SUSTAINABILITY: THE REAL COST OF DEVELOPMENT IN PUBLIC SERVICE MEDIA

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ABSTRACT

Public Service Media (PSM) is one of the many industries having to rethink their development methods to reduce their environmental impact. But how do you reconcile market imperatives with environmental ones in the development of new PSM services? The answer has often been to focus on increasing technological efficiency, with the unintended consequence of a rebound effect, in which efficiency with the purpose of decreasing consumption actually results in the opposite effect.

This paper proposes a different more holistic approach. We deconstruct the full cost and impact of technical development in our industry, and address the issue of rebound effect. We then discuss recent technical design and engineering approaches based on notions of leanness and simplicity, learnings from unexpected collaborations amongst different sectors, which could be applied in the context of PSMs, and even - as a positive side-effect and in conjunction with green organisational policies - help support their public service values and public remit.

INTRODUCTION

According to the 'Oxford Dictionary (1)', sustainability is "the use of natural products and energy in a way that does not harm the environment." The 'Brundtland (2)' Report highlighted the three concepts and interconnectedness of economic, social and ecology. This three-dimensional notion was popularised and used as the basis of the 1992 Earth Summit in Rio de Janeiro. The three pillars express the following 'My Climate (3)':

- Economic, social and ecological concepts are interconnected. The actions of public and private stakeholders cannot be considered as isolated, one-dimensional aspects; instead, one has to consider the interrelationship between them all; environment, economy and society.

- Sustainable development is more than just environmental protection. To satisfy our material and immaterial needs, we require economic well-being and a society based on solidarity.

- The effects of today's actions on the future have to be taken into account so that future generations needs are also satisfied.

- Sustainable development is a long-term structural change in our economic and social system thinking, with the goal of decreasing environmental and resource consumption to a sustainable level whilst maintaining economic performance and social cohesion.

'Investopedia (4)' takes the three-pillar sustainability concept and moves it further into how enterprises can utilize them. Sustainability encourages companies to frame decisions operating the three pillars impact for the long-term, and not only on short-term gains such as the next quarter's revenue report. It influences them to contemplate more factors than simply the immediate profit or loss involved. Increasingly, companies have issued sustainability goals such as commitment to zero-waste packaging by a target year, or to reduce overall emissions by a certain percentage.

Although the previous paragraph seems to point at profit making organizations only, the same rhetoric can also be applied to non-profit organizations, including PSMs. Regardless of organization status, finance and sustainability are interconnected. Finance is a scarce resource in all organizations, however, PSMs also have a public duty to uphold, and be leaders in sustainable initiatives.

The Future Laboratory produced a ranking system called The Three Tiers of Sustainability 'Vijayan and Kamarulzaman (5)' for stages of sustainability in organisations and their supply chain of operations, from extraction of resources to waste disposal and including manufacturing, media production, and user consumption. In this ranking, the lowest tier 1 is 'getting the basics right' (i.e. focusing on taking basic measures such as office paper recycling or switching lights off at night), tier 2 is 'learning to think sustainably' (start to apply sustainable thinking in supply chains of operations), and tier 3 is 'the science of sustainability' (where techniques such as auditing and benchmarking are used to provide a framework to sustainable governance).

The media sector - much like most other industries - has not yet fully engaged in the necessary transition to sustainability and finds itself in between tier 1 and 2, when it should ideally position itself on tier 3. The industry's approach is still geared towards innovation and growth as first priority, rather than reducing its footprint on the environment. This is of course problematic from the environmental impact perspective, as recent studies 'Bihouix (6), Halloy (7), The Shift Project 1 (8)' have shown the important impact of the digital sector on the environment, in terms of energy and material resources consumption: from energy-hungry applications and rapidly obsolete digital hardware, high data-volume streaming services, server farms, and production equipment. Reciprocally, this also contributes to environmental changes that jeopardises the future of PSMs, as the infrastructures that media depends upon are themselves becoming increasingly vulnerable to the effects of climate change and environmental destruction 'Goodier (9), Lozano (10)'.

Facing the environmental crisis, the temptation is often to try to engineer more energy-efficient solutions, operating under the straightforward assumption that a technology consuming less energy on a machine/device-level means decreased environmental impact. However, this assumption is erroneous. As observed since the industrial revolution, the energy savings resulting from an efficiency-based approach always lead to a fast increase in consumption of material resources and as a net result: an increased negative impact on the environment. This is known as the rebound effect, or Jevons Paradox 'Jevons (11)'. Just like the invention of more efficient steam machines led to an

explosion of their use throughout that era's society, and therefore an explosion on the use of coal instead of its intended reduction, our energy-efficient LED screen technology has led to an explosion of screens in today's society: screens that require material mined from finite sources and contributing to the destruction of the environment.

How do we then plan the necessary transition to more sustainable PSMs and secure our services for future audiences while avoiding this pitfall? We argue that the answer is three-fold: 1) in media technology design, 2) in management, and 3) policy. Following recommendations from 'The Shift Project (8)', we advocate for a more "sober" approach to media technologies development, based on leanness and simplicity. Sobriety in technological development is in a way the opposite of efficiency: Instead of trying to aim for maximum features for minimum energy consumption, the idea is to decrease complexity and rethink whether the feature is really needed or not in the first place, whilst trying to opt for lower tech solutions that rely on existing infrastructures and devices rather than new ones. We should also look for creative, mutually beneficial collaborations with other sectors that help them become part of the same closed loop of production, consumption and waste. Last but not least, organisations should include sustainability in its core vision and mission, and make it a priority in their KPIs.

Below we deconstruct the full environmental cost of various aspects of the media industry, and discuss possible ways to solve these issues, using the approach proposed above.

ENVIRONMENTAL COSTS OF THE MEDIA INDUSTRY

In the public service media industry, three domains that bear the biggest impact on the environment are: buildings, servers and streaming.

Buildings

As many other large-scale organizations, a large part of PSM's energy consumption comes from its buildings and their operation. According to 'Davies (12)', a typical US commercial building uses about 22.5kWh/ft2 (= 242.2kWh/m2), with the following approximate breakdown (see Figure 1):

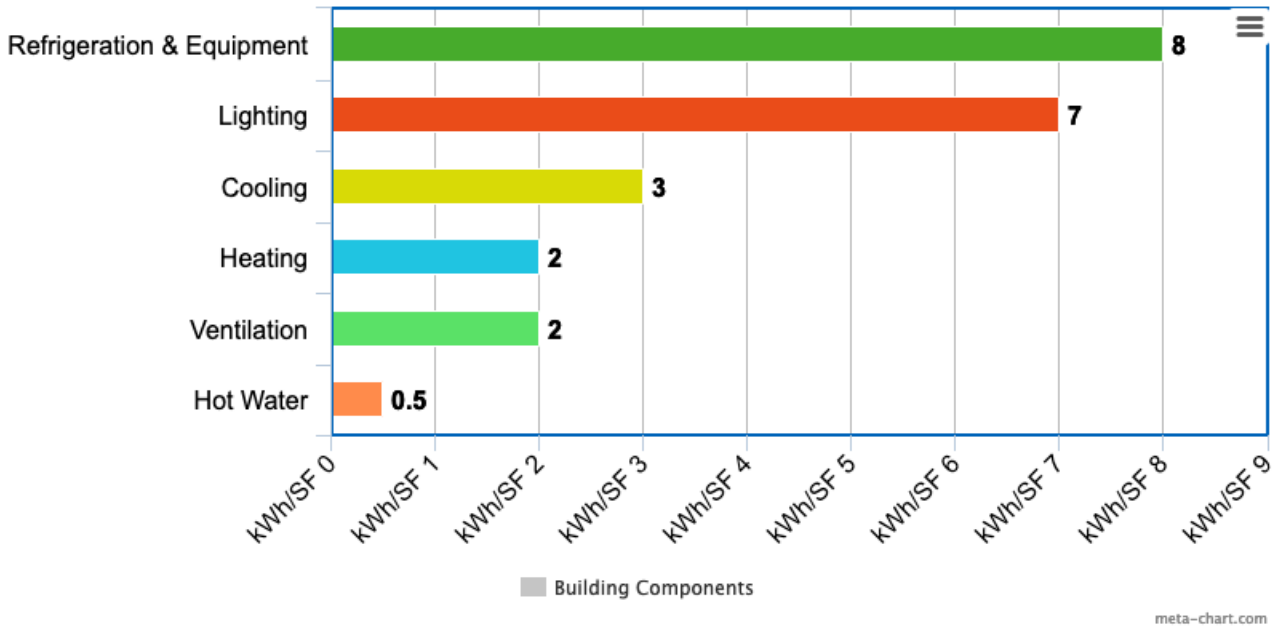

Figure 1 - Energy consumption breakdown 'Davies (12)'

The difference with PSMs is that part of their building spaces - such as newsrooms - are used for almost 24 hours a day. One broadcaster generally also spreads across multiple buildings. Therefore, the amount of energy consumed just by one broadcaster can be significant. For example, a medium-sized PSM European broadcaster building of 270000 ft2 (approximately 25000m2) (based on the half size of the TVC BBC), will consume 48m kWh (i.e. approximately 2000kWh/m2) per day during the traditional office hours of 9am-5pm alone, not to mention out-of-office hours and additional buildings. These figures would be approximately 10 times higher than a typical commercial building, before looking into the extra energy cost of office technology, e.g. 24/7 data centres, or studio equipment.

As most PSMs have been in existence since at least the 1950s, in some cases longer, they will typically have gone through changes and updates on their buildings a number of times. Some move into eco-buildings as a way to reduce these energy costs and incorporate the latest sustainable initiatives as much as possible. For example, the PSM ORF reduced their costs by optimising the operating time of air conditioning, replacing the bulbs to energy saving lights, implementing global energy measures in their studios, and by reducing the use of air and water cooling. Similarly, RTS's new building will be constructed following the Swiss 'Minergie-P (13)' standard on building energy performance: this will reduce the broadcaster's energy consumption and CO2 emissions in operation, improve waste, water and heat emissions, and will be using of renewable sources of energy, roof solar-panels and LED light fixtures among other measures. 100% renewable energy (EPFL heat pump using lake water).

Although these measures greatly improve the energy efficiency and cleanness of the buildings in the long term, they still require the construction of an entire new building and of a new set of building infrastructures, which in themselves have a considerable footprint. Could such ecological improvements be done on existing buildings? How long should a

broadcaster stay in a particular building for the move to be worth it from an environmental perspective?

In terms of the buildings, there are a number of projects underway, however the authors of this paper are sure the current pandemic crisis will have some lasting effects on the topic of work buildings. Many organizations will be researching on working from home or remote working becoming the new norm. It is too early to speculate; however, we can be sure it will have some effect.

Data Centres

Data servers are notorious energy consumption black holes 'Andrae and Edler (14), Jones (15), Marasi (16)'. However, advances in power efficiency have mitigated their originally predicted eruption in energy consumption 'Patrizio (17)'. The actual increase in global data-centre energy consumption over the past decade is negligible in terms of environmental impact compared to the rise of workloads and deployed hardware during that period.

Data centres accounted for approximately 205 terawatt-hours of electricity usage in 2018, (about 1% of all electricity consumption worldwide) a 6% increase in total power consumption since 2010. Meanwhile, data centres compute instances increased by 550% over that same period 'Patrizio (17)'.

The reasons for these manifestations are that hardware power efficiency has improved. The move to server virtualization has resulted in a six-fold increase in compute instances with only a 25% increase in server energy use. The move to faster and increased energy-efficient port technologies has brought about a 10-fold increase in data centre IP traffic with only a modest increase in the energy use of network devices 'Patrizio (17)'.

Some of the methods below are often added to help reduce this energy consumption 'Marasi (16)':

- Reduce cooling dependencies - optimizing and streaming airflow. Clean workloads and remove unnecessary equipment. Consolidate virtual machines. Remove old equipment and replace them with efficient technology. Use new air economizers. This needs to be looked at into detail, to see if buying new greener equipment outweighs the throwing away old equipment and its environmental impact, e.g. how long will it take the old equipment to decompose to a point where it no longer has a footprint.
- Experiment with optimizing temperatures.
- Identify and remove zombie servers.
- Find energy saving partners.

PSMs tend to use the above ways to reduce energy consumption and to help reduce costs. One might think that this increased efficiency has a positive impact on data centres' overall environmental footprint. However, this is where the rebound effect can come into play. Energy-efficient and therefore cheaper computing power coupled with increasingly cheap to manufacture components, means that there has been a significant increase in data servers being used globally, and therefore an explosion of the total amount of materials used to physically make them 'Bihouix (14), Halloy (15)'.

Moreover, merging digital technologies, e.g. machine learning, blockchain, 5G, and VR, are likely to further accelerate demand for data centre and network services. Studies have begun to look at the potential energy consumption and emissions impacts of these technologies ‘Marasi (16)’.

Streaming

A number of recent studies have put a spotlight on the environmental cost of audio-visual content streaming, most of them focusing on Netflix and YouTube, among the largest services. According to ‘Kamiya (18); streaming a 30-minute show on Netflix releases 0.028 - 0.057kg CO2e (equivalent of driving 200m in a car), whereas ‘The Shift Project (19)’ calculates this to be 1.6kg CO2e (equivalent of driving 6.4km in a car). Although the carbon footprint of streaming video remains relatively modest according to Kamiya, both Kamiya and The Shift Project expect the overall impact to rise, given the exponential increases in usage. The ease of accessing streaming media sees a rapidly rising overall video streaming consumption and carbon footprint.

However, the main crux of media consumption’s carbon footprint is not in media consumption itself but in the manufacturing of the devices as well as setting up and maintenance of the infrastructures that allow for this media consumption to happen. These require material resources that need to be mined or pumped out of the ground, manufacturing processes that consume a large amount of energy, transport of goods and so on. Finally, at the end of the cycle: disposal of electronic equipment that are filling landfills. These processes that are for the most part invisible to the consumer are the most environmentally-speaking heavy processes.

For instance, with the sudden global increase of streaming during the COVID-19 crisis due to lockdowns, there have been attempts to reduce streaming data footprint and burden on infrastructures by reducing default video resolution or switching off video-images for users using YouTube only for music listening. Results from similar previous experiments have not shown the expected drastic reduction of footprint of streaming media ‘Priest et al. (20)’, as the reduction for switching off video only reached at best 5% compared to not using these tricks. Nevertheless, when multiplied across the number of streams these small changes could become worthwhile.

On-the-fly streaming encoding depending on quality of content using AI can reduce CPU power by switching to the lowest “good enough” encoding rate. It is estimated that this use of AI has reduced CPU usage by 30% ‘Diascorn (21)’ and even increased Quality of Experience (QoE) for viewers. However, AI use means AI training, which can become extremely energy consuming, therefore as with all technological innovation, these claims of power saving need to be substantiated holistically by including the entire footprint of the process ‘Ekin (22)’.

It is becoming more likely that efficiency gains of current technologies may be unable to keep pace with this growing data demand. To reduce the risk of rising energy use and emissions, investments in R&D for efficient next-generation computing and communications technologies are needed according to some, however, the authors believe that organizations need to find ways to reduce the amount of energy required to power new machines, reduce investment in purchasing new equipment for old equipment

to be thrown away to result in increasing landfills. We need to move towards a circular economy.

SIMPLICITY, COLLABORATIONS AND POLICY

Based on the discussion above, we argue that the current approaches used by PSMs to reduce their environmental impact is insufficient and can even lead to rebound effects (23), 'Owen (23), Gavin (24), Gossard (25), Santarius (26)'. This leads to the inevitable question: Do we really need all this? How much technological innovation do PSM actually need to fulfil their remit? Could we aim for a more "sober" development and use of technological innovation? 'The Shift Project (8), Godwin Paccard (27)' Could solutions be found in other sectors through creative ways to help them and ourselves "close the loop" in terms of lifecycle? Should we perhaps even establish policies to bridle our thirst for "bigger, stronger, better" and keep our activities to a more sustainable level?

For a Simpler and Leaner Approach to Digital Technology

A leaner approach means aiming for reduced complexity. A complex system, however optimised, will always consume more than a simpler one 'Detcherry (28), Monnin (29)'. We propose that PSMs should move to the 3rd tier of the Three Tiers of Sustainability, and establish an inventory of their immediate and future needs and of low-level tools and up-coming technologies they plan to use to fulfil these. Then develop metrics to measure the impact each of these technologies might have both on the energy and material plan, and in their entire lifecycle, in order to determine whether using these are worthwhile or if there is a simpler, less complex solution - and therefore intrinsically using less resources - available that could accomplish the same service? These types of evaluations are not uncommon in PSMs and other organizations but are typically geared towards cost-reduction. We propose to follow a similar approach, but with overall reduced environmental impact as a target and main criteria. Not just at the point of use, but in the entire supply chain including manufacturing, production, waste disposal, buildings footprint, etc. Some PSMs already use the concept of a minimal viable product (MVP) as part of the software development methodology, and this takes it one step further into getting to the roots to truly focus on the concept to include the idea of minimalism on many levels, e.g. reduce energy consumption, simpler functionality and minimising the heaviness of the code base.

One such example from other digital sectors are public service applications that give access to public transportation or public service information: Do such services need to be provided as an application or could text messaging be used instead? Besides the accessibility advantage of using the lowest common denominator in terms of available technology in a population with varying means, and the sturdiness of the infrastructure that this technology relies on, using text messaging also means that older devices (brick phones) are still usable and given a longer lifespan instead of being made obsolete. Public transportation in Geneva, Switzerland for instance allows passengers to purchase tickets via text message, whereas the same public service in Gothenburg, Sweden now relies on owning a smartphone with the latest OS which cannot be installed on older smartphones. In the context of PSM, such considerations could be taken about current applications that survey public opinions or allow them to call in radio/TV programmes.

Another example of such sober, simplified approaches is to be found in web design, illustrated by the work of Gauthier Roussilhe and of the online publication Low-Tech

Magazine. Roussilhe promotes a design approach where ecological considerations are the main design priority ‘Roussilhe (30)’. This manifests in his websites that counter the current trend of increasingly bloated websites: they use plain text, dithered images with lower resolution and simpler colour palette, and none of the now ubiquitous power-hungry features found in regular websites, such as cookies or visitor analytics. This makes these websites much lighter in data usage and reduces their data footprint in servers. They can even be hosted on low-tech servers made of very little components, thanks to their simplicity ‘Roussilhe (31)’.

Figure 2 - Screenshots from Gauthier Roussilhe’s website

Taking one step further, the solar version of Low-Tech Magazine is a website of similar lightness that is even hosted on a solar-powered server in Barcelona ‘De Decker (32)’. This means that if the local weather has been cloudy for a few days, the website is temporarily no longer available, until it becomes sunny in Barcelona again and the battery can recharge. Although extreme and not applicable for all, this approach is interesting in how it questions the notion that websites need to be always online and available, the relevance of the promise of an “always-on” digital world and the inevitability of its resulting footprint.

Creative Collaborations with Other Sectors

One PSM activity that seems to evade the rebound pattern in their sustainability approach (although not necessarily reducing their carbon footprint) is the construction of new PSM buildings. This is partially due to the larger timescales of their design and of city infrastructures they rely on, which are more immune to quick consumption turnarounds. If managed right, they can also exemplify successful collaborations among sectors. Similarly to how RTS uses water from the lake to cool the server rooms, one case of such collaborations for instance that is of interest for PSMs in relation to the physical issue of hosting data servers, is how some server farms in a number of European cities have been placed at the basement of accommodation buildings, office buildings and green houses as a source of heating for these spaces ‘Widrat (33)’. This example shows how thinking outside of the box and reaching out to other sectors – real-estate in this case – can inspire new mutually beneficial solutions, both environmentally and economically: closing the loop. The waste products of one activity (the heat generated by the servers), becomes a resource for another (accommodation heating). Can more such transformations of one

sector's waste be turned into another sector's resources, and can one of these sectors be PSM?

Policies for Sobriety and Circularity

Finally, in conjunction to simpler technological design and creative management, comes policy as a tool for improving PSM environmental impacts. Organizations are starting to create technical policies in order to reduce their footprint beyond just increasing energy efficiency. For example, the BBC is moving from a linear economy use of technology to a circular one 'Chandaria (34)': moving from manufacture, use and dispose, to reusing, refurbishing and recycling. They are also not purchasing new equipment as frequently as they used to and therefore reducing their use of new physical resources that would have needed to be extracted, processed and transported. They are introducing the concept of eco-design to their staff, from educating on various ecomodes of equipment to finding ways of repairing and maintaining them.

CONCLUSIONS

Of major importance in all moves towards sustainability is that sustainable considerations need to be part of the research and design aspects of a product/service from the very beginning. Sustainability cannot be an afterthought: It is a requirement that is put into the product backlog and is part of every story and functionality. Only once it is part of its core can sustainability permeate an organisation's all outputs, inputs and culture.

PSMs do however find themselves in a tricky spot. On one side they have to compete with private companies, in most cases much larger than them, and on the other side they have the citizens they are also representing and their duties as public service providers: The perks of being a public organisation in a neoliberal economy. Nevertheless, now is an ideal time for PSMs to take brave measures that might go against industry norms. If anything, the current COVID-19 crisis has widened the public discussion on the environment and showed that changes within the anthropocene (i.e. the era of direct human impact on the planet) 'Bonneuil and Fressoz (35)' are indeed possible, even within a very short timeframe.

This window into possible futures combined with the mandate provided by public mobilisations we have seen among others in climate marches, can and should become a springboard to create some real meaningful change in our sector.

Depending on the socio-cultural context, such as public opinion and level of governmental support, such changes might require help in the form of coordination among broadcasters, in order for them to take this plunge together and support one another. Substantial changes never come easy, but change is the only way forward and the common values and remits of PSM can help us tackle this challenge together.

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