Automatic Generation of an Informative Marketing Technological Platform

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Abstract: In the current global context, Small- and Medium-sized Enterprises (SMEs) must face challenges in order to reach and maintain a fitting competitive level, and improve their performance. Today, information is one of the most important resources for them. Being able to correctly manage information is a key factor, also with reference to digital marketing activities. The paper presents InfoMkBuilder, a tool able to automatically generate Informative Marketing (IM) technological platforms, i.e., digital platforms for SMEs, in order for them to carry out IM campaigns and strategies. IM is a novel digital marketing model based on valuable information definition and delivery. InfoMkBuilder supports SMEs in overcoming and/or sidestepping their limitations and barriers in adopting digital technologies. The tool implements Model-Driven Architecture (MDA) transformations and a Unified Process (UP) methodological approach to generate the IM technological platforms, and is able to deploy them on the Cloud.

1 INTRODUCTION

In the current global context, any company or organization must face challenges in order to reach and maintain a fitting competitive level and improve its performance by adopting digital technologies (Martínez-Caro et al., 2020). In such a scenario, Small- and Medium-sized Enterprises (SMEs) generally face limitations and barriers to a greater extent than other firms. For instance, limited resources are one of the primary factors affecting SMEs capability to compete globally (Masroor and Asim, 2019). The lack of international experience (Pereira et al., 2022), and the low levels of digital skills among firms (Scuotto et al., 2021) are other primary factors. The Covid-19 pandemic has impacted on the scenario depicted above as well (Thorgren and Williams, 2020).

Today, information is one of the most important resources for any company or organization, including SMEs (Mutula, 2010). If information is not adequately managed and processed, it risks resulting useless for the business structure. Being able to correctly manage information is a key factor, also with reference to digital marketing activities (Ismoilova et al., 2021). Information is one of the main means by which it is possible to transfer the value of a proposal to potential customers (Tafesse and Wien, 2018). An increasing number of people are spending more and more time on the Web searching for information about products and services (Dwivedi et al., 2020). This search is essential for the final choice they make. Concerning this point, (Clark et al., 2009) stated that providing basic information should be the dominant role of advertising.

The importance of information in digital marketing enhances the need for digital solutions in order to manage, create, and spread valuable contents. (Di Valerio et al., 2020) proposed a new digital marketing model, named Informative Marketing (IM), in order to stress the importance of information to be delivered to customers while setting up and implementing digital marketing strategies. The adjective "informative" is meant to point out that the information purposely gathered and structured is targeted to a specific segment; therefore, it can be assumed that it is relevant for the selected audience. The IM is implemented by means of a technological platform derived from (Sun et al., 2015).

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In order for a SME to implement digital solutions, it must overcome and/or sidestep the limitations and barriers previously mentioned. In this regard, model-driven techniques (Brambilla et al., 2017) are a relevant solution: model-driven refers to a set of methodologies and instruments based on models and model transformations, which prove to be effective in designing and developing software systems. Using model-driven development approaches allows for automatic code generation, though they're not widely adopted yet to generate whole systems (Whittle et al., 2014). The Unified Modeling Language (UML), and the Use Case construct in particular, is another means able to simplify system designing and development. UML diagrams are often used in automatic code generation. According to (OMG, 2017), Use Cases "*are a means to capture the requirements of systems, i.e., what systems are supposed to do*". A Use Case exists in a business context regardless of the automation process. (Paolone et al., 2010) proposed a model-driven methodological approach for ensuring continuity among business modeling, system modeling, design, and implementation. The work is part of a long-term industrial project, whose last main pillar is (Paolone et al., 2020), regarding the automatic generation of enterprise web applications. (Paolone et al., 2010) adopted a Use Case-driven approach (Paolone et al., 2008), based on the Unified Process (UP) (Kruchten, 2003).

This paper presents a new tool, called InfoMkBuilder, based on (Di Valerio et al., 2020) and (Paolone et al., 2010). InfoMkBuilder is an automatic code generator of IM technological platforms, based on model-driven techniques and able to deploy the generated solution on the Cloud. InfoMkBuilder is meant to be a tool that actually supports SMEs in enhancing their digital visibility and competitiveness in the global scenario, helping them overcome the well-known limitations and barriers in implementing digital technologies in their structure and processes. As far as we know, there are no proposals in the literature concerning automatic code generators for creating digital marketing platforms.

This paper consists of five sections: after the Introduction, Section 2 summarizes the background; Section 3 describes our proposal. A case study is given in Section 4. Section 5 contains the conclusions and the future work.

2 BACKGROUND

The background concerns: 1. the IM, a new marketing model which aims to use valuable information as primary marketing instrument; 2. the automatic code generation by means of model-driven approaches (Model-Driven Architecture - MDA in particular) and UP.

2.1 The IM Technological Platform

(Di Valerio et al., 2020) investigated the state of the art of digital platforms, identifying the model proposed in (Sun et al., 2015) as starting point for building up an IM technological platform (Figure 1).

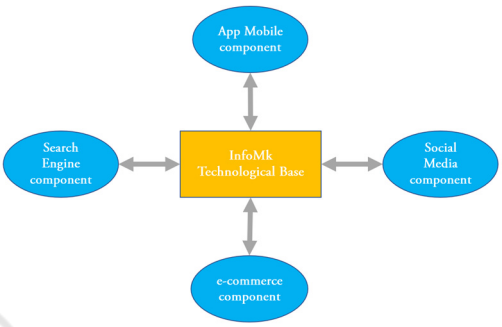

Figure 1: The IM technological platform.

The IM technological platform is composed of four add-ons (e-commerce, social media, search engine, App mobile) and a technological base (Figure 2). The latter is composed of a DB, an Autoresponder, and the following subsystems: Opt-in page, Thank you page, Landing page, and Sales page.

Figure 2: The IM technological base.

The IM technological platform can be used to promote and sell any kind of product or service.

2.2 Automatic Code Generation

From a technological perspective (in addition to UML as modeling language, and Cloud Computing as deployment environment), the MDA model transformations and UP are the foundations of our proposal. A short description of the well-known basic concepts above mentioned is given below.

To better clarify what a model transformation is, the definitions of model and metamodel are provided. A model is "*a simplification of a system built with an*

intended goal in mind" (Bézivin and Gerbé, 2001). A model is an abstract and simplified view of a system, however complex. A metamodel is "*a model that consists of statements about models*" (Jeusfeld, 2009). Essentially, a metamodel is a model of a model. A model transformation converts models between different abstraction levels, gradually adding more details by means of transformation rules and transformation languages. Transformations are defined at a metamodel level (Magalhaes et al., 2019). Transformations are categorized as Model to Model (i.e., between models) or Model to Text (i.e., from a model to the code written in a programming language).

Model-driven refers to software development paradigms that emphasize the use of models as primary artefacts in the software development lifecycle. According to (Jörges, 2013) Model-Driven Engineering (MDE), Model-Driven Development (MDD), and Model-Driven Software Development (MDSD) are largely used synonymously, although some distinctions can be made regarding these acronyms, as in (Brambilla et al., 2017). The goal of model-driven is to automate different steps in software development and improve the software overall quality. MDA is an approach defined by the Object Management Group (OMG) (OMG, 2014), that provides guidelines to perform model transformations across three levels (progressively decreasing the abstraction level): Computation Independent Model (CIM); Platform Independent Model (PIM); Platform Specific Model (PSM). (Sebastián et al., 2020) is a systematic mapping study of MDA. UML is a standard used to specify models in MDA, although it is not mandatory.

UP is an iterative and incremental process for planning and managing software projects (Kruchten, 2003). It includes disciplines (Business Modeling; Requirements; Analysis and Design; Implementation; Test; Deployment; Configuration and Change Management; Project Management; Environment), and phases (Inception, Elaboration, Construction, Transition). UP can be applied to any type of system to be automated.

3 INFOMKBUILDER

This section starts by briefly discussing about implementing an IM technological platform with a non-generative process, then gives an overview of InfoMkBuilder: model transformations and the related UML diagrams are provided. Next, a subsection about how-to use the prototype of InfoMkBuilder follows.

3.1 Developing an IM Technological Platform

According to a non-generative development process, the creation of an IM technological platform requires that an IM Manager (i.e., a SME manager/employee who has previously learned the basics of IM) relies on a development team for implementing the software solution. A development team (or a single developer) is needed to develop each subsystem of Figure 2; the development process has to be repeated for each of them. The subsystems of the technological base can be developed in Java technology, Microsoft.net technology (C# language), PHP, etc. The DB can be developed in Microsoft SQLServer, PostgreSQL, etc.

In order to improve the process and make SMEs autonomous in creating their own IM technological platforms, we propose an automatic generation process and a tool, InfoMkBuilder, able to return the solutions and deploy them on a Cloud environment. Thus, only the IM Manager is needed: he could use InfoMkBuilder without relying on developers and with no programming skills. The IM Manager must know: 1. IM principles; 2. what a UML Business Use Case is.

3.2 InfoMkBuilder Overview

InfoMkBuilder is a tool developed in Microsoft.net technology, C# language, according to the specifications of the Microsoft Model View Controller (MVC) pattern. InfoMkBuilder implements the model transformation defined at a metamodel level, and adopts the OMG vision about MDA (see Subsection 2.2).

InfoMkBuilder is meant to generate the IM technological platform in (Di Valerio et al., 2020), and deploys it on the Cloud. According to (Paolone et al., 2010), the model transformations occur across the MDA levels as shown below. At a high level of abstraction, the IM technological platform can be modeled as described in Figure 3. The design of an IM technological platform is a complex process, since it represents the automation of a web system. The most delicate part of this process is identifying the Use Cases, which express the interactions between end-users and the system according to the IM process and establishing the communication between all stakeholders. The solution we developed starts from the business modeling with business analysis, distinguishing between business Use Case modeling

and business analysis modeling: business modeling layers remain the same, with a realization process that connects them. Instead, during the system analysis phase, we introduce a trace operation of both business modeling layers (Business Modeling in Figure 3) into the two system modeling layers (System Modeling in Figure 3).

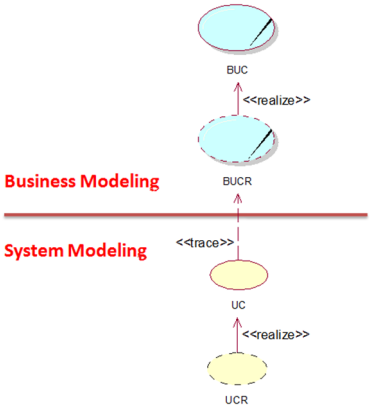

Figure 3: The methodological process.

The Business Use Case Realizations (BUCRs) diagram presents the Business Actors (for example, Manager and Customer) and the BUCRs - those that are directly instantiated and generated by InfoMkBuilder. BUCRs describe a behavior from the user's perspective. The diagram is the CIM of the automatic generation process, concerning the system's behavioral aspect. This diagram has to be manually realized. Using InfoMkBuilder, all the other subsequent Use Case diagrams don't have to be realized: InfoMkBuilder performs the automatic model transformations. The PIM and PSM diagrams are simulated by the generator, that returns the software code and deploys the application.

The System Use Cases (SUCs) diagram presents the System Actors and the SUCs corresponding to the BUCRs. This diagram is the PIM of the automatic generation process. The PIM is directly related to the IM technological platform model in Figure 1. Each BUCR is to be traced to a SUC. The Business Actor is traced to the System Actor and is named with the same name of the Business Actor with the addition of "Admin". The "communicate" action in the business model is replaced by "use", to specify that the Actor will *use* the Use Cases in the software system according to UML. In fact, "*A use case is a description of sequences of actions that a system performs that yield observable results of value to a particular actor.*" (Booch et al. 2005).

The PSM is described by means of a System Use Case Realization (SUCRs) diagram. SUCRs describe the behavior from the machine's perspective. Technological Use Cases can be added to SUCRs, for example *login*.

Then, InfoMkBuilder transforms the PSM into code. The transformations output is described in Section 5, where a generated case study is shown. The Opt-in page, Thank You page, Landing page, and Sales page subsystems are generated in Microsoft.net technology (C# language); they are built on top of a Microsoft SQLServer DB.

3.3 How It Works

This subsection describes the process for generating an IM technological platform. We describe InfoMkBuilder from a user perspective. Since the tool and the approach are in an early development stage, we provide an abstract description of both, to be expanded and detailed in the future research activities. InfoMkBuilder is, in fact, still a prototype, which is able to perform the model transformations across MDA levels.

The Admin, i.e., the InfoMkBuilder general manager, creates a Company and enables an IM Manager – see Subsection 3.1 - to use the tool. The Admin Use Cases are shown in Figure 4.

Figure 4: Admin Use Cases.

The Admin, who has a comprehensive view of all the Use Cases of InfoMkBuilder, registers the SME of the IM Manager (Company Use Case in Figure 4) and enables him to create a number of Projects, up to a maximum of 10 (Enabling Use Case in Figure 4). The Admin can also assign multiple SMEs (networks or company group) to a single IM Manager.

The IM Manager receives a notification by email, and then, by clicking on the link in the email, he can set his credentials and start creating his Project(s). The IM Manager Use Cases are shown in Figure 5.

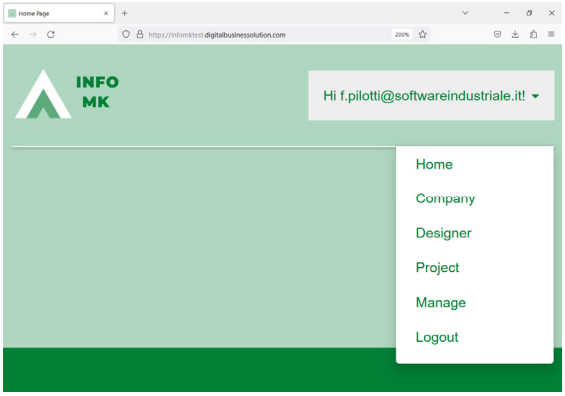

Figure 5: IM Manager Use Cases.

The IM Manager can view and manage only his Project(s) and his Company(ies). The Project Use Case is shown in Figure 6.

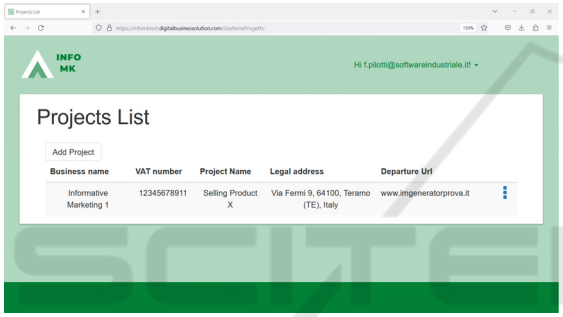

Figure 6: Project Use Case.

For each Project, the IM Manager Actor has the included Use Cases shown in Figure 7.

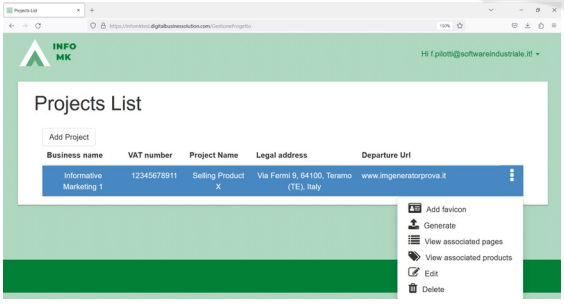

Figure 7: Project included Use Cases.

The IM Manager can choose the subsystems to be generated by the tool, by means of the View Associated Pages Use Case (Figure 8). He can also upload the information regarding the products/services to be promoted and sold, by means of the View Associated Products Use Case (Figure 9). Each Sales page subsystem is directly linked to a single product.

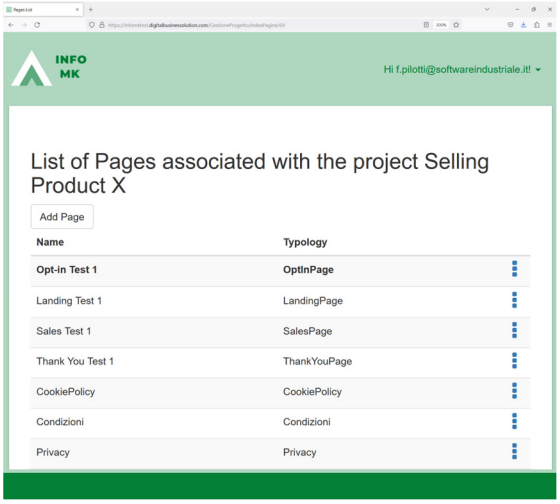

Figure 8: View Associated Pages Use Case.

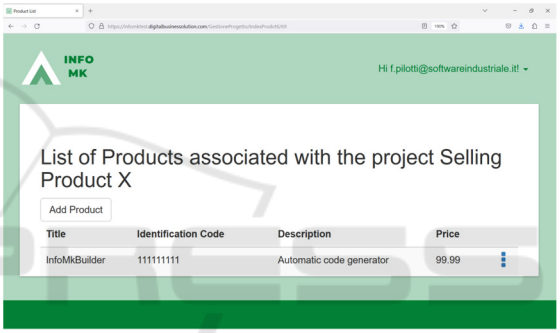

Figure 9: View Associated Products Use Case.

The IM Manager can choose whether to enable a Designer – an employee of the IM Manager's SME – as responsible for the definition of a Project's digital contents, linking him to the Project. The Designer can only view and manage the Project he is in charge of. The IM Manager chooses and gets an URL actually identifying an instantiated domain to deploy the IM technological platform. It's possible to get a preview of the subsystems by using the Preview Use Case (Figure 10).

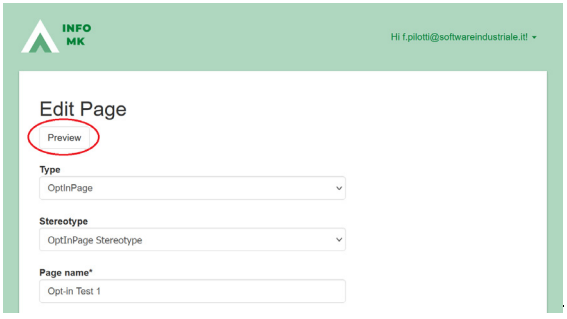

Figure 10: Preview Use Case.

With the Generate Use Case, the IM Manager generates the IM technological base subsystems. The scenarios sequence of the Generate Use Case is Shown in Figure 11.

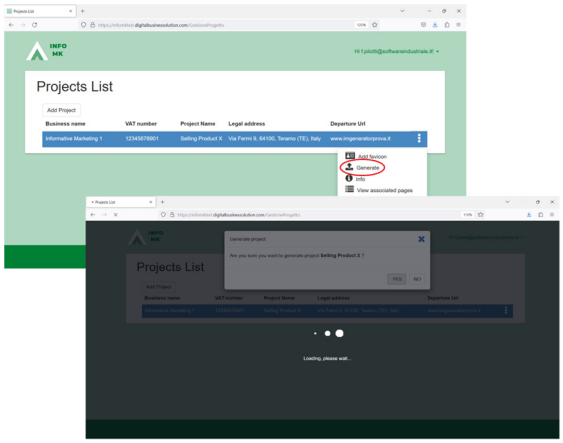

Figure 11: Generate Use Case.

The tool deploys the subsystems on the Cloud (on the domain chosen by the IM Manager) and at the same time creates an empty DB and an Autoresponder associated with the IM technological platform. Since the purpose of InfoMkBuilder is to generate a working website, the tool generates also the Cookie Policy, Conditions, and Privacy web pages by default.

4 A CASE STUDY

The section describes a case study that shows the automatic generation process with InfoMkBuilder. The case study is the Project "Natural Wine". The Project concerns an IM campaign to inform potential stakeholders about the features of natural wine. In this Project, we create two Opt-in pages for two different stakeholder classes, three Landing pages to describe the peculiar features of three different products (natural wines), and the related Sales pages. The Thank You pages have to be generated both after the Opt-in pages and the Sales pages (after a purchase).

As stated in Subsection 3.1, the IM Manager must know the UML Business Use Case construct and a UML modeling tool. All the following diagrams are realized with StarUML (https://staruml.io/).

The BUCRs diagram in Figure 12 presents the Business Actors (Web User and Potential Customer) and some of the BUCRs. As stated in Subsection 3.2, this diagram is the CIM of the automatic generation process, concerning the system's behavioral aspect. This diagram has to be manually realized.

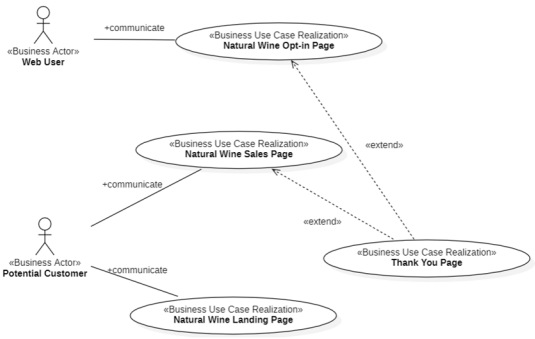

Figure 12: Natural Wine BUCRs diagram.

The SUCs diagram in Figure 13 presents the System Actors and the SUCs corresponding to the BUCRs. This diagram is the PIM of the automatic generation process. Each BUCR is to be traced to a SUC. The Business Actors are traced to the System Actors and keep the same name. The "communicate" action is transformed into "use".

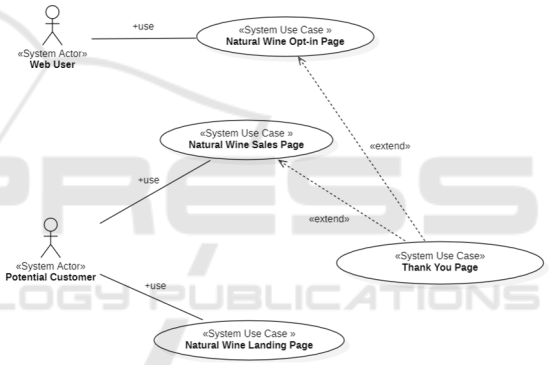

Figure 13: Natural Wine SUCs diagram.

The PSM is described by means of SUCRs in Figure 14. Technological Use Cases can be added to SUCRs. In our example, for the sake of simplicity, a one-to-one correspondence is shown.

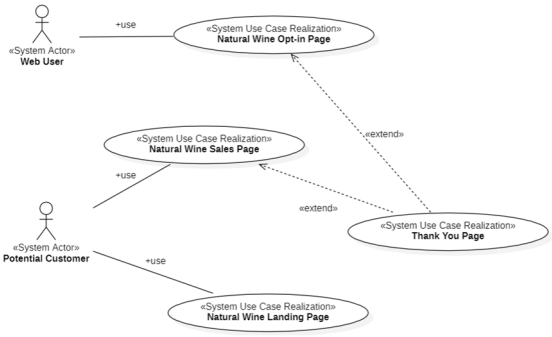

Figure 14: Natural Wine SUCRs diagram.

InfoMkBuilder generates the code by implementing the automatic model transformation from CIM to PIM (from Figure 12 to Figure 13), from PIM to PSM (from Figure 13 to Figure 14), and from PSM to code (from Figure 14 to C# code).

InfoMkBuilder also creates the deploy unit on the domain defined by the IM Manager. A couple of screenshots of the generated Natural Wine IM subsystems are shown in Figure 15 (Opt-in page) and Figure 16 (Landing page).

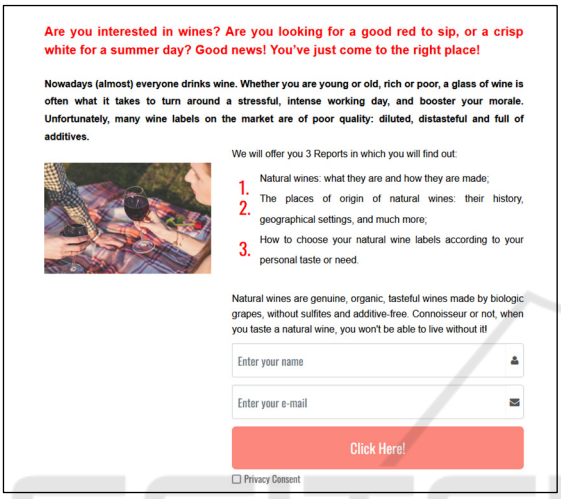

Figure 15: Opt-in page.

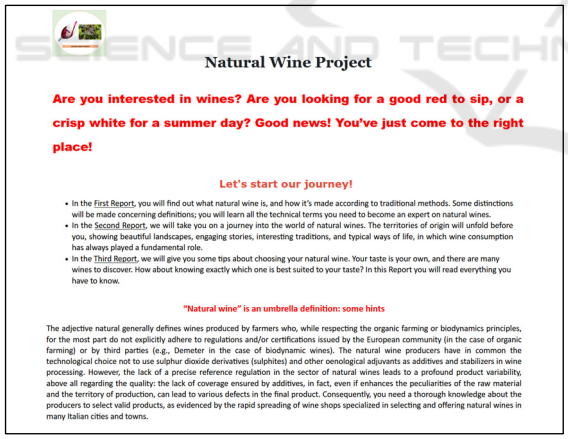

Figure 16: Landing page.

5 CONCLUSIONS AND FUTURE WORK

As recently stressed in (Farida and Setiawan, 2022), innovation is one of the most effective drivers to foster SMEs competitiveness. The "*best use*" of digital platforms, adopting technology, digital marketing, and innovations, according to (Hossain et al., 2022), ensured "*the peak of success and profitability*" for enterprises during the Covid-19 pandemic. With InfoMkBuilder, the proponents intend to release a tool specifically tailored to SMEs needs, in order for them to innovate their infrastructures and be able to implement digital marketing activities with little economic investments and no programming skills, and so compete - and hopefully thrive - in a globalised scenario. By using InfoMkBuilder, interested SMEs will be facilitated in instantiating by themselves an IM technological platform.

The IM and InfoMkBuilder prototype are part of an ongoing industrial research project. Future work concerns primarily the improvement and formalization of the model transformation rules (digital transformation semantics), and subsequently the tool full development. At present, the prototype is able to automatically generate the subsystems of the IM technological platform. The automatic generation of the add-ons in Figure 1 will have to be implemented, to make the tool able to automatically generate a whole IM technological platform. Then, testing activities and validation of the tool through case studies in real contexts (in different sectors) will be carried out.

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