidal energy potentials.

Currently there are some renewable energy technologies being used or tested in Namibia, such as solar water heaters (SWH), solar photovoltaic (PV) systems, and wind turbines. Solar energy, and especially photovoltaic technology, has vast possibilities in Namibia due to the high solar radiation levels and the country's optimal location near the equator. Actually, Namibia is one of the sunniest countries in the world. Namibia has over 300 sunny days in a year with an annual solar radiation average exceeding 6 kWh/m²/day, and majority of the solar radiation is direct radiation. These conditions are optimal for solar electricity production.

Currently solar energy is mainly used for heating hot water. The idea of integrating photovoltaic technology into modular housing and industry solutions, takes solar energy technology near the end user, and turns the common energy buying and consuming customer into energy producer. Considering the energy infrastructure in the area and the need for electricity and domestic hot water in residential buildings, the integration of solar energy would be beneficial. Solar electricity could be utilized on a larger scale where the PV-system installation would serve several buildings in the residential area. For a single building, a PV-system could be used for cooling and for other appliances, and thermosiphon for domestic hot water. A combination of these systems would reduce the need of purchased energy and increase energy security in the future.

When integrating photovoltaic systems into the building environment, special attention must be paid to safe and stable installation of the system, energy storage in off-grid systems, and to the possible energy feed processes to the local or national

energy grid. For this, reliable system designers and providers are needed. These systems could also be implemented in existing buildings in both residential and public sectors. The need for reliable providers for turnkey systems is recognized.

Bioenergy solutions were designed for Walvis Bay. Walvis Bay is located along the Benguela Current Large Marine Ecosystem within the Atlantic Ocean, one of the richest ecosystems on earth. Walvis Bay is the key area for fish products, which are the second most important export products after mining. There are several large fish factories in Walvis Bay area, and currently, the fish chum is used for feeding animals, and as manure for gardens. It is also exported to Botswana and other African countries. Since fish chum can be used for biogas production, biogas technology is the preferred technology for bioenergy production.

Teija Järvenpää (2017) made her Bachelor's thesis in the degree programme in Energy and Environmental Engineering at Satakunta University of Applied Sciences (SAMK) about the applicability of biogas production in Namibia. Successful implementation of a biogas plant in Namibia requires a suitable biogas plant for local circumstances, the right size of biogas plant and service offering such as training along with the technical solution.



HOUSING SOLUTIONS

In Namibia, there is increasing demand for low cost housing. Unprecedented increases in house prices continue to reduce people's ability to access affordable housing. There are several ongoing "affordable housing"-projects but their costs per square metre varies a lot, and many of them are still unattainable for the common people. There is a great need to build homes for low income earners in a mass housing scheme.

Half of all housing in Namibia are kraals and huts – build of thatch, mud and cow dung. One third of all housing are detached houses made of solid tree and Portland cement. The continued consumption of large quantities of trees (estimated 150 solid trees are required to build one traditional house), and the continued used of thatch for roofing will exacerbate the serious deforestation occurring in the northern areas of the country.

Single-family houses are often built on the plot from blocks. Prefabricated elements are seldom used, although, affordable residential areas consist of houses of the same type and size making the use of prefabricated elements ideal. When considering the material of elements, it is good to acknowledge that common people tend to prefer stone or concrete to wood as building material. There is an interest to find new building materials and use local raw materials to decrease the costs and for example, the cooling need of the buildings. The use of sand and acacias for construction panels is being researched, and energy efficient housing (i.e. insulated homes), are experimented at NUST. The new building materials and methods open up opportunities for trainers in capacity building, material providers and manufacturers. Especially the need for structural engineers and site supervisors is recognized.

Energy efficiency in buildings and processes is a rising aspect. For residential and public buildings, it would mean retrofitting new technologies, smart automation, materials and renewable energy systems. For industry, optimization of processes and measures with reasonable payback time are seen as optimal solutions. Retrofitting government buildings with energy efficient systems and solutions would work as a good example to others.




WASTE MANAGEMENT SOLUTIONS

Recycling process has not taken place inside the country, as the local recycling industry is still in its infancy. Waste management can no longer act on its own, which means it must be adhered to the production of energy and materials. First of all, waste recycling requires education and spreading of knowledge to local communities.

Waste can be seen as a resource. This means working in all the following waste hierarchy spheres: 1) waste prevention, 2) preparation for reuse, 3) recycling, 4) waste to energy and fuel, as well as 5) safe localization of the mixed waste at the landfill site.

The current waste management solutions in Namibia are burning the waste, domestic waste containers, communal waste storage facilities, hazardous waste cells, water-borne sewage systems, and deep waste collection system (the Finnish Molok system).



Collecting waste at the source is important in designing residential areas. Waste bins need to be positioned in the proper places. This is done in cooperation with locals, since local expertise is extremely important to examine where are the best places to put the bins and waste collection plants. Also, hazardous waste has to be taken care of in a proper way at the construction site. Empowering the local people with small scale entrepreneurship in collecting the waste is also practicable. The collected waste could be sold to the waste plants, or waste could be used as handicrafts material.

There is no sustainable way to dispose or recycle electronical devices, which causes the hazardous substances to end up in the environment. Therefore, a full concept of e-waste recycling is needed. The poor e-waste recycling is a problem especially to the inhabitants of informal settlements who are forced to find food and other utilities in dump sites (also known as Kupferberg 'scavengers').



IOT & ICT SOLUTIONS FOR MEASURING AND CONTROL SOLUTIONS

When the overall concept includes energy and/or process management and optimizing, also measuring and control solutions must be integrated into the concept. In the NAMURBAN concept, measuring and control environments were designed in such a manner, that IoT and ICT technologies and solutions are fully utilized. The solutions are modular, scalable, cost-effective, and open interfaced. The latter keeps the system updated, and makes the extension easier and cheaper than by using the existing technologies with closed interfaces.

The designed IoT and ICT solution in the NAMURBAN project included sensors, data measuring, data analysis, and control features as well as gateways and platforms for further development of smart services.

Currently, there are mobile phones, digital television, broadband connection, and 4G Long Term Evolution (LTE) technologies in use in Namibia. There is a need for an extensive electricity supply, and to develop skills to support and enable the utilization of available ICT solutions. Cyber security legislation, internet access in schools, and international internet bandwidth, are also needed.

LOGISTICS SOLUTIONS

Namibia shares borders with Angola, Botswana, South Africa, and Zambia, and has good ports and trunk roads to link them all with the rest of the world. This gives Namibia a huge potential to be an international logistics hub for the inland areas of the Southern African Development Community (SADC).

The port of Walvis Bay is the main entrance to SADC, as it is the most important international sea harbour in Namibia. It is currently the first port of call for certain carriers to the Africa region from South America, Europe and the Far East. The planning and construction of a €300,000,000 harbour expansion project (from 350,000 TEUs to 800,000 TEUs per year) started in the year 2014. When completed, the port will employ about 1000 workers directly, and 10 000 workers indirectly.

Currently ships, trains, airplanes and trucks are used for transport, as well as containers, bunkers for oil products, and warehouses for storage. There are also tracking systems in use. In 2013, Cargo handling volume at the airports in Namibia (Hosea Kutako International Airport, Walvis Bay, Eros, and Lüderitz) was about 8000 tons. Rehabilitating the railway is still in progress, as the rail line from Walvis Bay to Windhoek (420 km) is not at a satisfactory level. After completion, cargo volume transported by rail is estimated to increase 2.5-fold, compared to the volume in 2013. However, there is a need for more efficient network of transportation and logistics.





Suitable resource efficient solutions in an industrial pilot

The other originally planned pilot was to plan renewable energy solutions for industry (fish factories) and study the potential of fish chum for biodiesel production.

After intensive background work, a fish factory Merlus Sea Food Processes Limited in Walvis Bay was willing to co-operate as an industrial pilot. Merlus is part of an international seafood product company called [Mascato S.A.](#) Mascato S.A. has operations in Asia, Chile, Spain, Namibia, South Africa and USA.

Merlus Seafood Processors in Walvis Bay was the first fishing company in Namibia to obtain certification from both top-ranked food-safety management systems, ISO 22000 and BRC in 2008. ISO 22000 is an international standard that defines the requirements of a food-safety management system covering all organizations in the food chain, from “farm to fork”. British Retail Consortium’s (BRC) Global Standard for Food Safety was created to establish a standard for due diligence and supplier approval.

Merlus has their own fishing fleet. The main products are hake and monkfish, and the main market area is Spain. On ships, the fish is filleted, frozen and packed for future treatment on shore. At the factory, the fish is glazed with fresh water and packed by hand in selling bags. The fish chum is mainly discharged into the Atlantic Ocean, but there are some Namibian fish factories producing animal food or fertilizers from the chum.

Based on the discussion with Merlus, their need and interest in resource efficiency was mainly in the grey water purification processes, renewable energy, such as solar energy and biogas, LED lighting and reduction of their carbon footprint.

The specific solutions from the NAMURBAN companies were:

- grey water treatment from Sansox Ltd.
 - solar energy systems from Naps Solar System Ltd.
 - biogas system from Rannan Kone Ltd. (fish chum treatment e.g. to biodiesel) and Fimuskraft Ltd. (biogas and electricity productions)
 - system management with ICT and IoT solutions from Riffid Ltd. and Swocean Ltd.
-

In Namibia, legislation has been prepared to limit the discharge of grey water from fish factories to the Atlantic Ocean. New legislation for grey water treatment is being expected. Merlus has been active in this matter. In the NAMURBAN project, the technological aspects of this matter were studied.

Calculations for a solar photovoltaic system were made for Merlus Seafood Processing plant. The plant started operations in Walvis Bay in 2003. The company converts bulk sea-frozen fish into retail products. The plant uses mainly electricity for freezing processing lines and cooling facilities. Also electricity is used for lighting and warm water. Our calculations were based on the energy audit report made in 2012 and available electricity figures from 2012 to 2015. There were some inconsistencies in these two reports and some assumptions had to be made. Energy consumption has also decreased during the last few years.

Final calculations were made for six different sized PV plants. The system was designed to be installed on the factory roof. System sizes varied from a 100kWp system to a 350kWp in 50kWp steps. Monthly production for each system and monthly solar coverage percentage was also calculated. Only 300kWp and 350kWp system production was calculated to exceed monthly consumption in January when the processing plant was not in operation. There were also some hourly consumption estimates made but due to consumption data provided only by month, these were thought to be too inaccurate. When taking into account potential decrease in consumption, the recommended system size would be 100kWp. Because the solar PV system prices are going down rapidly and there is no experience with subsidies, network tariffs or permission policies in the Walvis Bay area, the recommendation is to start with a smaller system.

Close co-operation with VTT's EEP project "Fish based biodiesel for Namibia (FIBINA)" and discussions at Merlus showed that the use of fish chum for biodiesel is not a cost-efficient solution. The fish in Namibian shores have low fat content, which is not suitable for biodiesel production. In addition, as most of the chum is not transported to the shore, the ingredient for biogas production is currently too limited.

Fimuskraft Ltd. had a face-to-face business meeting with Merlus in September 2016 to discuss about the possibilities in practice. The applicability of biogas production in Namibia was studied in Teija Järvenpää's Bachelor's thesis. The thesis was published in 2017, and it is available in the online [Theseus database](#).

Changing the inner roof lightning to LED lighting was studied in co-operation with N-Tech. The work consisted of measuring and defining the correct lights for the company's purpose.

Study of the company's carbon footprint was initiated, but was not finished due to time limitations and difficulties in gaining basic operations data. There is an obvious need for energy efficiency in fishing industry. The work is planned to continue in the near future.



Capacity building between stakeholders in Finland and Namibia

As a part of capacity building for Finnish companies, information on Namibian permits and licensing was gathered as well as data on the current capacity of the research areas of clean water, sanitation, energy, housing, waste management, and IoT and ICT. The permits and licences in the logistics sector are not included in this report.

Capacity building processes included also the upgrading of technological knowhow and skills, creating a systematic model for knowledge transfer processes in technology, and developing the local operation environment. The capacity building was realized as several face-to-face events.

PERMITS, LICENCING AND CURRENT CAPACITY IN NAMIBIA

CLEAN WATER SECTOR

There are challenges in collecting and handling data regarding water resources and water management. The capacity to design and develop unconventional water resources is limited, since the considerations and application of data captured through research is poor. To incorporate research to facilitate future planning, there is national Integrated Water Resources Management (IWRM) evaluation.

To take water from the water source and to use water, one requires a license from Water Resources Management Agency (WRMA). In addition, there are tariffs and subsidies, permits and licenses for borehole drillers. The government's approval for work permits for trained people experienced in Integrated Water Resources management is strict.

Moreover, there is a need for legal backup to stop enterprises from polluting, if the enterprise does not adhere to the conditions set out in the exemption permit. Currently, if the permit is not granted or if it is withdrawn, the enterprise can continue polluting with little fear of being penalized or the operations being shut down.

SANITATION SECTOR

To build sanitation facilities, building permits and requests for inspections are needed (e.g. Building Control Division). A permit is also needed for discharging of effluent. As mentioned in the previous chapter, there is also a license to abstract and use water (under Water Resources Management Agency, WRMA).

There is lack of knowledge of sanitation technologies, particularly alternative systems, such as dry sanitation. Funding for water demand management and sanitation capacity building and research is not available.

Structures for reporting status of water supply and sanitation, to support towns in improving their monitoring performance to enable better planning and management at the state level are needed.

ENERGY SECTOR

In Namibia the electricity industry is regulated by the Electricity Control Board (ECB), that submits electricity licenses. The licenses are approved by the Ministry of Mines and Energy (MME). There are also electricity tariffs. For electricity distribution entities, there is an Operating and Reporting Manual (ORM) to determine the amount of tariffs. In addition, foreign energy companies need entry visas to the market. The legislation and subsidy mechanisms related to renewable energy are still under development. Technologies related to solar power (such as photovoltaic panels) need to be exported.

HOUSING SECTOR

There are statutory regulations regarding the sanitation, safety, health and working conditions at building sites and dumping of building rubble. Building permits and requests for inspections are handled by the Building Control Division. It is compulsory to submit a written application to the municipality and wait for their approval. In addition, foreign housing companies need entry visas to the market.

The rising costs of land, building materials and labour have made housing unaffordable for many Namibians in both rural and urban areas. There is, however, a constant supply of land outside of Windhoek to the extent that municipalities are financing such transactions well below inflation rates and commercial lending rates to stimulate demand (some do not offer the same returns of investments as the growing towns).

WASTE MANAGEMENT SECTOR

Capacity to manage waste and control pollution is limited. There is neither data nor proper records of waste management, and there is no tracking system for hazardous substances. That is to say, that organized reporting systems for waste data need to be developed for all towns in Namibia.

Currently, management and prevention of groundwater pollution is based on a permit system administered by the Department of Water Affairs (DWA, exemption permits). Processing Zone Enterprise Certificate is applied from the Minister of Trade and Industry. In addition, foreign waste management companies need entry visas to the market.

IOT AND ICT SECTOR

Namibia's mobile phone network population coverage is approximately 95%. There are more mobile phones than people in Namibia.

For broadcasting services, telecommunications services and network facilities services one needs a license (Broadcasting Service license, Telecommunications Service License, Class Network Facilities Service License).

REALIZATION OF CAPACITY BUILDING

Capacity building processes included the upgrading of technological know-how and skills, creating a systematic model for knowledge transfer processes in technology, and developing the local operation environment.

The capacity building was realized as several face-to-face events:

- Launch event 1st of October 2015 at Embassy of Finland in Windhoek, Namibia, with 34 participants: Keinänen-Toivola, Koivisto, rector of the Polytechnic of Namibia (currently Namibia University of Science and Technology), ambassador Anne Saloranta, local stakeholders, and local media.
- Tekes BEAM Kick-off seminar for new research projects in Helsinki, Finland, 29th of October 2015. Oral presentations by Keinänen-Toivola and Roberts.
- SAMK Ympäristötekniikan perusteet -kurssin innovaatioiltpäivä: case NAMURBAN 2015 and 2016. Oral presentations by Keinänen-Toivola.
- Namibian business delegation in Seinäjoki, Finland, 6th of November 2015 (Keinänen-Toivola, Olenius).
- Field trip to Namibia 18th–28th of November 2015. (Separate travel report has been made.)
- Field trip to Namibia February 14th–March 2nd 2016. (Separate travel report has been made.)
- 1st Finland–Namibia workshop 12th of April 2016 in Rauma, Finland. Minister of Higher Education of Namibia visit to Finland Predelegation (12 persons) of Namibians lead by PS at SAMK 21st of April 2016.
- Field trip to Namibia April 24th– May 6th 2016 (separate report)
- Namibian business delegation with 24 companies and two governmental officials in Finland 16th–19th of May 2016: Tekes, Helsinki 16th of May; FinPro Business Seminar Helsinki, 17th of May; European Maritime Days and Navigate Fair, Turku 18th of May; Seminar, matchmaking event and site visits in Rauma 19th of May. Led by Keinänen-Toivola and Koivisto.
- Brainstorming event in Seinäjoki, Finland, 16th of June 2016, led by Keinänen-Toivola.
- Field trip to Namibia September 25th – October 8th: Finnish Business Delegation and Finnish Education Delegation in Namibia. Keinänen-Toivola led both delegations participating to Windhoek show with a stand.
- Networking lunch at Embassy of Finland in Windhoek Namibia on 3rd of January 2016.
- Welwitchia University meeting in Pori 5th of December 2016.
- Finnish Education Delegation's "Feedback and how to continue" day in Rauma 14th of December 2016.

- Field trip to Namibia in March 26th – April 8th 2017. (Separate travel report has been made.) Keinänen-Toivola, Koivisto, Salahub
- Africa's Urban Future seminar in Helsinki, Finland, 12th of May 2017.
- Africa Innovates! African–Nordic Business Conference 2017 in Helsinki, Finland, 4th of May 2017. Consultant Niels Hauffe in Finland coaching of companies in May 2017.
- Field trip to Namibia: Workshop in Walvis Bay, SARIMA conference in Windhoek Namibia, 14th – 27th of May 2017. (Separate travel report has been made.)
- Field trip to Namibia in September 2017. Final conferences in Walvis Bay 1st of September 2017 and in Windhoek 7th of September 2017. (Separate travel report has been made.) Koivisto, Salahub, Kukka.
- Nordic Innovation Network Seminar: “Urban or Rural? – How does urbanisation effect infrastructure, construction and design in Africa”, in Helsinki, Finland, 22nd of November 2017. (No cost to the project.)

In addition, Internship Agreement between SAMK Faculty of Technology and NUST Department of Civil and Environmental Engineering will be initiated, and the first internship agreed to realize in spring semester 2018.





SWOT

Feasibility study: SWOT analysis

The results from mapping the operational environment and the technological resource efficient solutions were combined. The feasibility study included necessary information about the local business environment and matters affecting it, important networks, detailed engineering designs of resource efficient housing and industry concept, plan for the usage of local labour resources in concept building, such as work force, manufacturing, and co-operation companies.

SWOT analysis was used as a method, to recognize the strengths, weaknesses, opportunities and threats for each sector. Availability of local workforce was seen as a common strength for all areas, as well as employment possibilities in the future. SWOT analysis for all sectors is presented in the following chapters.

CLEAN WATER

STRENGTHS (S)

- Educational campaigns for clean water, organized by the city of Windhoek, have raised awareness among people.
- The government has addressed the issue, and now there are policies and plans for water management. There are various water service providers, local workforce and good local understanding of climate and conditions.
- City of Windhoek has implemented the new drought response plan, which has created major water savings.

WEAKNESSES (W)

- The water management is not adequate, and there are challenges in implementing the clean water policies. The performance of clean water service providers is considered to be weak.
- To protect the limited water resources of Namibia, activities along rivers and lakes need to be controlled by law. Currently the rules are poorly communicated or the laws are missing altogether.
- Water-consuming appliances are not standardized for efficient consumption and resource utilization.

OPPORTUNITIES (O)

- The existing resources could be utilized more efficiently, if water saving technologies were in use.
- Raising awareness about efficient household water use and industrial utilization through educational campaigns and training.
- Water desalination is thought to be an alternative and the best solution in mediating water insufficiencies. This is an opportunity to direct more research and investments in establishing other desalination plants, which may be able to support the growing demand.
- Establishing water reclamation facilities in Walvis Bay – along the desalination plant – would enhance the availability of potable water.
- Authorities could enforce retrofitting the appliances that use less water compared to the current ones.
- Namibia's perennial rivers Orange and Okavango may serve as future water resources for urban areas. These rivers could be used as an additional water supply to remove a burden from the current sources.

THREATS (T)

- Uncontrolled population growth is a major threat to access to clean water, since massive influx of people into the urban areas causes exploitation of water resources.
- Lack of potable water may cause conflicts both within and across borders.
- Extreme weather conditions, such as draught and floods, impact the water sources.
- Currently agriculture along the rivers (Orange and Okavango), and especially the pesticides being used, cause pollution and health problems.
- Activities, such as fish industry, along Walvis Bay coastline contaminate the water and affect the desalination process, and may greatly increase the costs of the desalination in the future.

SANITATION

STRENGTHS (S)

- Knowhow has been gathered during the previous educational and latrine construction projects. The local understanding of best practices is in good shape.
- Sanitation has been improved in most of the informal settlements, which are now provided with some sort of toilet structure and clean water supplies. The quickest way to meet the needs of the communities has been to build shared sanitary facilities.

WEAKNESSES (W)

- Legislation and regulations are not in place, harmonized and communicated well enough. There is currently very little legal backup to stop an enterprise, especially small enterprises from polluting, if it does not adhere to the conditions set out in permits, or if permit is not granted, the enterprise can continue polluting with little fear of being penalized.
- Sanitary “flushing toilets” and adequate potable water supplies are not sufficient for populations in informal settlements as required per demand.
- There is lack of coordination in Water and Sanitation sector. Water and sanitation responsibilities within the government are divided, where urban matters are governed by the Ministry of Health and Social Services, while rural activities are overseen by the Ministry of Agriculture.

OPPORTUNITIES (O)

- Latrine building schemes could be organized and established in urban areas. These could be financed by government or private investors.
- The treated effluents could be used for irrigation, the biosolids as fertilizers for the needs of agriculture, and biogas could be used for energy production.
- There are opportunities to use the biosolids at the wastewater treatment plant as a source of energy for its power-driven engines and operations. The wastewater treatment plant can become energy self-reliant.

THREATS (T)

- Untreated water may cause health issues (communicable diseases, malnourishment), which may lead into epidemics and increased mortality rates.
- Fragmentation of the existing legislative and institutional framework threatens national targets of adequate provision of sanitation. Combined with poor accessibility of water to communities, challenges in provision of sanitary facilities, is a major long-term problem.
- Tested options of sanitation in informal settlements have been temporary solutions thus far. People do not keep the facilities clean, because there are issues of ownership and responsibilities of the maintenance work.
- Environmental pollution from activities along the coast line form a threat for sanitation. The new port of Walvis Bay brings along many marine impacts of increased vessel traffic causing thermal and hypersaline discharges.

ENERGY

STRENGTHS (S)

- High winds in southern Namibia, as well as high solar radiation levels, present strengths in renewable energy generation potential for the country.
- Currently hydro-electricity – with low carbon footprint – is used as main energy generation source.

WEAKNESSES (W)

- Namibia is dependent on foreign energy sources (e.g. ESKOM). This leads into high energy prices.
- There are challenges in getting permissions concerning renewable energy initiatives (e.g. solar panels).
- In the past and current national budget years, there has been a low budget allocation to the energy generation and infrastructure development sector.
- Top decision makers are poorly coordinating the implementation of best solutions for the energy crisis, for which the poorly communicated, ongoing and contradictory Kudu gas project (implemented by the government) is a warning to be heeded.

OPPORTUNITIES (O)

- The costs of many renewable energy technologies have significantly declined in the past decade. Establishment of innovative local value chains would create new local jobs.
- The general atmosphere towards renewable energy use has become more positive. The positive atmosphere has created improvements in the scale and scope of technology. There is good potential of qualified academic and research staff.
- Harvesting of invader bushes represent a significant and potential source for energy.
- Framework conditions for development in renewable energy and energy efficiency technologies, sustainable biomass energy production, and new manufacturing opportunities, could be improved through public-private partnerships.
- Implementation of off-grid solar and wind energization plans for all target communities.
- Increasing own electricity production in Namibia would reduce the dependence on imported electricity.

THREATS (T)

- Structural and institutional impediments continue to constrain the country's electricity sector. The number of load-sheddings might increase in the future.
- The energy shortage might affect economic growth negatively, since without adequate electrical energy, local and regional development ambitions cannot be realized.

HOUSING

STRENGTHS (S)

- Namibia has huge deposits of raw materials, such as clay, limestone, artificial and natural pozzolana, gypsum, building stone and marble, which could replace Portland cement. Locally available materials are already being used in housing construction.
- The city of Windhoek and the municipality of Walvis Bay have made available over 1440 serviced residential plots for landless and house buyers. The increased promotion of homeownership enhances the maintenance of properties, but on the other hand homeownership might be an inflexible housing option.

WEAKNESSES (W)

- Currently there is not enough serviced land for the increased demand. The complexity of land development and the poor land use planning system hinders the housing development.
- Lack of stringent building regulators to allow construction of quality infrastructure.
- The costs of building materials have increased.
- High real estate prices and housing finance costs compared to incomes are creating a wide affordability gap. Lack of regulations causes high rents and inaccessibility to the newly built houses. This creates socio-economic unrest.

OPPORTUNITIES (O)

- To accommodate the town's growing population, the municipality of Walvis Bay will set aside 2700 hectares of land for housing by the year 2030. The improved housing conditions often mean better physical and psychological opportunity to raise one's income.
- A development program in Walvis Bay endorses participation of women in initiating and promoting incentives for green building schemes.

THREATS (T)

- The increased house prices pose a threat to financial stability. There are inadequate service buildings for the growing population, and a growing amount of informal settlements.
- The increased amount of illegal constructions which do not meet the building standards, poses health risks, and results in the creation of slums.

WASTE MANAGEMENT

STRENGTHS (S)

- Local resources are being used as alternative energy sources. For example, the invader bush, that is encroaching the country's farmland, is being harvested, and the fish processing waste is collected.
- There are appropriate waste management plans in Windhoek and Walvis Bay. They see themselves as having the best knowledge of managing waste, where domestic waste, special waste and hazardous waste are deposited in separate landfill sites. Reuse and recycling of waste materials, such as bottles, is encouraged.

WEAKNESSES (W)

- Currently the waste management strategies in the majority of municipal areas are poor, and the unseparated waste is disposed at landfills. There is no separation between hazardous waste and domestic waste, which creates risks for people working at dump sites.
- Landfill security and protection is still poorly addressed, e.g. fencing of landfills is weak, so the scavengers and individuals have easy access into these hazardous sites.
- Existing legal frameworks addressing waste management and pollution control are outdated, and unnecessarily complicated. Many components are not regulated at all, as most of the existing regulations are of South African origin and are no longer appropriate for Namibia.
- There is no national system to monitor trends in waste generation or to provide feedback for continuous improvement and management.

OPPORTUNITIES (O)

- A larger amount of waste leads to a greater potential for income generation through recycling. The formal recycling should be enhanced at the source, as the greatest value of waste is achieved if it is recovered before being mixed with other materials that cause contamination. By appropriate recycling, also the environment is saved from toxic lead and sulphuric acid.
- To improve waste management and control, the training in waste management should be improved. The focus should be kept on monitoring, record-keeping and feedback.
- A composting programme would make a valuable contribution to waste management, as organic waste is rich in nutrients and has high water content.
- The brine, that is disposed by the desalination plant, could be used for agricultural, industrial and domestic purposes, which creates economic opportunities.

THREATS (T)

- Hazardous waste creates threats to the local environment and population, if it is not recycled properly. Surface and ground water gets polluted, as well as the marine environment.
- If the waste management situations in Namibia are analysed by using the extrapolating waste generation data from Windhoek-based waste studies, the possibilities to identify all the opportunities are limited to begin with.

IOT AND ICT

STRENGTHS (S)

- In urban areas, the information connections and availability of latest technologies is good.

WEAKNESSES (W)

- Unavailability of electricity infrastructure in semi-urban and remote rural areas hinder the provision and uptake of ICT services.
- There are limited internet access points in public facilities especially in rural areas.

OPPORTUNITIES (O)

- Wireless connections are one opportunity to keep rural areas populated. ICT could be used in education.

THREATS (T)

- Currently there are no policies, frameworks or strategies in Namibia dealing directly with cybercrime and cybersecurity, but the legislative work is in progress.

LOGISTICS

STRENGTHS (S)

- The Walvis Bay port is an important gateway to Southern African market.

WEAKNESSES (W)

- The transport infrastructure in Namibia is inadequate. The current road network is too old and limited to deal with the growing volume of road freight from Nampont to landlocked neighbouring states on the main trans-corridors, and vice versa.
- In addition, the rail network is outdated. The southern African railway systems are quite weak and running at a loss: the axle loads are small, speeds are low, and transit times long.

OPPORTUNITIES (O)

- The expansion of the port creates opportunities to enhance the logistics sector, employ local workforce, and improve transportation safety in Namibia.
- Efficient transport infrastructure is a key factor to Namibia's economical growth.

THREATS (T)

- Competition from other port-based countries might threaten the growth of the logistics sector of Namibia.
- On threat is the safety aspect of logistics and transportation: accidents or crashes cause human costs, delays, missed transportation connections and huge financial implications.

International aspects and future scenarios

When developing resource efficient solutions, several international aspects need to be considered. These are presented in the following part along with the future scenarios for resource efficient technologies.

CLEAN WATER

INTERNATIONAL ASPECTS TO CONSIDER

- Shared watercourses (Southern African Development Community, SADC)
- Bilateral agreements
- International water related commitments (such as Sustainable Development Goals, SDG's)
- Future need for pipelines from foreign countries

SCENARIO FOR CLEAN WATER SECTOR

- The high rate of urbanization and industrial development will increase urban water demand significantly.
- Old distribution pipelines affect the quality of water supplied.

SANITATION

INTERNATIONAL ASPECTS TO CONSIDER

- Development partners such as the EU, German Technical Cooperation Agency (GTZ) and international NGOs (such as the Red Cross), the African Development Bank
- International commitments (such as the SDGs)

SCENARIO FOR SANITATION SECTOR

- Access to improved sanitation services is lagging behind, especially in rural areas.
- Population distribution and density influences access to sanitary facilities in informal settlements.
- It is impossible for development planners to provide sufficient structures for communities living in a slum organization.
- The quality of sewerage system pipeline especially in the Walvis Bay area poses risks to health.

ENERGY

INTERNATIONAL ASPECTS TO CONSIDER

- NamPower's power supply agreements with the Zambia Electricity Supply (ZESCO) and Mozambique's Electricidade de Moçambique (EDM)
- Short-term energy market (STEM) offered through the Southern African Power Pool (SAPP)
- No binding carbon dioxide emission limits
- Aim for the positive international reputation building in Southern Africa

SCENARIO FOR RENEWABLE ENERGY SECTOR

- The gap between the need of electricity and availability will increase significantly.

HOUSING

INTERNATIONAL ASPECTS TO CONSIDER

- In 1996, The Government of Namibia became a signatory to the Istanbul Declaration on human settlement, and thereby committed itself to the implementation of the Habitat II Agenda and Global Plan of Action, as a full member of the International Organization for Standardization (ISO) and other international standardization organizations.

SCENARIO FOR HOUSING SECTOR

- The number of people living in improvised dwellings or informal settlements is increasing.
- There is a mismatch between supply and demand of housing in Windhoek and Walvis Bay, especially in the lower income groups: less homes are provided for low income populations, whose demand for housing is high.

WASTE MANAGEMENT

INTERNATIONAL ASPECTS TO CONSIDER

- The construction of the Walvis bay harbour will increase international trade, business and maritime activities.

SCENARIO FOR WASTE MANAGEMENT SECTOR

- Inadequate waste management threatens the well-being of the local society and business. People with little income living near landfill sites and working as scavengers in the landfills, are most at risk from exposure to hazardous substances.

IOT AND ICT

INTERNATIONAL ASPECTS TO CONSIDER

- Communications Regulators' Association of Southern Africa (CRASA)
- International Telecommunication Union (ITU)

SCENARIO FOR IOT AND ICT SECTOR

- Usage of ICT devices and services will increase, as well as the electricity consumption.

LOGISTICS

INTERNATIONAL ASPECTS TO CONSIDER

- The port of Walvis Bay is a natural gateway for international trade, as it offers vast and multiple opportunities for strategic partnerships
- Lack of rail networking between Namibia and landlocked countries in SADC
- International standards to consider uniform railways (standard gauge railways) in Africa

SCENARIO FOR LOGISTICS SECTOR

- Poor road and rail connections hinder the economic growth in Namibia.

NAMURBAN CONCEPT AND BUSINESS WITH IMPACT

In NAMURBAN project's fourth work package the key elements for successful concept of resource efficiency were studied. The research question was:

What are the key elements for successful concept of resource efficiency?

To form a successful concept of resource efficiency, the cost-benefits of each sector were analyzed. This chapter consists of the cost-benefit analysis, the performance indicators for sustainability, business opportunities, future steps with SAMK and the Finnish SMEs, and the NEEF legislation (New Equitable Economic Empowerment Framework).

Cost-benefit analysis

The social, economic, politic, technologic, ecologic and demographic drivers were studied to find the gained cost-benefits from using the resource efficient technologies.

Clean water

- When the local resource efficient clean water solutions are in use, operational expenditures of water utilities are lower. The skilled work force is available locally and no more technologies need to be imported.
- The Neckartal dam, assumed to be the biggest in the country, will receive water from the Fish river to produce energy and to create a reservoir capable of holding 857 million cubic meters of water. The water will be used to irrigate and to supply for domestic consumption of the areas around southern and western Namibia.
- The quality of water supplied to communities has proved to be exceptional with no evident complaints made over the years, despite the different treatment methods used across the country.

Sanitation

- With improved sanitation services to communities, the health statistics show huge reductions in waterborne disease prevalence over the years.
- When sanitation facilities are in order, the expenses in the health sector are lower.
- Decreased illnesses may increase households' productivity.

Energy

- The increased uptake of renewable and energy efficient technologies will hedge the country against price escalations of imported fuels.
- Local resource efficient energy generation solutions form long-term energy price stability and decrease non-productive currency outflows.

Housing

- In Windhoek, land costs are maximum one fifth of all building costs. Therefore, the biggest cost components come from the construction process and the materials being used, as modern industrial building materials are transported from neighbouring countries.
- Reduced building costs and the increased use of local construction material reduce the overall costs of housing construction.
- By involving beneficiaries in the building process, up to 40% of the total building costs could be saved.

Waste management

- Recycling reduces waste disposal costs, as the waste is now seen as a resource.
- Decreased use of chemicals, reduces pollution and water contamination, which furthermore reduces costs in water purifying operations.
- Between 1500 to 2000 tons per annum of e-waste is produced on a national level, and between 300 and 500 tons annually in Windhoek. 70% to 80% of those volumes can be recycled.

IoT and ICT

- The high import taxes on ICT equipment need to be considered when developing ICT solutions in Namibia.
- The unit cost of rolling out infrastructure is high.

Performance indicators defining economic, social and environmental sustainability

We formed various sets of performance indicators focusing on three pillars of sustainability: economic sustainability, social sustainability and environmental sustainability.

These performance indicators define a set of qualitative values against which to measure. The economic sustainability related performance indicators include for example cost-effective solutions and maintaining infrastructure in time. The social performance indicators include for example the acceptability of technology, such as reuse and recycling of wastewater, and participation in planned new developments. The environmental performance indicators include for example disposal of sewage sludge and impact to the environment.

CLEAN WATER SECTOR

Economic sustainability

- Sufficient pay for the workers in water industry ensures motivated workers, and motivated workers ensure success

Social sustainability

- Education about good practices, adoption and acceptability (social and cultural) of new water management systems
- Local ownership
- Proper understanding of different working cultures
- Creating a culture of water consciousness in conservation and water quality

Environmental sustainability

- Wastewater reclamation allows huge water conservation benefits by recycling and utilizing less of the natural resource, such as that stored in aquifers
- Ensuring efficient use of available water resources without exploiting them
- Maintenance of water facilities
- Well-constructed monitoring and evaluation process

SANITATION SECTOR

Economic sustainability

- Affordability of products and services
- Sustainable job creation
- Cost recovery
- Sewage waste at wastewater treatment plants for fertilizers production and energy generation

Social sustainability

- Accessibility, adoption and acceptability (social and cultural) of new sanitation systems
- Education on good practices and sharing information and transferring knowledge
- Local ownership
- Proper understanding of different working cultures

Environmental sustainability

- Maintenance of sanitation facilities
- Well-constructed monitoring and evaluation process
- Advocate for timely water safety procedures for immediate response to environmental sanitation stressors

ENERGY SECTOR

Economic sustainability

- Affordability, reliability and accessibility of electricity
- Renewable energy solutions in use, such as solar, wind and bioenergy
- De-bushing: bush biomass can be used to substitute firewood in private households and fossil fuels, such as coal or oil, in industrial boilers and power plants.

Social sustainability

- Affordability of electricity
- The awareness and willingness of domestic users to systematically identify and embrace technologies and activities that have a potential to save energy

Environmental sustainability

- Maintenance of energy production facilities
- New domestic construction and housing development adds thermal and light-efficient buildings
- The condition of the electricity distribution and supply network, and upgrades and investment requirements for its up-keeping

HOUSING SECTOR

Economic sustainability

- The manufacturing of building materials through small-scale industries at different locations throughout Namibia is a feasible option
- Small manufacturing enterprises (small scale industries) should be promoted and supported throughout the country

Social sustainability

- Accessibility, adoption and acceptability (social and cultural) of new housing systems (material, design)
- High-quality and adequate service buildings or public institutions to provide enough services for the growing population

Environmental sustainability

- Use of lasting materials and suitable construction techniques for the local climate conditions (non-flammable material, overheating, extreme cold)
- Use of available local material, and more optimal use of land (building more upwards than sideways)

WASTE MANAGEMENT SECTOR

Economic sustainability

- Adequate rewards in recycling hazardous waste
- Affordability of appropriate disposal of waste
- Capturing of methane at landfills for electricity production, and to power conventional engines and drive electric generators on-site in waste management

Social sustainability

- Education on good practices, adoption and acceptability (social and cultural) of waste management system
- Adequate sanctions and rewards
- Need for health protection of waste management workers and proper tools

Environmental sustainability

- Safe storage systems for hazardous waste
- Landfills should not be located near waterways
- Innovative waste management plans that reduce waste loads and emissions into the environment through reuse, recycle and energy recovery

IOT AND ICT SECTOR

Economic sustainability

- Availability, affordability and accessibility of information and communication services

Social sustainability

- Awareness and understanding of the relevance of ICT

Environmental sustainability

- Control of ICT waste
- Low electricity consumption of ICT devices

LOGISTICS SECTOR

Economic sustainability

- Affordable prices of land for logistics to attract international logistics companies

Social sustainability

- Sufficient education and training

Environmental sustainability

- Safe loading and transportation of hazardous substances
- Energy efficient transportation as well as maintained and upgraded transportation vehicles
- Decreased fossil fuel consumption, e.g. use of electric forklift trucks (instead of fossil fuel) at warehouses

Business opportunities

Although business opportunities in Namibia itself exist, there are limitations due to the relative small population of the country at 2.5 million inhabitants. The country itself is democratic, politically stable, and business-friendly.

Namibia, however, is the entry point to the growing economic region known as the Southern African Development Community (SADC) of 300 million inhabitants. The business opportunities go beyond the energy industry, with Namibian partners willing and able to begin value-added manufacturing, as well as distribution activities into the SADC region, in a varied number of industries with Finnish companies.

A joint venture between the Finnish company Fimuskraft and a Namibian company is well under way. The country has made leaps in the industrialization process, and the exemplary mining industry is state-of-the-art as a global pioneer in various technologies.

The country exudes grassroots entrepreneurship due to the developmental conditions of the country over the past decades: small to medium-sized businesses are growing, with managers capable of taking operations to the next step.

The businesses entering the SADC area via Namibia would benefit from the expertise of SAMK staff, including professional relationship building and business coaching. The knowledge gained from the past years and the development of a useful network provides the support needed to achieve commercial goals.



Future steps with SAMK and the Finnish SMEs

The NAMURBAN project has successfully identified the needs of Namibia's major industries and made recommendations for meeting those needs, particularly by partnering with SAMK and the Finnish SMEs.

The next step should be to identify partners for Satakunta region in Finland and the Finnish SMEs through Procurement Partnerships, which are part of the Namibia's Vision for 2030. Several Finnish SMEs have already shown an interest in exploring the Namibian market. The recommendations for a successful entry into the Namibian market are not only to find suitable partners but also to forge relationships with them. Like in many other countries, personal relations are paramount to engendering trust and a willingness to do business. Business success will require a long-term commitment to the market.

The visits to Namibia have demonstrated that there are a number of willing partners that have relevant needs and would play a role in facilitating entry into the market. This fishing and mining industries are the biggest industry areas in Namibia. Both offer several opportunities for Finnish SMEs.

New Equitable Economic Empowerment Framework

President Hage Geingob's keen desire to reduce poverty in Namibia will no doubt affect potential procurement partnerships. The NEEF legislation (New Equitable Economic Empowerment Framework) that is expected to be tabled soon has the following objectives:

- Ensuring the sharing of Namibian resources in an equitable and sustainable basis by the people of Namibia
- Creating a socially just society
- Implementation of measurable policies of redress and redistribution
- Creating vehicles for empowerment
- Removing barriers of socio-economic advancement to enable previously disadvantaged persons to access productive assets and opportunities of empowerment
- Economic empowerment may be organized in the following forms of ownership: public, private, joint public-private, cooperative, co-ownership, and small-scale family owned
- Equitable empowerment is addressing disparities occasioned by class, gender and generational relationships.

Under NEEEF, all businesses, however small, would have to be at least 25%-owned by “previously disadvantaged persons”, broadly meaning black Namibians. No company would be allowed to “allot, issue, or register the transfer of any portion of its ownership to a person that is not previously disadvantaged or to a domestic or foreign enterprise owned by a person that is not previously disadvantaged”. At least half of all company boards and management would have to be previously disadvantaged Namibians.

Details of the proposed legislation are still being hammered out. For instance, what funding will be available to previously disadvantaged Namibians to enable them the opportunity to buy equity in Namibian companies? How will the legislation affect Finnish suppliers of technology?

At this point, potential investors are keeping a wary eye on developments and a tight hold on their purse strings. The recommendation to Finnish SMEs is to “wait and see” by keeping a close eye on future developments and seizing opportunities as they present themselves.

IMPACT AND DISSEMINATION

Project's fifth work package was to efficiently disseminate the collected information. For example, workshops and conferences were arranged in Namibia and Finland, and both master's and bachelor's theses were done in Finnish universities. The research results were published in scientific papers as well as in publications for stakeholders. In addition, there were other publications, such as videos, newsletters and newspaper articles about the project. Also webpages, social media channels, TV and radio were used to spread the word. All the publications and presentations are listed in the following pages.



Minna Keinänen-Toivola and Anne Saloranta (ambassador of Finland) presented NAMURBAN project on TV in Namibia.

PEER REVIEWED SCIENTIFIC PUBLICATIONS

Savela N., Levänen J., Lindeman S., Kgab, N., Koivisto H., Olenius M., John S., Mashauri D., Keinänen-Toivola M.M. 2018. Rapid Urbanization and Infrastructure Systems Change: Comparison of Water and Energy Regimes in Namibia, submitted to a peer reviewed scientific paper.

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John. S., Keinänen-Toivola M.M., Chisale P., Chirwa P., Mashauri D., Simasiku B., Koivisto H., Tarah T., Matros-Goreses A. 2017. NAMURBAN – Urban Resource Efficiency in Developing Countries. NUST Publications. 28 pages.

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Minna Keinänen-Toivola and Heikki Koivisto presenting NAMURBAN poster in SARIMA conference.

OTHER PUBLICATIONS

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This report provides information about the research work conducted within NAMURBAN project in years 2015–2017. NAMURBAN was a BEAM – Business with Impact -programme research project on urban development using Namibia as a pilot country.

The project focused on efficient use of resources in developing urban areas. The main actions were operational environment mapping, technological resource efficient solutions for urban concept, and NAMURBAN concept and business with impact.

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