

The Challenges of Digitalization at Unije Island

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Abstract: Digitalization and the introduction of new technologies into the everyday lives of islanders is a much bigger challenge than typically implied. The problems are numerous, from insufficient education and “not in my backyard” syndrome to a variety of different external obstacles as well as fixed action and behavioural patterns that make it harder to accept new ideas or initiatives. It is very often a mistake to take a “helicopter” approach to project implementation, where solutions are introduced without more thorough awareness-raising and education of the population, and this creates problems in the context of achieving longer-term sustainability. The example of the Croatian Island of Unije demonstrated in the context of the ongoing H2020 INSULAE project, dedicated to the introduction of innovative energy approaches and technologies on EU islands, clearly depicts what challenges the project team faced and how they approached them in order to reach the project objectives. The problem of technology and digitalization acceptance is common, however, to other small island communities. This paper presents practical experiences from the first phase of the Insulae project gained in interaction with the residents of the Unije and provides expert recommendations for a new approach to the digitalization of islands and calls for a more integrated management of island digital transition.

Keywords: Smart Island; Kvarner archipelago; island digitalization; technology acceptance; information and communication technology

I. INTRODUCTION

The Social Dilemma – while island digitalisation can be quite beneficial, could it affect our lives without us even knowing it?

Today, we are facing a global problem such as climate change, and we are witnessing the need to decarbonize our economy as soon as possible. Decarbonization is an environmental and a security imperative, as the events surrounding the current energy crisis in Europe clearly show. Reaching a climate agreement is just one of the preconditions for adopting renewable energy technologies and other measures to mitigate climate change, especially on islands [1] [2] [3]. Unfortunately, the increase in the use of new solar and wind technologies is associated with significant opposition from various social groups, including lobby groups representing the fossil fuel industry and, unexpectedly - groups of “environmentally” aware citizens. Although new technologies are significantly more effective in reducing CO₂ emissions than any fossil source, there are growing opponents to new infrastructures [4], with difficult-to-understand arguments that are often irrational or purely aesthetic (an example is

the “disruption” of the traditional appearance of an island settlement with photovoltaic panels on the roofs of houses).

Many doubts about the new technologies we encounter daily express people's concern about the changes that will occur in the context of moral values, human health, and environmental safety. But very often, behind these genuine concerns lie deeper but unrecognized or hidden, sociological, economic, historical reasons or banal quarrels [5].

The application of any new technology necessarily leads to controversy. Most controversy is fuelled by uncertainties related to real or perceived risks and real or perceived benefits. Technological controversies do not occur in a vacuum but real-time and space. Perceptions of immediate risks and long-term distribution of benefits affect the intensity of citizens' concerns. As a result, society is more likely to oppose new technology if it realizes that the risks will be visible in the short term and the benefits in the long term. In addition, innovations that threaten to change communities' cultural identities (especially if they are smaller communities) usually provoke more intense resistance to change.

Finally, the non-acceptance of new technologies is often reinforced by the perception that only small sections of society (the elite) will benefit from innovation. At the same time, the risks will be more widespread (to ordinary people).

Why people do not accept technological changes

Human understanding of the role of technological innovation in society is described by three factors [6]. First, historically, technological innovation has been a slow process. Today, many new technologies and engineering solutions are being created faster than society can accept them in economic, sociological, or political terms and reflect changes in legislation or new institutions. Second, such a pace of innovation has far-reaching social implications and creates new types of fears, such as concerns about privacy threats due to mass data collection. Third, globalization further accelerates all this and creates opportunities for the rapid diffusion of new technologies to all parts of the world. This, in turn, creates significant problems in the context of losing local jobs due to the low competitiveness or innovation of smaller communities.

International and local research indicates that a good portion of residents' concerns are driven by their perception of loss, not necessarily by some objective loss. This perception of loss may take material form (financial

or social losses) but may also include intellectual and psychological factors such as loss of local worldview or identity (changing population structure or using new technologies).

In the absence of understandable explanations or reliable authorities, individuals usually return to intuitive answers that seem irrational but reflect patterns of automatic behaviour that rely on phobias from previous experience (unfulfilled promises of the local or regional government, etc.).

A particular problem is the spreading and accepting untruths that spread through social networks [7]. For example, unfounded claims are that installing smart meters based on NB IoT or 5G technologies causes many problems. It is stated that "Smart meters increase bills (?), affect health, violate security and privacy." It warns that "Children, pregnant women, the elderly, people with immune deficiencies, health conditions, pacemakers, and implants are particularly vulnerable to new technologies." Psychological problems are also mentioned: "Smart meters can help you monitor your energy consumption - but always be aware of how much you spend has a downside, especially for older people with fixed incomes. Some may feel anxious as they watch the numbers rise, panic, and turn off the lights and heat to save money." [8]

Paradoxically, some of these fears are being spread by monopolistic service providers due to increasing public involvement in utility (cost and quality) control.

Attempting to counter myths or use scientific evidence about a community that relies on such psychological or cultural responses has been shown only to reinforce or even proliferate previous beliefs.

II. PROJECT APPROACH

In the first phase of the H2020 island decarbonization INSULAE project [9], a series of workshops were held to explain the methodology and expected results of the project to the islanders [10]. The goal was to establish a platform that will enable field data collection from households, their analysis, and future energy production and consumption planning. As a result, the Smart Island platform based on IoT technologies supported by AI analysts was developed within the Ericsson NT pilot project activities. The basic scheme of data collection and sharing is shown in Figure 1.

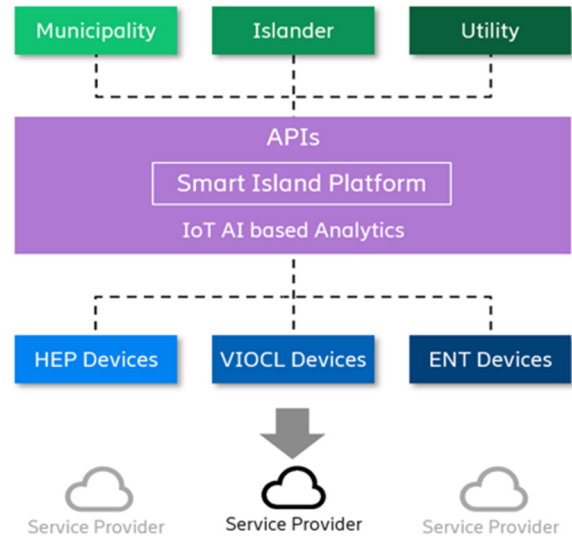


Figure 1. Smart Island Platform

The platform is implemented in the Cloud (AWS). In family houses, appropriate measuring and control devices and sensors have been installed that exchange data with the central platform via 4G and NB IoT communications. Islanders have at their disposal a user interface (WEB) through which they can get all the information about energy consumption in their household (both real-time and historical data). The basic elements of the interface are shown in Figure 2.



Figure 2. INSULAE user interface

The data collected in this way, depending on the number of installed sensors, enables the profiling of each household, and the result depends on the number of installed sensors. Ideally, each consumer in the household should be able to measure the quality and quantity of energy delivered. In addition to the characteristics of equipment, household profiling also reveals patterns of

behavior of household residents, which is an important piece of information in the context of future forecasting of energy consumption in the community and management and automation within the household.

The schematic diagram of the process of data acquisition and analysis is shown in Figure 3

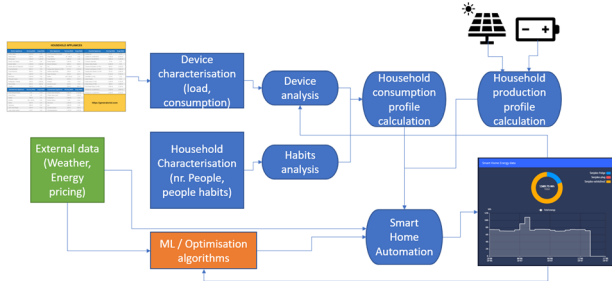


Figure 3. Household profiling diagram

In the case of the Insulae project on the island of Unije, we adopted methodology proposed in [11] and [12] to distinguish five steps:

- Step 1. Identify household variants by mapping all connected devices and their characteristics and behaviours (e.g., washing machine characteristic and usage).
- Step 2. Determine objectives (e.g., energy resilience vs. energy-efficiency and cost reduction).
- Step 3. Analyze user needs for specific application scenarios (e.g., elderly people permanently living alone in Unije, an active, young married couple occasionally arriving on Unije, a young family with children in like to move to Unije, etc.).
- Step 4. Create a well-founded model of the Unije households and use case scenarios.
- Step 5. Perform a cost-benefit analysis of the proposed approach for participating islanders.

Of course, this is also the source of potential privacy problems because one can learn a lot about an individual household from such a profile. In the case of Unije, encryption and anonymization have been realized so that only the owner of the data can view detailed data. For analytics, the data are primarily interested in the aggregate state.

Based on captured data, typical "households" modelled are represented by three of the most typical cases in Croatia and Unije (both islanders or tourists) - as presented in Table 1[13]:

- A middle-aged family composed of 4 people (parents and two children), where parents' age ranges from 30 to 50 years old (partially resident).
- An elderly couple, where both has over 65 years old (mostly resident).
- A young single traveller whose age ranges from 24 to 40 years (nomadic user).

TABLE I. HOUSEHOLD CONSUMPTION PROFILES

Scenario		Consumption (kWh)	Production (kWh)	Cost (kn)	Savings (kn)
Middle aged	AS-IS	224	0	196	0
	Scheduled	216	0	162	34
	Optimized	216	0	183,6	12,4
Elderly couple	AS-IS	176	0	154	0
	Scheduled	168	0	126	28
	Optimized	168	0	142,8	11,2
Single	AS-IS	168	0	147	0
	Scheduled	160	0	120	27
	Optimized	152	0	129,2	17,8

Using the obtained household models, different types of simulations were created, enabling a more precise understanding of energy flows on the island and thus the last phase of the project - energy autonomy and self-sustainability of the island.

The following scenarios were simulated:

- AS-IS scenario: It represents the current situation (i.e., people living in a household have their standard behaviour).
- Scheduled scenario: Users exploit the simple energy management functionalities like the smart device scheduling when energy is cheaper.
- Optimized scenario: Users fully use advanced energy management service driven by optimization algorithms and ML/AI capabilities. This scenario brings the greatest benefits, but the user cannot use appliances at will.

Ultimately, estimates of potential energy savings have been made, but the following shortcomings should also be considered:

- Small data sample for now (number of connected appliances and total time we were able to capture data).
- Data capture started late in the project
- Reliability of data communication is not sufficient in some cases, leading to technical issues.
- Devices not active all the time (homes closed at the end of the season – energy disconnected), several islanders not willing to participate due to privacy concerns.
- No household energy production at his stage.

All the above resulted in a relatively weak islanders' acceptance of the Insulae technological solution and platform, which certainly needs to be improved by the end of the project. It should be noted that all these activities took place during the two-year Covid-19 pandemic, which posed substantial organizational, logistical, and technical problems. We believe that this fact has significantly contributed to the project's status, given that most of the time, the project members could not be physically present on the island.

III. RESULTS

Based on several workshops and interviews conducted (partly unstructured during the installation of household equipment) with Unije islanders [13], their comments, and

fears regarding digitalisation of their houses could be grouped into the following categories and fit surprisingly well into some general characterizations [14]:

Loss of control. Change affects our autonomy and makes people feel like they have lost control over their property or privacy. When faced with potential change from others, our sense of self-determination is often the first thing we need to know.

Do I want my refrigerator or heater to be controlled by AI?

Excess uncertainty. If the change is vague or incomprehensible to them, people will reject it. People will often prefer to remain trapped in a bad situation rather than move towards an unknown better future.

If I let AI run my dishwasher - will the dishes be washed?

We don't like surprises! If decisions are imposed on people suddenly, without preparation, without time to get used to the idea or face the consequences, they generally resist. It is always easier to say "No" than "Yes".

They come from the mainland for a couple of days, do something quickly and then leave. Why would they accept that?

Everything looks different. Changes always bring something new, but how different is it? We humans are beings out of habit. Routines are slowly becoming automatisms, and change disrupts those routines, sometimes in awkward ways. Too much difference is not acceptable to most.

Why would I change the way I use home appliances for some vague or minimal benefit?

Loss of identity. Change is a departure from the past. When that change involves a major change of strategic direction, the people in charge of the previous direction fear the perception that they have certainly made the wrong decisions. Parts of the past that are worthy of respect and that make it clear that the world has changed need to be preserved. This makes it easier to let go and move on.

The new solar power plant will change the look of the place and ruin it forever!

Competence concerns. Can I do that? Do I understand new technologies? People usually resist change when they feel stupid or uneducated. They express scepticism about whether the new technology will really work or whether the smart home is worth the investment, but at the same time they are worried that their skills for accepting news will be insufficient or provoke ridicule.

It looks nice to you, but I don't understand it, and I don't care, I don't have time to study!

More work. There is a universal challenge here. Change is really (maybe) more work - but only initially. Once new technologies are mastered, there is usually significantly less work around maintaining or performing some activities.

I wouldn't do that; it's too complicated, you're just giving me more work!

Wave effects. An important acceptance problem, which in most cases spreads in waves, from so-called early acceptors to more sceptical users. A critical mass of acceptance of a solution is needed; when it is reached, expanding the implementation is not a problem. If it is not reached - the project fails.

And I hear you installed it at Marko's. Can I get involved too? Or: I wouldn't be the first, put it elsewhere, and if it passes, then I would get involved too!

Past anger. The ghosts of the past "never sleep". When life goes on normally, they remain hidden. But at a time when the cooperation of the locals is needed for something new or different; the spirits wake up abruptly! Old wounds are reopening, quarrels over the borders of estates, historical resentments against local or regional government are remembered - sometimes it goes back generations, such as confiscating land in previous regimes and the like.

What will this smart island do for us, when you haven't solved anything else before - we don't have children at school (!) We don't have an airport, the breakwater is not working and the sewage system, the lighting is shining...

Sometimes the threat is real. Now we come to the part where we talk about the middle ground. People are resisting change because it can really hurt. Data about us can be stolen or misused, technology can be more corrupt, our homes can be more complex and expensive to maintain. When new technologies displace old ones, jobs can be lost; prices can go down; investments can be erased, new players come - maybe future residents.

We want the Unije to be as they used to be. We will not change!

Meddling with nature does not protect nature

Our current definition of prosperity is measured by high levels of individual affluence, resource use, and educational levels, all of which often come at an unsustainably high ecological expense [15]. Some indicators are at a more advanced stage than others. For instance, measuring progress in natural regeneration is not comparable with data on household consumption or gender equality. A significant problem with digitalization is that technology can work two ways: helping preserve Nature and bringing it down to its' knees. People often don't see the results from "meddling with Nature" immediately, as it takes a couple of generations long. Therefore, having the climate crisis on our doorstep, the proof of mistreating nature's ecosystems is more apparent every day, having people think more about nature protection.

After the industrial revolution was heavily dependent on iron and coal, today's digital age is increasingly leaning towards renewable energy sources like wind and sun. Nature protection is dual: how much we use it and how much we protect it. Protecting our climate and the nature that surrounds us is the basis of the progress of our civilization and the human right to a healthy life and environment.

The digital revolution is directly relevant to the social practices and organizations concerned with nature

conservation. New technologies offer significant potential for better protection of the environment. The UN and EU frameworks are consistently pointing to this potential. For instance, the Convention on Biological Diversity (CBD) [16], signed in 1992 at the Rio Earth Summit, calls upon its contracting Parties to promote scientific and technological cooperation in the field of conservation and sustainable use of biodiversity. Furthermore, in line with strategic and legislative framework outlined above, the EU is continuously working on developing new financial tools to promote research, education and data collection on nature and environment protection, such as Horizon 2020, European Structural and Investment (ESI) Funds etc.

Experts in the nature protection sector often see today a behavior where some people tend to disapprove of digitalization and prosperity in the name of nature and environment protection; the argument is that every meddling with nature is destroying nature. Leaving nature untouched is the only way to protect it, which is no longer possible. It used to be that people who refused to use a lot of technology were the ones who were more "ecologically" oriented. Today we see a switch in human behavior where young people enjoy nature's fruits, promote a sustainable lifestyle, and use laptops, mobile phones, and a lot of data, energy, and natural resources. Some people don't see other types of technology as nature conservation means; instead, they see it as destroying the landscape and species. For example, during a direct communication with one of the house owners on Unije, the interlocutor expressed a clearly negative opinion on solar plant and desalinization plant as a way to destroy islands' tradition and nature, not as a good investment in peoples' wellbeing, assuring water and energy. At the same time, whenever there is a power and water shortage, locals go to their community district representatives and ask for a change in the supply system.

A way to change how people perceive nature and environmental protection is to inform them more on how sustainability and use of technology isn't a way to destroy nature but to protect it and achieve the goal of fighting the climate crisis and stopping extinction. Leaving nature as it is won't stop the crisis. It is necessary to use any means possible to tackle the problem, such as protecting nature (e.g., protected areas) and using technology in hand. By investing in the development of existing and new technologies that would enable a complete transition to sustainable energy sources, as well as changes in behaviour, only then would environmental protection take the right shape that's needed in order to save the planet.

In June 2019, following the INSUALE Focus group meeting, the locals at Unije were surveyed to obtain their perception of the energy developments on the island. The results showed that Unije inhabitants are more sensitive to water saving, making significant efforts to save it in their everyday life, which meant that some extra effort would be needed to explain the benefits of energy-saving and digitalization [13]. Additional surveying was conducted in June 2021 as part of the master thesis research [17] with the participation of not only permanent residents of Unije (80 % turnout) but also the occasional residents, i.e., people with property on the island but who visit the island occasionally. This questionnaire was focused on "the public attitudes towards the current 'Unije Self-Sufficient

Island' action plan, the willingness of locals for a more active personal engagement (financial investments, change of energy-consumption habits, taking part in island energy cooperative), and actions that could increase the overall public support towards the island energy transition." [17] It was concluded that the islanders are generally supportive towards RES technology implementation, even though what concerns them is the fact that it might affect the island's natural landscape and cultural authenticity. Still, they recognized the need for some social improvements, like the more continuous project communication, better risk management, stronger involvement of locals in projects' activities as well as the more tangible endorsement of renewable projects from the local government [17].

IV. CONCLUSION

The adoption of new technologies is largely a process of social learning [18]. Educating the general public plays an important role in determining the manner, speed, and methodology of adopting new technologies. Understanding the benefits and risks of new technologies will not be complete without considering the intuitive aspects of human psychology. Promoters of new technologies are mainly focused on rational and scientific arguments and practical technical solutions. However, as experience with the Unije shows, "social, ethical and particularly emotional" factors can be decisive for the adoption of new technologies. Recognizing the wishes and needs of the local community should come first and is, therefore, more important than a mere rational and technically optimal narrative.

Accepting innovation is not a rational process. Behavioural science has identified three main factors that trigger the psychological challenge of innovation:

- People's reluctance to break away from existing habits or routines.
- Perceived risks associated with innovation.
- Attitudes of the general public towards the subject of technology.

Contrary to expectations that may be appropriate in the first half of the 21st century, people do not rationally assess the risks and benefits associated with each new technology and do not make a decision based on that analysis. Instead, decisions are made emotionally, like deciding which party or politician will represent us.

The strategic document "Unije Self-Sufficient Action Plan" was created ten years ago, and survey results have shown that some of the actions contained in this action plan have really low support from the residents [17]. Thus, the measures outlined in this document should be re-examined in collaboration with the locals to fit their needs better [17].

There is also a need to create an appropriate transition narrative. The islanders should be well adequately informed about the benefits of digitalization and the introduction of new technologies. Bridging the gap between the new technology and society turned out to be a necessity, requiring the collaboration of both technical and social experts [17]. Of course, the technicians know how RES technology works and what are its pros and cons. Still, social experts could be better communicators,

bringing these technical topics closer to the (often elderly and digitally less literate) island population.

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