The Web of African Radios
Community radio stations entering the digital information age

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“That’s one small step for man, one giant leap for mankind.”
by Neil Armstrong
Abstract

Context. Digitalization in Africa is taking place at a breath-taking pace. Digitalization in Africa started much later than in Europe or North America and followed a different “leapfrogging” path, in which various stages of the innovation were skipped. Community radio stations in Africa are currently entering the digital age. Since they are widespread, important media outlets in rural Africa, many lessons can be learned from their digitization process.

Goal. With this research project I explore how community radio stations in Africa evolve from analogous broadcasting stations into fully digitized media outlets. The research will shed light on the opportunities, constraints and information needs of community radios in Africa.

Method. To do so, I combine design science with a participatory action research approach. This is carried out by iteratively designing and building a digital radio platform according to the requirements in close cooperation with radio journalists in Africa.

Results. My research produced a prototype of a web radio platform designed specifically for the African context in rural regions. Since many radio stations in Africa have not yet made the step towards digitization, this project can be considered the kick-off of a new innovation process.

Conclusions. The design process has led to an artefact that was co-created and evaluated by local users and to a series of recommendations how to support the digitization process for African radios. The design process leads to an understanding of the opportunities and barriers of the digitalization process in low resource environments in Africa.
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Chapter 1

The Digitalization of Africa

1.1 The same, but different...

From the moment the first personal computers became available to a wide audience, the world has been digitizing and has become more connected than ever. We have seen in Europe and North America that the digitalization followed certain stages in which innovation took place, since the 80s, computers have been commercialized and afterwards the internet, mobile phones, social media and smartphones followed, with each innovation making our society more digitally orientated. However, in Africa, digitalization started much later than in most other parts of the world, but they have been catching up rapidly regarding the adoption of information and communication technologies (ICTs) such as mobile phones. However, as displayed in figure 1.1 and 1.2 we can see that African countries are not following the same development stages of digitalization as it did in Europa and North America.

![Figure 1.1: % the population using the internet](https://data.worldbank.org/indicator/IT.NET.USER.ZS?end=2020&locations=XU-EU-ZA-GH-ML-BF)
Instead, digitalization takes place in a different and seemingly chaotic order and people sometimes even skip intermediate development stages. For example, mobile applications such as WhatsApp and Telegram are used by many people who have never used traditional email. Also, internet usage has increased in Africa faster than in any other part of the world, since the year 2000, the amount of internet users has increased with 13 233%[2]. Therefore, many people in Africa are now directly introduced to a mobile and internet-enabled environment without having the experience of a more rigid and stationary desktop environment. In this thesis I will refer to this phenomenon where intermediate development stages are skipped, as "technology leapfrogging". Notwithstanding, technology leapfrogging can be a very cost-efficient trajectory of development and digitalization. However, the social, and financial consequences of technology leapfrogging and its implications are rather unpredictable [1]. Especially in constraining and low-resource environments where contextual barriers and cultural constraints are different. Moreover, to learn from digitalization, research has to be conducted as we speak, while Africa is still in this process. This rapid change motivates this research in getting a better understanding of the rapid digitalization in Africa, how this process takes place, and what its implications are especially in a constraining and low-resource environment. Therefore the global question that this research contributes to is: “What can we learn from studying the rapid digitalization process that is taking place throughout Africa?”

Figure 1.2: Internet penetration in Africa between 2010 and 2020.[3]

https://www.internetworldstats.com/stats.htm
1.2 Why Community Radio Stations?

The choice to focus this research on the digitalization of community radio stations is not a near contingency but has a strong justification. Today, radio technology is still one of the most important ICT available in rural Africa, they have large numbers of listeners and are one of the most influential media outlets (2, 3, 4, 5, 6). Especially in parts of Africa that are missing critical infrastructure for reliable electricity or internet, and suffer from severe poverty and high rates of illiteracy (7), radio plays an utmost important role in people’s daily lives for a number of reasons.

First of all, radio technology is compared to the internet an old and accessible technology and has been around for a long while making it an affordable and fairly easy technique to implement for local and rural entrepreneurs (8, 9). Secondly, radio is a vocal-based communication medium, meaning that it is comprehensible for illiterates in a culture with strong oral traditions, community radio is made by the local people for the local people in their own relevant language. Lastly, radios are portable, you can already power a radio with a small set of batteries which makes radio less dependent on the availability of electricity. Altogether, community radio is for many people their only affordable and comprehensible information, knowledge and news resource which makes its existence essential (10). Nonetheless, the community radio stations, as well as the digitizing African radio listeners, are starting to use social media like Facebook and chat-message application such as WhatsApp and Telegram to share and disseminate news with their audience. Consequently, digitalization opens new possibilities for the community radio stations to interact and engage with their audience and extend their business model to improve their financial sustainability.

However, because community radio in Africa plays such an important role and is crucial for informing the population, the digitalization of one of Africa’s most important and influential media outlet is an important and interesting process that needs to happen sustainably to ensure the future existence of community radio stations. But because digitalization is a complex development process with social, technical and economical implications, it does not come with an unambiguous answer. Therefore, to get a better understanding and learn from the digitalization of Africa’s most important communication technology, this thesis is centred around the development of an ICT artefact in an action-research project that was carried out in collaboration with Radio Sikidolo, a community radio station in Mali. For
1.2 Why Community Radio Stations?

the development of the ICT artefact this research used a combination of use-case analy-
sis, requirements engineering and an action-research design science approach. By actively
participating, designing, experiencing, and being part of the digitalization of a commu-
nity radio station in Mali, this research brings new perspectives on the grassroots level of
digitalization of community radio stations. Subsequently, the following research questions
were formulated:

1. What are the requirements for digital communication platform for com-
munity radio stations in Mali?

2. What are the main constraints and opportunities in the design and de-
ployment of such a system/platform?

Figure 1.3: Adama Tessougue (key-user/main client) interviewing farmers in Mali (foto: A.
Bon, oct 2021)
Chapter 2

Related Work and Background Research

To provide this study with the necessary background knowledge and information about the digitalization in Africa and community radio stations, this section describes previously done work and the literature that was used to apprehend the constraining context in which community radio stations in Mali operate and how technology leapfrogging is described in other research.

2.1 Community Radio for Social Change in Africa

One of the earliest documented cases of the influence of community radio stations can be traced back to 1950 when community radio was successfully used as an instrument to pressure improvements in working conditions for miners[11]. This case showed how radio can be used to promote change and development in the direction of improving socio-economic status as well as political, governmental and legislative matters. These early success cases have led to the acknowledgement of the importance and influence community radio stations have on development and made community radio the most popular and influential media outlet to this day in Africa. Furthermore, the radio broadcasts in a local language or dialect to encourage listener engagement and participation. Because of its local relevance and focus, it lets people discuss topics that concern them more directly, and helps form dialogues, and diversify opinions about these topics. Because radio stations try to be objective, they can act as a platform for democratic discussion and debate about discord that is present in communities.
2.2 The Digital Divide

To understand the broader perspective of why radio technology is essential, it is important to understand that the digital divide in the world of today, does not only exist as an international disproportional distribution of technology \(^{12}\) but also on a national scale, large inequalities in accessibility and distribution of ICTs can be observed. The discrepancy between individuals using the internet in urban areas (50\%) and rural areas (15\%) of Africa is notable \(^{13}\) and affects the penetration of many other technologies. These numbers show that most people in rural areas do not have access to the internet, consequently, the information, knowledge and communicative opportunities are out of reach for the majority of the rural population, hence, radio is their only information and knowledge resource. Causes of the digital divide are far more complex than just an ICT accessibility problem and can be related to a wide range of economic, cultural, educational, technical, social and technical which makes it a multi-dimensional and complex problem to alleviate. The environment is constraining the operational extensibility and digitalization of their practices in general thereby challenging the opportunities to improve the sustainability of community radio stations that operate in low-resource contexts such as in rural Mali \(^{14}\).

2.3 Technology Leapfrogging Defined

To provide this research with an understand of technology leapfrogging, literature research about its definition, manners and implications has been done. Leapfrogging to new technology is not something that is done in a day but is a continuous process spread out over a period of time and requires careful planning of innovations. A case study about national ICT development in Azerbaijan conducted by Tan et. al. \(^{1}\) propositions a high-level conceptual framework of technology leapfrogging that consists of four sequential steps that can be used by governments as a guide for their decision-making towards ICT development. The first step, called *psyching*, emphasizes the importance of developing a national blueprint that specifies a high-level strategy for national ICT development to sets a vision and creates commitment to the development. Secondly, *planting*, involves the assessment and identification of ICT capabilities within a country, this step identifies the expertise and knowledge needed and exposes capability gaps for this reason. The next step is called *propelling*, this is where the actual leap is taken and new ICT capabilities are developed, for example, the TASIM project in Azerbaijan required a new fibre optic cable, this new cable allowed for high-speed internet, this development allowed other businesses to benefit from
2.4 Requirement Engineering Fundamentals

this improvement. The last step is called perpetuating, this step is focused on maintaining the trajectory that has been set for ICT development. This step is achieved by creating awareness and showcasing the accomplishments, this creates trust and confidence in ICT which is required by any sustainable system change.

In general, technology leapfrogging happens either accidentally which was the case with the rapid mobile phone adoption throughout Africa or is planned for by governments which was the case for the construction of the high-speed internet optic fibre cable in Azerbaijan. Technology leapfrogging can therefore be seen from two distinct perspectives, a top-down and a bottom-up perspective. Firstly, the top-down perspective or macro-leapfrogging, mainly focuses on ICT policies, laws, strategies, projects and coordination necessary to create a strategy for ICT development that is planned for and managed by governments. Secondly, the bottom-up perspective or micro-leapfrogging, focuses on the digitalization process on a grassroots level. Although, It should be noted that both perspectives of leapfrogging often interact and also enable each other. When a lot of people start using new technologies, and governments acknowledge the benefits, they tend to align policies and laws that can support and accelerate the leapfrog (bottom-up). This also works the other way around (top-down), when governments create a healthy breeding ground for ICT development through policies and state programs by for example investing in new infrastructure that allows businesses to use more advanced ICTs as seen in the example of the optic fibre cable from the TASIM project in Azerbaijan. Concluding, with this distinction, we suggest that the most effective way of leapfrogging is achieved by engagement of both perspectives and collaboration between public and private sectors of a country.

Unfortunately, this engagement and collaboration cannot be taken for granted in developing countries that struggle with social, political and economical instability. This makes technology leapfrogging a phenomenon that does not come without any risks when conducted and deployed carelessly in a low-resource and remote environment that is unfamiliar with the use of ICTs. Subsequently, many examples of failed ICT projects exist for this reason.

2.4 Requirement Engineering Fundamentals

The book "Requirement Engineering Fundamentals" by Klaus Pohl and Chris Rupp describes requirements engineering as an iterative process of documenting, and maintaining
requirements of a designed system and is widely used in software development and engineering. In general there are three types of requirements, functional requirements, quality or non-functional requirements and constraints (17). Functional requirements generally describe the behaviour, functional or data related aspects of a system. Non-functional requirements describe quality aspects of a system, such as maintainability, usability or availability. However, the solution space of the requirements are limited by the constrains. Thereby, requirements engineering helps this research assess and define the different types of requirement that were encountered during the development of the web-platform.

2.5 Design Science Methodology

An extensive methodology about design science approaches is provided by the book "Design Science Methodology" by R. J. Wieringa (18). In the book technical action research is described as a type of design science research that revolves around an object of study or an artefact that is designed and developed for a stakeholder to improve something. Also, it emphasizes the empirically validation of the artefacts performance in the context it was deployed. Because this is exactly what this thesis is about, technical action research as design science is one of the main research methodologies used in this research.

2.6 Web of Radios

The paper “The Web of Radios” (10) provides this research with the necessary background information on the conditions community radios operate in and their business activities. This paper proposes the web of radios as an interface of the web of data, and how the benefits of the internet can reach people who are excluded from the internet but do have access to radio technology. This case study will be an extension of the project described in this research paper.

2.7 Previous work: Nous Votos Bip!

Parallel to this research, a different project around community radio in Mali was carried out during the ICT4D course at the Vrije Universiteit Amsterdam and contributed to the general understanding of community radio, its activities and the constraining environment of Mali (17). The main assignment of the ICT4D course was to design a voice-based ICT

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application for the selected use-case. The use-case that we selected was about radio stations in rural Mali that want to make their radio broadcasts more interactive and engaging by letting listeners participate in polls/votings cost-effectively by using bip-calls. During the radio broadcast, the radio host will explain the intention and asks a question to the listeners and provide two phone numbers, A and B; A to vote “yes”, and B to vote “no”. Next, the listeners will bip-call either one of those numbers to cast a vote. Bip-calling is calling a phone number and disconnecting immediately to avoid costs. Hence, numbers A and B will still receive the missed calls, and the amount of missed calls on each phone number represents the number of votes for that option. Before, if a radio station wanted to organize such voting, the incoming votes had to be counted and checked for duplicates manually, which is time-consuming, prone to human error, and privacy risk for the listeners because their phone numbers are exposed to the radio station.

The application that was designed and programmed solves these issues and uses a MySQL database to automatically counts the votes and to reject any duplicate inserts, and respects the privacy of our voting participants by encrypting the phone numbers of the incoming bip-calls. The only prerequisites of the developed application are access to electricity and to the GSM network which all radio stations have. Our application is deployed on the Kasadaka raspberry pi which is connected to the GSM network with a dongle (19). This allows it to receive and process the incoming bip-votes. The application itself is very simple and has only 3 functionalities, start the voting, to allow incoming votes to be added to the database, end the voting to prevent incoming votes to be added to the database, and get the results of the voting. This can be managed through an Interactive Voice Response interface (IVR) which allows our application to be used by illiterate people, however, this requires calling our application which initiates costs for the radio station that uses the IVR. To circumvent these costs, we also developed a web interface to manage our application, the beauty of the Kasadaka is that it can create a local network, this allows the web interface to be used without the presence of the world wide web. However, the constraining environment of rural Mali poses a lot of implementation barriers for ICTs, poor electrical infrastructure, and the absence of internet are one of the most evident obstacles. Additionally, Mali suffers from high rates of illiteracy and the information and knowledge the internet has to offer are mostly text-based and in English which makes it unusable for a large population, hence, the reason why radio is still such an important communication technology because it is voice-based. Consequently, designing ICTs for such constraining environments is challenging, and many ICT4D projects fail because of a mismatch between technology and
context. To mitigate the change of such a mismatch, it is advocated for a bottom-up user-participatory development approach where the end-users are closely involved during all phases of the design cycle. Therefore it is of utmost importance that the context and the specific needs of the stakeholders are deeply understood. By building use-cases and rapid prototypes, requirements can be elicited. The financial sustainability of an ICT4D project can be assets with the use of e3 value modelling, however, the overall sustainability of an ICT4D project depends on other factors. If an ICT service has been successfully implemented and deployed by respecting the complex socio-economic constraints of rural areas, many projects are dependent on funding from NGOs or local governments, and when funding stops the project will too. This was the case for the Foroba Blon and RadioMarché projects in Mali, both projects were very successful by being well integrated within the low-resource context and improved the socio-economic status of many villagers, however, the Emerginov platform that these projects were built on stopped its service and pulled the plug. This is a typical example of an unsustainable ICT4D project that relied on a funded platform to sustain [20].

2.8 Chapter Summary

First a brief history about community radio stations is provided, and the digital divide is explained. The main methodologies that are used in this thesis are briefly discussed and an elaborate description of the concept of "technology leapfrogging" is provided. Lastly, the previous project that this research extends, "The Web of Radios", and a previous ICT4D project that contributed to the general understanding of the context and radio stations have been described.
Chapter 3

Research Approach

This section of the thesis describes the methodologies that were used to design, develop, document and deploy the web-platform of Radio Sikidolo. Firstly, the main research approach, technical action research (TAR) is described followed by requirements engineering (RE) and the ICT4D 3.0 framework. Secondly, to assess the sustainability of the project the E3 value conceptual modeling tool is described. The last section covers the two design cycles that were performed to develop the web-platform.

Figure 3.1: The ICT4D 3.0 Framework
3.1 Applying Design Science: Technical Action Research

The research approach this thesis used to develop the web-platform was a technical action research approach (TAR). TAR is a single-case and user-centred design science methodology that revolves around the development of an ICT artefact that is used to help a client. In this research project, the developed ICT artefact was a web-platform to help our client at Radio Sikidolo, a community radio station in Mali. This approach enabled this thesis to research the process of digitalization through the development, implementation and deployment of the web-platform, and observe and experience the implication that emerges from web-development in a constraining low-resource context. Moreover, during the development and implementation, all kinds of knowledge questions are encountered and observed such as "how do we organize the web-platform?" "How can we make sure the radio station can independently maintain the web-platform after the project?" "How can the web-platform interact with the community?" "Can we create new sources of income?" "How feasible and sustainable is the web-platform?". Consequently, these kinds of questions are exactly the ones that were looked for, because the answers to these questions create a foundation for answering the research-questions. Thereby, this combined approach is the most appropriate and aligned methodology regarding the goal and activities of this project and to answer the research questions.

3.2 Combining Requirements Engineering

Requirements Engineering (RE) has been applied to iteratively establish, document and maintain the requirements of the ICT artefact. By combining TAR with RE methodologies, a user-centred web-platform can be developed while establishing, documenting, maintaining and adjusting the requirements iteratively.

3.3 ICT4D 3.0 Framework

While TAR and RE are user-centred and iterative design and engineering methodologies, the low-resource environment and constraining context in which our client at Radio Sikidolo operates, needs to be taken highly into account during the design and deployment. This is to ensure that the design matches the constraining context of Mali. To mitigate the change of a mismatch between technology and the context, this thesis included a use-case analysis of a community radio stations in Mali and implements the ICT4D 3.0 framework (figure 3.1) in combination with TAR and RE. The ICT4D 3.0 framework, which was
3.4 Conceptual Modeling: E3 Value

developed by A. Bon, H. Akkermans and J. Gordijn (21), characterizes itself for its collaborative, iterative, and participatory research approach which makes it seamlessly fit next to TAR and RE methodologies. The ICT4D 3.0 framework is considered one of the most appropriate approaches to apply for this type of research because it demands considering the technical, social, and economical constraints of the context and environmental of Mali continuously throughout the project. It enabled this research to put the emphasis on ICT development in a constraining low-resource development context.

3.4 Conceptual Modeling: E3 Value

To assess and analyse the sustainability aspects of the developed web-platform the E3 value conceptual modeling approach was used. E3 value is a dynamic modelling tool to assess the financial sustainability of an ecosystem developed by Jaap Gordijn and Roel Wieringa (22). It enables the assessment and design of an economic ecosystem where all actors benefit the most from each other because a healthy ecosystem is one where all participant are financial sustainable. By applying E3 value we can assess the needs and value exchanges between actors and market segments that participate in the value network of that ecosystem and calculate and estimate how financially sustainable actors are. Thereby, E3 value modelling helps significantly in understanding how value is created and by whom while it exposes the financial limits, boundaries, supply and demands, dependencies and sensitivities to changes from the environment.

Figure 3.2: Storyboard of the key idea of the web-platform
3.5 Iterative Design Cycles

The web-platform, this thesis is centred around and functioned as the main digitalization subject during this research, was developed in an iterative and agile manner, by performing design cycles the web-platform was incrementally improved and adjusted to our client-specific needs. The first version of the web-platform was developed rather quickly without specific consideration of the environment in Mali, while this is considered to be extremely important in order to create sustainable ICT solutions in a low-resource environment \(21\).

In order to adapt and adjust the web-platform to its relevant context, a second design cycle was performed. The second design of the web-platform was based on knowledge and information obtained during the active collaboration with our client in Mali, the conducted interviews with radio stations in Burkina Faso, and our domain experts from the Vrije Universiteit Amsterdam (VU), see table 4.1. This resulted in a user-centred and context-aware design. The web-platform had the following two design cycles:

1. The first design cycle implemented the most essential technical requirements that are needed to designing and deploying a web-platform. This included the selection of the IT infrastructure and the development framework for the web-platform to enabled the key-idea (see figure 3.2). The key-idea of the web-platform is to have the radio stations to upload their media content to the internet in order to ensure the re-usability of their content. Normally when a community radio station broadcasts, the information and knowledge is disseminated in an ephemeral manner and lost after the broadcast, hence unsustainable. By having a web-platform, the radio station is able to make their content re-usable over the internet, hence sustainable. This is also the version of the web-platform which is currently online and used by our main client, see figure 3.3.
2. The second design cycle of the web-platform was focused on extending and exploring the key-idea with new features to create a more context-relevant and user-centred design. The new design of the web-platform implements new features and methods for radio stations to interact and engage with their audience and additionally brings the opportunity to create new sources of income for the radio stations to improve their financial sustainability, which were thoroughly explored during this research.

3.6 Chapter Summary

To research and develop a web-platform for a low-resource environment a combined methodology of a use-case analysis, technical action research and requirements engineering was used. This combined methodology was the most appropriate approach for this type of research because it allowed to iterative design and develop the web-platform and establish its requirements while considering the low-resource environment of Mali.
Chapter 4

Understanding the Context

This sections of the thesis covers the context analysis and needs and requirements assessment. Firstly, the interviews, workshops and collaboration with our key-user at Radio Sikidolo are described which led to an in-dept understanding of the constraining and low-resource context in which the community radio stations in Mali operate. Secondly, a more detailed analysis of distinct contextual aspect that affect the community radio station is provided, consisting of; technical, cultural and individual, organizational, legal and regulatory, and financial aspects and barriers. Lastly, the main output of this section is described which is the identification of the different stakeholders and their respective needs and operational goals that followed from the context analysis and needs assessment.

4.1 Interviews, Workshops, and Participation

An important aspect of the ICT4D methodology is to create user-centred and context-aware ICT solutions, therefore a total number of four interviews were conducted with radio stations in Mali and Burkina Faso and weekly collaborative workshops were organized with our domain experts from the Vrije Universiteit Amsterdam (VU), see table 4.1. The interviews and workshops, and collaboration with our client are essential to analyse and assess the context-specific needs of the web-platform, elicit requirements for use-cases, and implement and evaluate new features and ideas for the web-platform. Additionally, I was added to a WhatsApp group used by our key-user at Radio Sikidolo. He uses it to distribute news items to his audience, see figure 4.1. This provided this research with practical knowledge about how the radio station uses new technology in their business operations and other activities through experience. Also, this enabled direct contact with our client to evaluate the observation that was made and features that were implemented
4.2 The Context of Community Radio Stations

on the web-platform. Additionally, by applying E3 value, the financial sustainability of the web-platform was assessed and new configurations for a healthy financial situation were explored.

Table 4.1: Data collection

<table>
<thead>
<tr>
<th>ID</th>
<th>Type</th>
<th>Participant(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D20220124</td>
<td>Collaborative workshops</td>
<td>Supervisors, domain experts VUa, A. Bon, H. Akkermans</td>
</tr>
<tr>
<td>D20220321</td>
<td>Collaborative workshops</td>
<td>ICT4D consultant and domain expert VUa, A Baart</td>
</tr>
<tr>
<td>D20220401</td>
<td>Interview</td>
<td>Radio Sikidolo, Mali, Radio director, Adama Tessougue</td>
</tr>
<tr>
<td>D20220517-A</td>
<td>Interview</td>
<td>Radio Savane, Burkina Faso, Journalist, Burkina Adama Sankara</td>
</tr>
<tr>
<td>D20220517-B</td>
<td>Interview</td>
<td>La Voix du Sanguïé, Burkina Faso, Journalist, Bayala Hermann</td>
</tr>
<tr>
<td>D20220517-C</td>
<td>Interview</td>
<td>Radio La femme et le développement, Burkina Faso, Journalist, Jean Arnaud Sawadog</td>
</tr>
<tr>
<td>D20220609-A</td>
<td>WhatsApp group observations</td>
<td>Adama Tessougue, Mali, 223 group members</td>
</tr>
<tr>
<td>D20220609-B</td>
<td>Direct WhatsApp contact</td>
<td>Adama Tessougue, Mali, 223 group members</td>
</tr>
</tbody>
</table>

4.2 The Context of Community Radio Stations

The interviews that were conducted with the radio stations in Mali and Burkina Faso provided this research with the required knowledge to gain an in-depth understanding of the constraining context and environment and how the community radio stations operate. It is necessary to understand how the community radio stations operate and what technical, organizational, cultural and individual, legal and regulatory, and financial capabilities are available or constraining the development, implementation and assessment of the feasibility and sustainability of the web-platform and its requirements.
4.2 The Context of Community Radio Stations

4.2.1 Technical Aspect

The radio towers used by the community radio station often reach a radius between 100-200 kilometres. However, the technical constraints are among the most evident to be observed and relate to the ICTs available at the radio station. Due to the constraining environment in Mali and Burkina Faso there are many problems related to poor infrastructure, issues with internet quality and availability, deficiency of system capabilities, and insufficient electrical supply hence, the availability and accessibility of ICTs in general (14). Especially in rural areas, “last mile problems” are major reasons why people are unconnected to the world wide web and cannot benefit from it. Therefore, the environment in which the community radio stations are located constraints the availability of certain ICT technologies. We see that some radio stations have computers with internet, some have computers without, while others are completely operational through only analogue equipment (10). However,
4.2 The Context of Community Radio Stations

because more and more people are moving to smartphones and internet is slowly becoming available, we also see that the radio stations have started using smartphones, Facebook, Telegram and WhatsApp to distribute their news items, and interact and engage with their communities through other technologies than radio.

4.2.2 Cultural and Individual

The radio stations have considerable influence on the population and the communities they serve, on average they reach between 80,000 and 200,000 daily listeners. However, each radio station serves a different region with differences in cultural and individual values. The diversity and complex social demographics, plurality of languages and local dialects, greatly affect the content created by the radio stations, and you see that each radio station primarily broadcasts and produces content in the relevant local dialect. In a low-resource context, content has to include topics that are meaningful for rural communities and serve it in their own relevant language or dialect. However, in contrast to the local relevance of radio content, content consumption on the internet is still problematic. The main reason has to do with the consequences of high illiteracy rates and low education levels in Mali, and because most of the internet is text-based and in English. Thereby the web automatically excludes people who are cannot read or not proficient in English or any second language besides their own regional dialect. Additionally, this problem is conserved by an unequal amount of content creators respectively to the number of content consumers, meaning only a handful of people on the internet produce content for the majority. Nonetheless, because community radio stations are deeply rooted within their communities and are the main gateway for local relevant news items they function as the most important information hubs and play a key role in supplying user-relevant content to the rural population.

4.2.3 Organizational

Most people in Mali that live outside of the city do not have formal education which poses knowledge and awareness gaps about technology. This was observed in one of the interviews with a radio station in Burkina Faso where he expressed that he does not have the knowledge to build a website but really wanted to learn how. The insufficient organization and structure were observed during the interviews with the community radio stations and also after our key-user/client at Radio Sikidolo used the first version of the web-platform for a couple of months. In both cases, the radio station did not organize, structure or archived the produced media content properly by attributing meta-data, or with recognizable and
identifiable names, see figure 4.2. This eventually leads to a disorganized and cluttered media database of content and audio files which are unmanageable and unsustainable. Looking for a specific audio file becomes like searching for a needle in a haystack.

Figure 4.2: Media library with unrecognizable file names

### 4.2.4 Legal and regulatory

These include the need for policies, regulatory frameworks, and governmental support that are necessary to implement and utilize ICT systems. Often, governments and institutions lack understanding, policies are not aligned with the implementation and operationalization of ICT services. However, the legal and regulatory aspects that affect the radio stations the most is the intellectual property (IP) licence. The radio stations need to acquire rights to broadcast music or other intellectual property (IP) that is protected. Therefore they pay a yearly flat fee to the association or licensing company in their country. One of the interviewed radio stations in Burkina Faso told us he pays a local licensing organization the BBDA. However, the fee they have to pay to obtain the IP licence is over 500 euros per year, which is very expensive for the radio stations, but necessary to sustain their broadcasts.

### 4.2.5 Financial aspects

Throughout Mali and Burkina Faso, community radio stations can be distinguished based on their financial situation; state-funded, private or community funded or completely self-supportive and controlled. The interviewed radio station told us that they employ on average 5-7 people and make between €1000-1500 per month, which is very low considering all costs that need to be covered with this. Most of the radio stations’ revenue is generated by selling air-time, advertising and doing paid announcements. However, our client at
Radio Sikidolo expressed concerns about his financial situation because he saw a decline in submissions for paid announcements. Subsequently, the low purchasing power of community radio stations greatly affects the adoption and implementation of new technologies because you need to have sufficient financial capabilities and maintain the web-platform. However, the Internet is still very expensive in Mali and Burkina Faso, during the interviews it was expressed that having a website is very expensive. Additionally, our client at Radio Sikidolo told us he pays around €20,- for only 1GB of internet each month.

### 4.3 Identifying Stakeholders and Needs

One of the main outputs of the context analysis and needs assessments is the list of identified stakeholders and the role they play or goal they have with respect to the radio station’s web-platform, see table 4.2. The list of stakeholders is later also used in chapter 6 where the E3 value methodology is applied in order to assess the financial sustainability of the radio station’s web-platform.

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Role/Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio station</td>
<td>Represents the radio staff that manage and operate the station and maintains the web-platform.</td>
</tr>
<tr>
<td>Citizen journalists</td>
<td>Sell local news items to the radio stations for a fee.</td>
</tr>
<tr>
<td>Listeners</td>
<td>Listen to radio, and hear announcements and advertisement on the radio</td>
</tr>
<tr>
<td>Smartphone users</td>
<td>This actor represents the people in the community that have a smartphone and internet and are able to visit the website.</td>
</tr>
<tr>
<td>Announcement customers</td>
<td>Special type of customer that buys announcements from the radio station by calling to the radio station.</td>
</tr>
<tr>
<td>Air-time customers</td>
<td>Represent the special type of customer that buys air-time from the radio station for special programs.</td>
</tr>
<tr>
<td>Local businesses</td>
<td>This actor represent the local businesses that want to advertise through the website of the radio station.</td>
</tr>
<tr>
<td>Telephone companies</td>
<td>Provide the population with the service to call using the GSM network.</td>
</tr>
<tr>
<td>Third-party services</td>
<td>Provide a specific utility service or product for the radio stations website.</td>
</tr>
</tbody>
</table>

Continued on next page
Table 4.2: Operational Goals of Stakeholders (Continued)

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Role/Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intellectual property rights (IP licence)</td>
<td>Yearly fee paid by the radio stations to obtain broadcast rights for music or other IP protected content.</td>
</tr>
<tr>
<td>Internet service providers (ISPs)</td>
<td>Sell internet access and prepaid data plans or subscriptions to smartphone owners.</td>
</tr>
<tr>
<td>Hosting providers</td>
<td>Supply hosting service, domain, SSL certificate as a bundle.</td>
</tr>
</tbody>
</table>

4.4 Chapter Summary

In this chapter the data collection which included four interviews with community radio stations and direct contact with our main client and key-user at Radio Sikidolo was described. This let to an in-depth understanding of the context in Mali and the list of the needs and goals of the stakeholders. Furthermore, this chapter identified the most important aspects that affect the community radio stations.
Chapter 5

Designing the Platform, Technical Implementation; Requirements and Opportunities

In this chapter a detailed deception and explanation of the implementation and the deployment of the radio-platforms technical, social and financial aspects is provided. This chapter is structured according the two design cycles that where performed. At the end, an overview of the requirements that are necessary for a web-platform in a low-resource context like Mali is presented.

5.1 First Design Cycle: Startup and Preparations

The first design cycle describes the implementation and the decisions regarding the essential technical requirements and infrastructure for web-development and the choice of the development framework that enabled the key idea and the web-platform our client is currently using, see figure 3.2 and 3.3. Lastly, the preliminary preparations that were required to enter the second design cycle without affecting the version of the platform used by our client is descibed.

5.1.1 Selecting Infrastructure

The first thing that is required to have a web-platform online is a domain name and a hosting provider. Fortunately, hosting a web-platform and acquiring a domain name is not difficult and is also not expensive. Hosting prices range between €2 and €3 euro/per month and in most cases include the registration of your domain name and include an SSL
5.1 First Design Cycle: Startup and Preparations

certificate for secure connections. Thereby, having a web-platform online is not a large expense for the radio stations.

5.1.2 Selecting a Development Framework

The technology used to develop, build and design the web-platform for Radio Sikidolo was the content management system (CMS) WordPress. WordPress characterizes itself as being an accessible tool for web development because it is free, well supported and updated, and used by over 450 million websites on the internet making it one of the most used and reliable web-development tools. It was for these reasons decided to develop the web-platform with WordPress. The main advantage of using a CMS like WordPress is that it requires no coding skills for the web developer, instead, it uses a visual drag and drop interface to design the front-end of the web-platform. Subsequently, the visual and aesthetic aspects of the design of the web-platform are defined by the theme that is installed on the web-platform. However, besides a visually appealing look, the web-platform also needs to perform functionalities. Adding functionalities to the web-platform can be achieved without the need to code similarly to WordPress themes. WordPress provides a plugin library with a plethora of plugins that can bring any desired functionality or feature to your web-platform. There are dedicated plugins to integrate specific social media, do online payments, automate workflows and organize media content. By installing plugins, new functionalities and options become available either to modify the front-end of the web-platform or the back-end and administrator dashboard from where the content of the web-platform is managed.

5.1.3 Preparing the Second Cycle: Offline Developing Environment

To enter the second design cycle without affecting the version of the web-platform that is online and in use by our client, an offline local development environment was created. This allows the developer to play around freely with different designs and functionalities without affecting the online web-platform. When the design is finished, it can be migrated to the online web-platform to minimize the amount of time that the current site will be offline. An accessible way to do this is by using Docker-compose containers. Docker is an application that allows you to locally host a web-platform inside a Docker container. When an application can run in a Docker container, it becomes more portable and can efficiently run on any device that supports Docker. For the development of the new version of the Radio Sikidolo web-platform, a combination of GitHub and Docker was used to make
the development of the web-platform portable between different devices. Furthermore, because the Docker container is on GitHub, it is only required to pull the latest version of the container’s repository and you can immediately spin up the web-platform and run it on your localhost by using the docker desktop application and start developing.

5.2 Second Design Cycle: Proposing a Full Radio Platform

Through the active role in the development and evaluation of the web-platform and the implementation of the features and ideas with our key-user at Radio Sikidolo, the first version of the web-platform was iterative, and incrementally improved by sequentially adding new functionalities and re-designing the web-platform of Radio Sikidolo. In general, our key-user was very happy about the new design and the new features that were implemented, his input helped construct the list of requirements, and opportunities that were explored, encountered, observed and implemented. Subsequently, this sub-section is structured according to the four most important functional and non-functional requirements that affect the web-platforms’ operational feasibility, sustainability and contextual relevance which are; financial opportunities, usability, maintainability, and interaction and engagement.

5.2.1 Financial Opportunities

The ability to generate new income sources and revenue streams with the web-platform is an important motivation why a web-platform can strengthen the financial sustainability of community radio stations. Interviews with the radio stations in Burkina Faso showed that having a web-platform is expensive, however, this might be true when the web-platform is still in its infancy phase and not actively visited, but will become irrelevant when the financial opportunities are fully utilized and the generated revenue from the web-platform will out weight the costs.

5.2.1.1 Cost Efficiency

Because the financial capabilities of community radio stations are limited. It is thereby required that the web-platform needs to be developed with the least amount of initial and recurring costs. Also, the potential investment that a radio station has to make to have a web-platform must be minimized.
5.2 Second Design Cycle: Proposing a Full Radio Platform

5.2.1.2 Advertisements

The most used and common method on the internet to make money with a web-platform is to sell advertisements. Google Ad-sense is an advertisement platform which can be integrated with WordPress to sell advertisements in an automated manner. This approach would generate revenue based on the number of visitors and activity on your web-platform, but because the web-platform is still in an infancy phase, the expected revenue to gain from this is hard to estimate. Nevertheless, during our collaborative workshops, the idea of promoting local produce on the web-platform through local advertisements was incepted. The idea is to sell advertisements to producers of local products and services. This way a mutualistic ecosystem could be stimulated where all parties benefit from each other, the radio stations earn money from displaying local advertisements, and the producer gets more awareness about their products and sells more.

5.2.1.3 Subscription-based and Exclusive content

Besides advertisement, a way to generate revenue is to sell subscription-based access to exclusive content. During this research, multiple ways to achieve this were explored, one of them was the idea to monetize WhatsApp or Telegram group chats/channels that our client uses to distribute news content, as in figure 4.1. Unfortunately, WhatsApp is closed source software and does not have accessible and available developer options to create your

![Image](image.png)

Figure 5.1: The web-platform after the second cycle
5.2 Second Design Cycle: Proposing a Full Radio Platform

own WhatsApp integration, thereby WhatsApp implementations could not be explored. Nonetheless, Telegram is open source software, therefore you see a lot more development happening on GitHub around the implementation and use of Telegram Bots. Bot accounts are a special type of Telegram accounts that can be programmed to perform certain tasks automatically, such as removing people from channels after they used specific insulting language. During the implementation, the use of Telegram bots to monetize a Telegram channel with paid subscription plans was widely explored, in this channel the radio station could post "exclusive content" for its subscribers. The bot worked as follows; a new customer starts a chat with the bot and asks for access to a private channel for a certain amount of time depending on the amount of money paid, the customer selects a subscription plan and the bot prompts a payment link, after completion the customer is added to the telegram channel by the Telegram bot, after the subscription period is expired the customer is automatically deleted from the channel by the bot and has to apply for a new subscription to regain access to the channel.

5.2.2 Design for Usability

To design for usability means that the visual layout of the web-platform has to be accessible as possible for the majority of visitors. The UN Education sector has developed guidelines for "Designing Inclusive Digital Solutions". These guidelines helped to understand why it is important to create inclusive digital solutions and give handles for designing them.

5.2.2.1 Theme Customizability

One of the most important choices you have to make when developing with WordPress is the theme. The installed theme will determine how much of the design of the web-platform can be modified without the need for coding. Because WordPress is such a popular CMS, there are many themes you can download and install, all having a different layout, colouring and out-of-the-box functionalities and options. Some themes are even marketed as optimized for specific business goals, such as blogging, magazines, news-site, web-shops or podcasting. The first version of the web-platform used the default WordPress theme TwentyTwenty (see figure 3.3). However, the customizability of the default theme was very limited and could not be adapted to the context-specific needs of our client. Therefore, a deliberate decision was made to switch and install a different theme that provided the required modifiability in order to adapt the design to the needs and requirements of our client, the new theme that was used is Blocksy, see figure 5.1.
5.2 Second Design Cycle: Proposing a Full Radio Platform

5.2.2.2 Smartphone Optimization

The population of Mali and Burkina Faso is adopting and transitioning to smartphones and the internet. During the interview and evaluation of the first version of the web-platform, our client mentioned the importance of having the web-platform optimized for smartphones. To create a smartphone and desktop-accessible web-platform, the design has to be responsive to different screen sizes. The Blocksy theme that was used for the design of the web-platform, is completely responsive for mobile devices, thereby choosing the correct theme and internal settings optimizes the design of web-platform for mobile devices.

5.2.2.3 Visual Guides

An important part of making a web-platform more usable for low-digital skilled visitors is to use context-relevant logos. The symbolic meaning of expressions can differ a lot between cultures, a thumbs up can have different meanings depending on the specific culture and context. Therefore it is important to choose the most context-relevant logos for the intended target audience of the web-platform. However, to implement logos within WordPress, a special plugin had to be installed to create the logos for each category. This plug-in allows the developer to upload any image as a logo for a specific category and menu item, making it easy to exchange logos that fit a specific context. Subsequently, the web-platform has distinct colours for each category (see figure 5.2), this was achieved by adding custom CSS styling to the web page and required some basic-coding skills. By having category-specific logos and colours a person aided in their memory and is more able to see relationships between different categories and site structure.

5.2.2.4 Multi-language Support

To create a web-platform that is relevant for its visitors, the front-end of the web-platform and its content must be presented in the most relevant language of the visitor. Throughout Mali and Burkina Faso, a plural of local languages and dialects such as Bambara or Leyly are spoken besides the official language French. Unfortunately, most web content is provided in English and therefore incomprehensible for the majority of the rural population. Thereby the textual aspects of the web-platform have to be available in the most relevant languages of the target audience.
5.2 Second Design Cycle: Proposing a Full Radio Platform

5.2.3 Interaction and engagement

When people visit the web-platform, it should not only have an appealing and visual relevant look, but the web-platform should also incentivize interaction with the visitors to keep them engaged. Several features were explored to increase the visitors’ engagement and interaction.

5.2.3.1 Voice-enabled Comments

Currently, when a new broadcast is published on the web-platform, visitors can reply and comment on a broadcast by leaving a textual reply in the comment section. Our client at radio Sikidolo envisioned his web-platform to evolve as some kind of social- and discussion platform. If we observe how people communicate within chat applications such as WhatsApp and Telegram, we see that the audience of Radio Sikidolo primarily uses the voice message options, despite the textual focus of WhatsApp. Over a period of two months of being in the WhatsApp group of our main client at Radio Sikidolo, not a single textual message was found, everything was communicated by using voice messages, see figure 5.2. It shows the importance of voice-enabled features and it is for this reason that WhatsApp and Telegram are so popular because they have very intuitive voice message options. Thereby we can conclude that to enable discussions by visitors on the web-platform, voice-enabled features have to be implemented. The ability to have a voice-enabled comment section is therefore one of the most important requirements regarding the interaction and providing relevant and accustomed methods to communicate.

5.2.3.2 Social-Media Integration and Post Automation

A feature to enable more engagement and interaction and to generate more activity on the web-platform is to integrate social media features. The social media buttons that are displayed on the web-platform redirect visitors to the social media platforms or start chat sessions. For example, on the web-platform, WhatsApp and telegram buttons are

Figure 5.2: Distinct colors and logos for each menu item
5.2 Second Design Cycle: Proposing a Full Radio Platform

implemented to let visitors start chatting sessions with the radio station. Thereby visitors can easily contact and interact with the radio stations. Another feature that becomes possible by integrating social media on the web-platform is the ability to automate the creation of social media posts.

Our client has a Facebook page and showed interest in creating automated Facebook posts and Telegram messages when a new radio broadcast is published or updated on the WordPress site (see figure 5.3). Such a feature alleviates the redundant work of manually posting or forwarding new broadcast publications to different media platforms.

Figure 5.3: Post automation to Telegram Channel

5.2.3.3 Voting Polls

A common way for community radio stations to engage and interact with their listeners is through voting polls. Organizing votings is something familiar for the radio stations and also for the listeners. The radio station asks a question during a broadcast for the audience to respond to by calling specific phone numbers, see 2.7. Similarly, with WordPress, polls can be activated on the web-platform by installing a dedicated plugin. By implementing polls, the web-platform interacts with the visitors by asking their opinion about some statement or question. The radio station could direct people to the web-platform during a broadcast to cast votes, this way the radio station can also generate more activity on the web-platform. Our client at Radio Sikidolo thought it was a good idea to implement something familiar on the web-platform. The current poll on the web-platform asks visitors about how they experience the web-platform.
5.2 Second Design Cycle: Proposing a Full Radio Platform

5.2.3.4 Live-stream

Another feature of the web-platform that was explored was providing an online live stream while the radio station is broadcasting. This enables visitors of the web-platform to listen to the current radio broadcast live over the internet. Additionally, this makes it possible for people living outside Mali or diaspora to listen to the radio broadcast live. Currently, the live stream is created by the combination of a free third-party service, Zeno, and a desktop application, Butt, see figure 5.4. Zeno is a free radio and podcast streaming provider that utilizes Icecast and Shoutcast server encoding. Furthermore, Butt is an Icecast and Shoutcast broadcasting client to relay audio from an input device, such as a line microphone, to an Icecast or Shoutcast server such as Zeno. Consequently, the audio input or output from your device can be live streamed to your Zeno account. Additionally, Zeno provides an audio player that can be embedded on your web-platform.

However, if a radio station would host its own server it should be considered that this server needs to be capable enough to handle the number of requests. For example, if the live stream would have 100 listeners, the hardware running the server at the radio station needs to be powerful enough to serve the live stream to 100 devices, but if this number quickly grows to 1000 listeners, the server capacity needs to be scalable enough. However, the hardware and the required ICT skills and the data that is required to upload the audio stream to the internet may not be sufficient enough to enable such features.

![Audio stream from Butt to Zeno to RadioSikidolo.com](image)

**Figure 5.4:** Audio stream from *Butt* to *Zeno* to RadioSikidolo.com

5.2.4 Maintainability

So far, most requirements and opportunities that were found are about the front-end of the web-platform and how the web-platform can interact and engage with its visitors. However, a web-platform has two faces, the front-end and the back-end. From the back-end of the
web-platform, the content that is visible on the front-end is managed. The media library in WordPress is the database where files get uploaded and stored. However, maintaining an organized and structured media library is essential to be able to manage the content on the web-platform sustainably.

5.2.4.1 Organization and file structure

Our client expressed having problems with the organization of the media content of the web-platform. Therefore, to structure and organize the media library, a file organizing feature was implemented to create custom nested folders for each content category, see figure 5.5.

![Figure 5.5: Files organized within category folders](image)

5.2.4.2 Documentation

To ensure the maintainability of the web-platform, it is required to have documentation about how to maintain and update the site and its content. The documentation should include instructions on how to create and publish new broadcasts on the web-platform, and how to update WordPress itself, the plugins and the theme that is used. Thereby, even staff members of the radio station that are lower-digitally skilled could possibly maintain and keep the web-platform updated under the conditions that the documentation is up to date with the latest version of the web-platform.

5.3 Requirements overview

The development of the web-platform used an iterative and agile design method which included a feature backlog to keep track of the implemented features during the project. Table 5.1 below shows the overview of the feature backlog and all the requirements that
were implemented and explored during the implementation of the web-platform attributed with the respective data ID from table 4.1 that was used to elicit the specific requirement.

### Table 5.1: Requirements Overview

<table>
<thead>
<tr>
<th>ID</th>
<th>Requirement</th>
<th>Obtained from and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>A multi-language website</td>
<td>Obtained from D20220124. This was one of the first requirements that was discussed and deemed as very important because of the plural languages spoken and is a key to make content relevant to content consumers</td>
</tr>
<tr>
<td>F2</td>
<td>Representative logo’s and colors</td>
<td>Obtained from D20220401. Visually guide visitors, allows visitors to see relations between different parts of the website, also by attributing content with contextual appropriate images or figures, the website will become more relevant to it visitors.</td>
</tr>
<tr>
<td>F3</td>
<td>Advertisements</td>
<td>Obtained from D20220321. Create advertisement banners to enable the radio stations to sell advertisements to local businesses or other entrepreneurs</td>
</tr>
<tr>
<td>F4</td>
<td>Implement social media functionalities/integration</td>
<td>Obtained from D20220321. Key to allow visitors to engage and interact with the radio station. Our client uses Facebook, Telegram and Whatsapp.</td>
</tr>
<tr>
<td>F5</td>
<td>Auto post to Telegram, Whatsapp, Facebook when a new post is created</td>
<td>Obtained from D20220124. An automation feature to omit redundant actions such as sharing a new publication manually to all social media platforms and chat groups.</td>
</tr>
<tr>
<td>F6</td>
<td>Live stream on the website</td>
<td>Obtained from D20220401. Enable website visitors to listen to a live broadcast of the radio station.</td>
</tr>
<tr>
<td>F7</td>
<td>Optimize website for mobile phone</td>
<td>Obtained from D20220401. The majority of the population uses mobile phones, therefore the website must be more optimized for mobile screens than desktops.</td>
</tr>
<tr>
<td>F8</td>
<td>Improve website and media library organization/structure</td>
<td>Obtained from D20220321. From the conducted interviews and observations it became clear that inconsistent structure and organization is a problem that leads to unsustainable practices, especially file management must be reorganized.</td>
</tr>
</tbody>
</table>

Continued on next page
<table>
<thead>
<tr>
<th>ID</th>
<th>Requirement</th>
<th>Obtained from and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>F9</td>
<td>Cost efficiency</td>
<td><em>Obtained from D20220124 &amp; D20220517-A.</em> A requirement that is necessary to minimize the implementation and deployment costs of the web-platform.</td>
</tr>
<tr>
<td>F10</td>
<td>Provide exclusive content behind a paywall</td>
<td><em>Obtained from D20220401 D20220609-B.</em> Besides selling advertisement our client is interested in providing exclusive content, e.g. through paid news channels/groups.</td>
</tr>
<tr>
<td>F11</td>
<td>Enable voting polls on the website</td>
<td><em>Obtained from D20220124.</em> Organizing voting polls to interact with listeners is a common practice of the radio station and should also be a feature on the website, this also allows us to collect feedback on the website from visitors.</td>
</tr>
<tr>
<td>F12</td>
<td>Voice comments</td>
<td><em>Obtained from D20220401 &amp; D20220609-A.</em> As observed in Whatsapp groups and Telegram channels of the radio station, everyone comments with voice messages to each other, the website should also allow visitors to leave voice comments on the broadcasts.</td>
</tr>
<tr>
<td>F13</td>
<td>Documentation</td>
<td><em>Obtained from D20220321 &amp; D20220517.</em> To increase the maintainability and sustainability of the website, documentation explaining how to update and create publications is important.</td>
</tr>
</tbody>
</table>

5.4 Chapter Summary

This chapter provides the answers to the first research question *What are the requirements for digital communication platform for community radio stations in Mali?*. The most important requirements of the web-platform are; the the financial opportunities it opens through advertisement and subscription or exclusive content, the voice-enabled features, and an organized, structured and documented approach to manage the content produced by the community radio stations to ensure a maintainable web-platform.
Chapter 6

Sustainability Assessment and Constraints

This chapter describes the assessment of the sustainability of the web-platform and the encountered constraints. The sustainability aspects that involve or affect the web-platform are divided into the financial, technical, and social dimensions of sustainability. Lastly, the overall sustainability of the platform is discussed by assessing the combination of the financial, technical and social features of the web-platform.

6.1 Financial Sustainability

A healthy financial situation is the cradle of community radio’s existence (9). Notwithstanding that the sustainability of the community radio stations has been a challenge in general, community radio stations are having the most trouble in being financially sustainable (14). Nonetheless, the web-platform will unfold new possibilities for generating additional sources of income which have the potential to improve the overall financial sustainability of the radio station. However, besides being financially sustainable, the web-platform needs to be socially and technically sustainable.

6.1.1 E3 value analysis

The radio station generates its revenue with several activities, which have been identified from the interviews, collaborative workshops, and previously done work by J. Gordijn and A. Bon (25) about E3 value and community radio stations in Mali. To assess the financial sustainability of the community radio station, the E3 Value methodology was used. Applying this modelling approach, the sensitivity of the community radio stations’
6.1 Financial Sustainability

financial situation was exposed. It was found that the radio stations’ main revenue comes from selling air-time, radio advertisement and doing paid announcements. However, if one of them would half, the radio station’s current situation becomes financially unsustainable quickly. However, the web-platforms’ possibility for new income sources such as web-advertisement, and subscription-based content make the radio stations less vulnerable to change. The E3 value analysis found that if the opportunities the web-platform creates are utilized correctly, the community radio stations become much more financially sustainable. For the complete overview of the E3 value, analysis please see appendix 8.

6.1.2 Costly internet

With WordPress being free to use, and the financial impact of the domain name and web hosting service almost being negligible, it was firstly surprising why the interviewed radio stations are convinced that having a web-platform is expensive. However, this premise is in many cases true and is primarily caused by the high costs of the internet that is required to enable specific features on the web-platform and to update and maintain the web-platform with new media content. The availability and reliability of the internet in
Mali is unfortunately still a problem. Despite the internet being available at the radio station of our client, it is very expensive for him. As mentioned earlier on, our main client at Radio Sikidolo pays around €20,- for only 1GB of internet. A 1,5-hour audio recording file in low audio quality is on average 15MB in size. This means that if our client wants to upload a 1.5-hour recording every day for 1 month, he uses around 450MB per month which costs him €10,-. While this might not seem like a lot, this becomes a huge expense for the radio stations if they would upload more content or higher-quality audio files. Thereby the data package is a huge constraint regarding the frequency the web-platform can be updated with new content. Consequently, having a live stream is thereby not feasible at the moment due to the high costs of the internet. 1 minute of live stream is roughly equivalent to 1 MB of data, dependent on the streaming quality, thereby to have a 6-hour live stream per day for a month, you would require a data package of at least 10GB which in Mali costs around €75,- which is currently too expensive.

Table 6.1: Required data to upload recordings or live stream to WordPress

<table>
<thead>
<tr>
<th>Data (GB)</th>
<th>Value (EUR)</th>
<th>day/month</th>
</tr>
</thead>
<tbody>
<tr>
<td>0,5 GB</td>
<td>€10,-</td>
<td>1,5 hour recorded audio</td>
</tr>
<tr>
<td>1 GB</td>
<td>€20,-</td>
<td>3 hour recorded audio</td>
</tr>
<tr>
<td>10 GB</td>
<td>€75,-</td>
<td>6 hour live stream</td>
</tr>
</tbody>
</table>

6.1.3 Third-Party services

By default, WordPress is a free CMS to build and develop web-platforms. However, what’s often the catch with free products, is that you become the product unless you pay. This is exactly the case with WordPress. Many themes and the plugins that you need to utilize to add custom design options or functional requirements, have different versions, meaning there is a free and a PRO version. From experience, it is usually the case that the free version of a theme or plugin is very limited in its customizability, thereby you are pushed towards subscribing to the PRO version. Consequently, the monthly initiated costs accumulate rapidly when more PRO functionalities are required, such as an advanced anti-spam filter which will become a requirement when the web-platform would grow in user activity. And all of a sudden, WordPress is not free anymore but rather too expensive

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51MB * 60min * 6hours * 30days = 10800MB/month
6https://internetpkg.com/mali-internet-packages/
for the radio stations. However, this will not be a problem when the revenue generated with the web-platform out weight these costs. Nonetheless, the new design of the web-platform does not utilize any PRO or paid plugins or themes, implementing the new design is free, except for the required hosting and domain name costs. However, by using only free versions of plugins and themes, other more technical-related sustainability issues can emerge.

6.2 Technical Sustainability

Because WordPress is the most used and most popular CMS to build web-platforms, it is a very sustainable choice to develop your web-platform with, mainly because a large part of the world wide web is dependent on the availability of WordPress. Nonetheless, while remaining in the free zone of WordPress by not using any paid plugin or theme, as a developer you are obligated to use free versions of themes and plugins. Thereby, you need to be on the lookout for outdated and unsupported plugins, this was the case for a plugin that enabled voice comments. The use of this plugin was technically unsustainable because it did not have a security update for over 2 years, but did require a login with Google, or Facebook. Thereby, the decision was made to not implement this feature, also because the usability of the plugin was not as intuitive as using the voice message functions in WhatsApp or Telegram.

6.2.1 Content Organization

The sustainability of the web-platform is greatly affected by the organization of the audio content in the back-end of the web-platform, the media library. As displayed in figure 4.2, the names of the audio files do not refer to specific episodes and categories and are often the automatically generated audio file names from audio files that have been posted in WhatsApp group (figure 4.1) or have been downloaded to the clients’ smartphone. This unstructured approach greatly affects the sustainability of the web-platform because the media library will become unmanageable as it grows in size. For example, one of the interviewed radio stations recorded and stored their broadcast on a USB hard drive, but noted that it was very difficult to maintain this database. The main reason for this was an unstructured approach, the audio files were not uniquely identifiable which results in a disorganized audio database where searching for a specific broadcast becomes impossible or time-consuming task. This example highlights the importance of a structured and
organized database approach in order to effectively and sustainably reuse the information and knowledge from their previous broadcasts.

6.3 Social Sustainability

The social aspects of the web-platform are important factors regarding the overall sustainability, a lot of aspects are dependent on the social success of the web-platform and the number of recurring visitors it can attract and can keep. A good approach to keeping visitors and motivating them to re-visit the web-platform is through engagement with relevant content, it is therefore very important that the web-platform is updated frequently with new content and broadcasts. Frequent updates work as an incentive for people to visit the web-platform, for example, if you would visit a news web-platform, but it only shows news items from last month, you would be less motivated to visit that site again, on the contrary, if the web-platform displays relevant content from today or yesterday, it gives people a reason to visit and consume content which generates activity on the web-platform. Thereby financial sustainability is inherently dependent on social sustainability which will only grow and sustain when frequent updates of relevant and new content are published on the web-platform.

6.4 The Sustainability Circle

The sustainability of the web-platform for Radio Sikidolo is entangled with social, technical and financial capabilities. This is mainly caused by the fact that many aspects of the web-platform are enabled by each other, see figure 6.2. To have the web-platform improve the financial sustainability of the radio station, the web-platform needs to generate revenue. When the revenue is used to create and update the web-platform with quality and relevant news content frequently, the content will function as an incentive for people to visit the web-platform. Next, the web-platform incentives visitors to generate activity. The growing amount of activity on the web-platform makes it attractive for customers to buy advertisements and increases the possibility of people subscribing to exclusive content. However, when looking at the different aspects of the web-platform we can see a vicious circle of sustainability, where the growth is dependent on the snowball effect the web-platform can create.
In this chapter we have covered the sustainability aspects of the web-platform. By applying E3 value analysis we concluded that the financial opportunities of the web-platform strengthen the financial sustainability of the community radio stations. However, the high prices of internet are posing a major barrier for updating the web-platform with new content which is one of the most important activities to make a web-platform social, and economical sustainable. This has to do with the entanglement of social, technical and economical factors that determine the overall sustainability of a web-platform. Thereby the most important constraints and opportunities of the web-platform have been identified and provide the answer to the second research question; What are the main constraints and opportunities in the design and deployment of such a system/platform?
Chapter 7

Discussion and Future work

This chapter covers the discussion and future work that followed from the implementation and deployment of the web-platform. First, the monetization of web-development and its implications are discussed. Secondly, the social interaction and language related short comings are being questioned and a shared platform is proposed. Lastly, the financial opportunities that the web-platform enables and the barriers that withhold doing business with the web-platform are discussed.

7.1 Monetized Development

In this sub-section, the most important encounters with the monetization of technology and its development implications are discussed.

7.1.1 Choice of development framework, easy and free?

As a basic web developer, using WordPress and understanding how it worked was not a very complicated task. However, my understanding of the Internet and web-technology in general is different, and my basic skill set is not something that can be taken for granted in rural Mali. Therefore I question how easy WordPress is for someone who has never used the Internet in such a way. Understanding a drag and drop interface, and how the front-end is connected to the back-end you still require some basic understanding of ICT concepts, such as query looping. I would not underestimate the learning curve of WordPress for someone who is low-digitally skilled. Lastly, to get the most out of WordPress, it is everything besides free or cheap. Subsequently, many plugins and themes are monetized by their developers and sometimes even marketed in a deceiving way. First, you think the plugin is free to use, and only after installing and activating the plugin, you discover
7.2 Language and social interaction

that the specific functionality you were searching for, is behind a expensive paywall. Consequently, the monthly recurring costs of the web-platform will grow tremendously when paid plugins become a requirement and could cause the web-platform to become financially unsustainable.

7.1.2 Monetization of WhatsApp by third-parties

An implementation and development barrier that was encountered multiple times is the monetization of software by third-parties. Similarly as the monetized themes and plugins surrounding WordPress, are WhatsApp business integrations monetized by third-party companies. This is unfortunate because WhatsApp is used by a lot of people in Mali and also by the Radio Station. Currently, a business integration of WhatsApp at the community radio stations is not possible due to the development costs invoiced by third-party app developers. Additionally, if you want to start developing applications for WhatsApp yourself, you need to apply for a business account, which requires a registered business at the chamber of commerce, and it also includes an interview to assess the intent of your development before you get access to their API and start developing your application. This bureaucratic process withholds development around WhatsApp, in contrast, Telegram is open source software, therefore development around Telegram is much more out in the open, and integrating Telegram into your business is free and accessible if you know how to use their API.

7.2 Language and social interaction

This sub-section describes the implementation constraints that were identified regarding language and interaction on the web-platform and what future development is required to overcome these and advocates for a shared platform.

7.2.1 Inconsistent multi-language websites for "small" languages

The requirement of having multiple languages is essential in making the web-platform relevant to the target audience of the radio station. However, many of the plugins that can be used to activate such a feature rely on auto-translating parts of the web-platform. Unfortunately, the local dialect and small-languages are not supported for auto-translations because they have been under-resourced to develop such features. Because of the ineptitude of auto-translation tools, everything on the web-platform has to be translated manually. For the static parts of the web platform, such as the names of the categories or contact
7.2 Language and social interaction

information page, this would be a one-time effort. However, for dynamic content on a platform, such as new publications, you have to do double work, the more languages the web-platform supports, the more manual translations have to be done for each new post-publication. A post about agriculture and was written in French should also be manually translated into Bambara or any other small-language or local dialect that the web-platform wants to support. Additionally, each translation of a post counts as a new post in the post overview and can therefore be seen as a duplicate post, but in a different language, see figure 7.1. Consequently, it significantly increases the number of posts in the overview and can become cluttered as the number of posts grows over time and can cause similar organization problems that were observed around naming the audio files, see figure 4.2.

Figure 7.1: Site-map, post structure for multi-language websites

Furthermore, when a translation for a post is inconsistent, for example, post 4 in figure 7.1 is missing a translation to Bambara, the post will not be shown to visitors that have the language of the web-platform set to Bambara. Therefore, the effectiveness of this approach can be questioned because to effectively enable a multi-language web-platform, it would mean that audio files (the radio broadcasts) should also be presented in multiple languages or the web-platform could just only support the one language that is spoken the most by the target audience, because if a post is presented in two languages but the audio file is not, the radio broadcast is still only accessible to people who are proficient in that specific language. To alleviate the confusion this could cause to new visitors, a post could be attributed with a visual aid that shows which language is spoken in the broadcast, but then we should question what visual aid should be used? Lastly, many of the special
characters used in Bambara are not supported on the internet or by devices, thereby a
textual translation of English to Bambara would not include all the correct characters
and could still be incomprehensible for someone, therefore we need to develop the special
character set used in languages like Bambara before consistent translation features can be
developed. Concluding, a deliberate decision on the supported relevant languages should be
made, and a structured approach or method should be implemented to maintain consistent
manual translations.

7.2.2 The need for voice-enabled features

Our client at Radio Sikidolo envisions an African news and media platform for radio
stations. Before this could evolve, first the need for accessible voice-enabled features must
be satisfied to create a platform or forum where the visitor can comment and respond
to each other using their voice. The observations made by being in the WhatApp group
of our client proves the urgency of voice-enabled features. WhatsApp and Telegram are
primarily used because they are very intuitive with this. Currently, the web-platform is
missing this feature, with the consequence that many visitors cannot reply or comment on
the publications, therefore the web-platform is missing out on a lot of activity required to
attract advertisers and can be used to generate revenue. Furthermore, the consequences
of not having voice-enabled features affect the implementation of many other features
such as subscription-based content to generate revenue. The fact that the functionalities
of a Telegram bot are depended and enabled by text is a huge implementation barrier
considering the high rate of illiteracy in Mali. To develop a voice-enabled bot either with
Telegram or WhatsApp, the same contextual-need problems will be encountered as with
the implementation of interactive voice response systems (IVRs). To effectively implement
voice-enabled bots they need to be able to respond in the relevant language of the customer,
to enable such functionalities, text-to-speech and speech recognition technology is required
by the bot to interpret the voice messages from the customer and to be able to respond with
a voice message in the same relevant language. Unfortunately, accessible and easy-to-use
speech recognition technology is currently not available in the local languages spoken by
the Malian population (20). Therefore, web-platforms of community radios can only evolve
into the envisioned discussion, social and multi-media platform until better voice-enabled
features are developed.
7.2.3 Sharing the platform

The interviewed radio stations and our main client pointed out that they share and exchange content with each other. Thereby the web-platform could function as a central share point to let radio stations exchange media-content. However, an organized system and standardized methods needs to be developed to implement this sustainably. Nonetheless, by collaborating and sharing the platform, the costs involving the platform and exchanging data can also be shared between the participating community radio stations and when more community radio stations participate, the web-platform can be updated more frequently which can the social and financial sustainability.

7.3 Doing business with the radio-platform

This sub-section discusses the business an financial aspects of the web-platform and the current short comings and future work which is needed.

7.3.1 Online payment systems for the unbanked

While exploring the options to create a system for the radio station to provide exclusive or subscription bases content for their target audience, the inability to do online payments in Mali was a major implementation barrier. This is the main reason why the financial opportunity of having paid or subscription-based content (see 5.2.1.3) was not successfully implemented on the new web-platform. While exploring the options to monetise a Telegram channel, it was found that a telegram bot to do this already exists, the “invitemember” bot. However, while testing the functionalities of this bot an important implementation constraint was observed. The “invitemember” bot allows customers to pay for their subscription plan only by credit card, PayPal or Stripe which are payment methods and services that are unavailable to the majority of the population in Mali, most people in Mali are not connected to an established bank and cannot apply for a credit card. The “invitemember” bot does provide functionalities to manage channel subscriptions with special access codes and cash payments, unfortunately, these functionalities are closed off behind a pay-wall of 49 dollars per month. This is again a perfect example of functionalities that are not feasible for the radio stations because they are behind a paywall which too expensive. This amount of money would only be worth spending if the radio station can make more than 50 dollars each month by selling Telegram channel subscription plans, nevertheless, with Telegram being open-source it might not be too difficult to develop a similar bot.
that is more aware of the contextual needs in Mali. On the other hand, why would we need online payments? The radio stations manage paid announcements, sell air-time, and manage their revenue themselves. Thereby the radio station could potentially manage the subscriptions and respective transactions also themselves. However, the key difference is the transaction throughput the radio station can handle. For example, currently, our main client manages three WhatsApp groups with 250 members, if all of those members would be on a subscription-based plan, the radio station needs to handle at least 750 transactions each month, notwithstanding that Telegram groups can have 200,000 members and channels are unlimited. Thereby an automated system that handles the payment transaction becomes a requirement to manage such amount of subscriptions or transactions efficiently.

However, the ability to do online mobile-money payments is becoming available throughout Africa. One of the technologies that are growing exponentially is mobile money. M-Pesa is one of the largest mobile money suppliers throughout Africa and has an open source API, thereby developing mobile-money applications with M-Pesa is accessible. On the contrary, in Mali, M-Pesa is not available and the largest mobile-money supplier is Orange-mobile, however, the API of Orange money is closed source, to start developing Orange-mobile applications you need access to their API and go through a similar registration process as with WhatsApp.

### 7.3.2 Web-advertisement

Besides being an easy feature to implement on the web-platform, the discussion around advertisements has to do with the question: who is going to create the advertisement? For example, a rural farmer, who does not have a computer or smartphone would like to advertise his products on the web-platform, who is responsible for supplying the advertisement, the farmer or the radio station? How inclusive is this method? Unfortunately, these questions remain unanswered but need to be solved before advertisements can be implemented effectively.

### 7.4 Chapter Summary

The discussion of the various aspect of the web-platforms showed that there is still a lot to be developed. The monetization of WordPress and other services and software barricade many implementations when financial capabilities are constraining. Furthermore, this chapter advocates for the development of a voice-enabled and shared discussion platform
as well as the development of online mobile money payments in order to enable and utilize the financial opportunities the web-platform brings to community radio stations correctly.
Chapter 8

Conclusion

This design science and action research project has made several contributions to the global question: "What can we learn from studying the rapid digitalization process that is taking place throughout Africa?". The implementation of the web-platform and its requirements answer the first research question "What are the requirements for digital communication platform for community radio stations in Mali?". The sustainability assessment shows that the web-platform can improve the financial sustainability of the community radio station when the opportunities that the web-platform creates are utilized correctly. The second research question "What are the main constraints and opportunities in the design and deployment of such a system/platform?" is answered through the sustainability assessment of the requirements. The monetization of software makes web-development costly when more advanced functionalities are required and barricade the possibility to development and integrate such features by yourself. Furthermore, the incredible high prices of the Internet make a live-stream to reach the diaspora of the community and an audience beyond their boarder not feasible. Consequently, it constraints the maintainability and the upload frequency of new content on the web-platform and limits the ability to archive and share the content online, which is an important requirement to ensure the overall financial and social sustainability of the web-platform and the sustainability of the disseminated knowledge and information by the radio stations. Additionally, standardized methods to update and organize the website and to ensure consistent translations when multiple "small" languages are supported need to be developed. Furthermore, the current inability to implement voice-enabled features, and do online mobile-money payments contribute to the same social and financial sustainability problems and have to be developed in the future. All together, the current constraints withhold the opportunities and the evolution of a shared social, multi-media and voice-enabled web-platform, but when internet prices
drop, the requirement of a voice-enabled discussion platforms is satisfied, and online mobile-
money payment options become available, the community radio stations can start to evolve
from analogous broadcasting stations into fully digitized media outlets.
References


[16] A. Shepherd. Lessons for sustainability – Failing to scale ICT4Ag-enabled services, 2016. 7


Table 8.1: Value objects

<table>
<thead>
<tr>
<th>Object</th>
<th>Value (CFA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>News Item</td>
<td>1000</td>
</tr>
<tr>
<td>Air time</td>
<td>4000</td>
</tr>
<tr>
<td>Advertisement</td>
<td>1500</td>
</tr>
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</table>

Continued on next page
### Table 8.1: Value objects (Continued)

<table>
<thead>
<tr>
<th>Object</th>
<th>Value (CFA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Announcements</td>
<td>750</td>
</tr>
<tr>
<td>Internet</td>
<td>13,500</td>
</tr>
<tr>
<td>Website</td>
<td>2000</td>
</tr>
<tr>
<td>Third-party functionality/service</td>
<td>7000</td>
</tr>
<tr>
<td>IP rights</td>
<td>450,000</td>
</tr>
<tr>
<td>Subscription</td>
<td>150</td>
</tr>
</tbody>
</table>

### Table 8.2: Size, needs and occurrences

<table>
<thead>
<tr>
<th>Market segment</th>
<th>Size</th>
<th>Needs</th>
<th>Occurrences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local businesses</td>
<td>300</td>
<td>1</td>
<td>300</td>
</tr>
<tr>
<td>Air time customers</td>
<td>100</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Announcement customers</td>
<td>1200</td>
<td>1</td>
<td>1200</td>
</tr>
<tr>
<td>Citizen journalists</td>
<td>85</td>
<td>8</td>
<td>680</td>
</tr>
<tr>
<td>Smartphone users</td>
<td>750</td>
<td>1</td>
<td>750</td>
</tr>
</tbody>
</table>
### Table 8.3: Netcashflow

<table>
<thead>
<tr>
<th>Interface</th>
<th>Port</th>
<th>Occurrences</th>
<th>Valuation</th>
<th>Transferred</th>
</tr>
</thead>
<tbody>
<tr>
<td>{internet, MONEY}</td>
<td>in: internet</td>
<td>1</td>
<td>- CFA</td>
<td>- CFA</td>
</tr>
<tr>
<td></td>
<td>out: MONEY</td>
<td>1</td>
<td>13.500 CFA</td>
<td>- 13.500 CFA</td>
</tr>
<tr>
<td>{web_site, MONEY}</td>
<td>in: web_site</td>
<td>1</td>
<td>- CFA</td>
<td>- CFA</td>
</tr>
<tr>
<td></td>
<td>out: MONEY</td>
<td>1</td>
<td>2.000 CFA</td>
<td>- 2.000 CFA</td>
</tr>
<tr>
<td>{functionality, MONEY}</td>
<td>in: functionality</td>
<td>1</td>
<td>- CFA</td>
<td>- CFA</td>
</tr>
<tr>
<td></td>
<td>out: MONEY</td>
<td>1</td>
<td>7.000 CFA</td>
<td>- 7.000 CFA</td>
</tr>
<tr>
<td>{ip_rights, MONEY}</td>
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<td>0,083</td>
<td>- CFA</td>
<td>- CFA</td>
</tr>
<tr>
<td></td>
<td>out: MONEY</td>
<td>0,083</td>
<td>450.000 CFA</td>
<td>- 37.500 CFA</td>
</tr>
<tr>
<td>{news_item, MONEY}</td>
<td>in: news_item</td>
<td>680</td>
<td>- CFA</td>
<td>- CFA</td>
</tr>
<tr>
<td></td>
<td>out: MONEY</td>
<td>680</td>
<td>1.000 CFA</td>
<td>- 680.000 CFA</td>
</tr>
<tr>
<td>{MONEY, air_time}</td>
<td>in: MONEY</td>
<td>100</td>
<td>4.000 CFA</td>
<td>400.000 CFA</td>
</tr>
<tr>
<td></td>
<td>out: air_time</td>
<td>100</td>
<td>- CFA</td>
<td>- CFA</td>
</tr>
<tr>
<td>{MONEY, advertisement}</td>
<td>in: MONEY</td>
<td>300</td>
<td>1.500 CFA</td>
<td>450.000 CFA</td>
</tr>
<tr>
<td></td>
<td>out: advertisement</td>
<td>300</td>
<td>- CFA</td>
<td>- CFA</td>
</tr>
<tr>
<td>{MONEY, announcement}</td>
<td>in: MONEY</td>
<td>1200</td>
<td>750 CFA</td>
<td>900.000 CFA</td>
</tr>
<tr>
<td></td>
<td>out: announcement</td>
<td>1200</td>
<td>- CFA</td>
<td>- CFA</td>
</tr>
<tr>
<td>{MONEY, subscription}</td>
<td>in: MONEY</td>
<td>750</td>
<td>150 CFA</td>
<td>112.500 CFA</td>
</tr>
<tr>
<td></td>
<td>out: Subscription</td>
<td>750</td>
<td>- CFA</td>
<td>- CFA</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td></td>
<td></td>
<td>1.422.500 CFA</td>
<td>€ 2.177,99</td>
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