

Creating a Digital Twin to the Online Promotion Process for Small Businesses

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Abstract—The article has developed a concept and algorithm for creating the digital twin (DT) of a small enterprise. Tools for generating high-quality information flows for prototyping and online promotion have been developed. The novelty of the concept lies in the fact that the digital twin is not a mirror of the existing enterprise. It is considered as a dynamic prototype of the development process from the simplest microenterprise to the necessary forms set by the matrix of targets and constraints (MTC). These developments reveal the potential of the digital twin for the development of small businesses, in particular, by improving scenario forecasting.

Keywords: *digital twin, small business, ontology, online promotion process, a conceptual model of online promotion*

I. INTRODUCTION

The digital twin technology is successfully used in large-scale industrial complexes [1], in various areas of large business. The term "Digital Twin" does not have an unambiguous definition and application. Often, when creating a virtual copy, the emphasis was placed on mirroring with a real object, and the emphasis was placed on visualization. This concept is suitable for building a digital twin in industry, for debugging mechanisms, etc. DT for modeling and designing digital description and process control systems does not have to be visualized, it is an artificial intelligence product that must repeat actions and reproduce the dynamic transformations that are taking place. The virtual copy can be used for observing actual processes, as well, as for predicting future ones [2]. Accuracy in forecasting is the key to the company's development. At the moment, there are methods for assessing the accuracy of enterprise risk research [3-4], tools for calculating business profitability, but they are available to specialists in the field of Economics or for businesses that can afford to have a staff of professionals. Small businesses, in particular microenterprises, usually do not have the financial capacity to employ a development specialist. The formation of a software, intellectual product of promotion or its forecasting, which can be applied in different areas of activity, is an additional tool for the development of small businesses.

This article is devoted to the method of building a digital twin of online promotion. The fastest way to find buyer is online resources. But not always the cost of an advertising campaign, traffic, and number of sales match the expectations of business owners. The tools for calculating the advertising budget offered by search engines usually do not match the actual expenses at times. This article describes the structure of online promotion. The main material for building digital twin is information flows [5]. Identifying data [6], structuring it, and transforming it is the most difficult task for modeling virtual copies. The article develops a method for converting information flows using ontology [7] into an interoperable form that can be used for digitization. The result of this work is the concept of a digital dtwin for online promotion, and an interface has been developed.

II. METHODOLOGY FOR FORMING A DIGITAL TWIN

It is proposed to use such a concept as "blackboard" architecture [8]. Building a DT requires a huge flow of information, elements of which can change over time or interact with each other. It is important to place this data correctly so that it can self-regulate depending on the situation. All information is placed on the "blackboard" and becomes available to all subsystems involved in the process, respectively, any change is immediately available to all elements and can be used to correct data in other subsystems. This principle of data interaction helps to improve the quality of dynamic information.

The complexity of forming digital twin is that the descriptive mechanism, a set of regulatory documents of enterprises does not have a single basis. Firstly one need to determine what data is high-quality, accurate, and necessary to achieve the goal. It is also important to clearly describe and transform information flows so that they become interoperable for machine representation of data. To transform a process into machine code, it is proposed to use the concept of ontology [9].

The term ontology in information technology refers to the formalized representation of data. This is a symbol structure that computer programs can understand. Using ontology, one

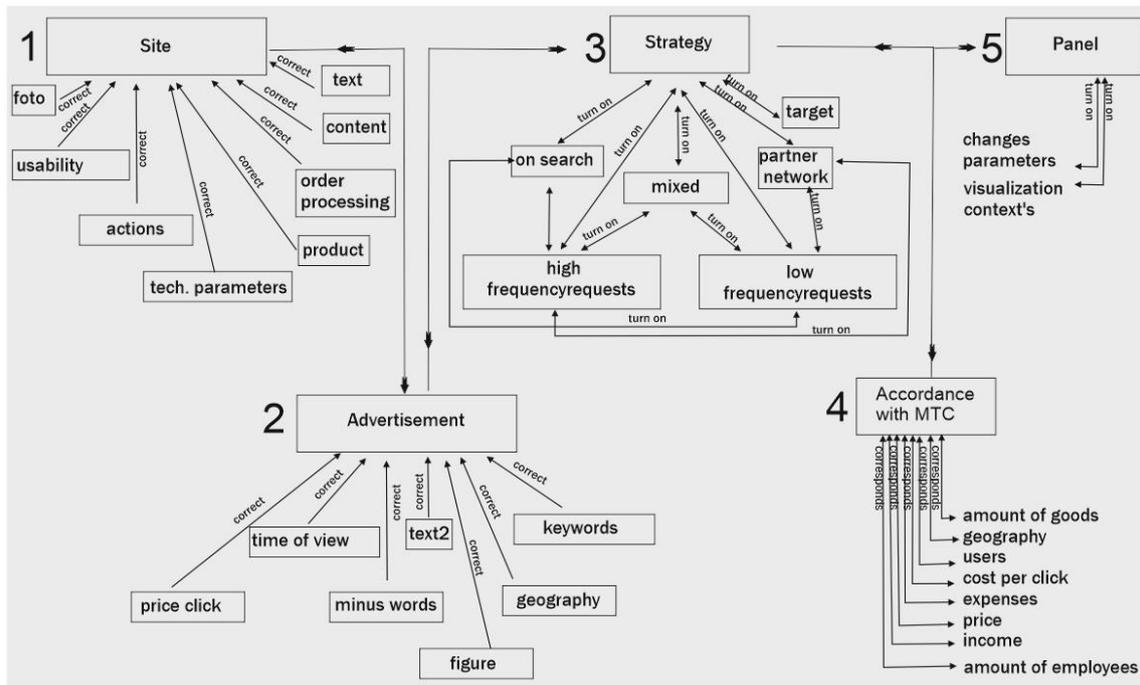


Fig. 1. The typical scenario of online promotion

can present knowledge in a way that makes it understandable for digital systems. Ontology is used when it is impossible to use sensors, systems that can immediately translate information into electronic form. The ontology contains "a finite set (C) of domain concepts (concepts), a finite set (R) of relations between domain concepts and a finite set (F) of interpretation functions defined on the concepts and / or relations of the ontology. It has the form $O=(C, R, F)$ " [8].

That is, first one need to define the structure of the object (or processes), define the concept of interaction, and on the basis of this data, the ontology of this object (process) is constructed): Process scenario → Conceptual model → Ontology

To check the quality of the applied strategies and adjust the parameters, a matrix of target and constraints is compiled. The MTC is an important resource of directions and limitations in the work of designing a digital twin. Data passes through the MTC and problem areas are detected.

Model-oriented process engineering using ontology looks like this: Ontology → Digital twin of the process → Dynamic DT of the process

Online business promotion consists of four main processes [10]:

1. Transformative.
2. Strategic.
3. Analytical.
4. Decision making.

The conversion process is a lot of work carried out on the site (usability, content), work with the product (purchase,

price, accounting, etc.), setting up advertising campaigns. The strategic process consists of several possible strategies: SEO, SMM, SERM, content marketing, e-mail marketing, video marketing, native advertising, contextual advertising, etc. The analytical process consists of a set of data collection and statistics. The decision - making process is a set that contains the findings from statistics and Analytics, and new introductions.

III. RESULTS

Small businesses are characterized by a tiny budget and a little organizational structure. Therefore, SEO promotion is the most popular and effective [11]. This method of online promotion was used for the algorithm of building a digital twin.

SEO promotion can be of two types:

1. Paid – through ads in search engines.
2. Organic – due to the weight of the content. The site naturally rises in positions in search engines. This type of promotion is designed for a long process, the result is not visible immediately and the search engine manages this process, not the owner of the company. Therefore, paid SEO promotion was taken as the basis for online promotion.

A typical online promotion scenario [12] consists of the following (Figure 1):

1. Planning work on the site. Recommendations for changing parameters: site loading speed, content, usability, product availability, pricing, etc.
2. Planning for setting up an advertising campaign. At this stage, keywords are selected, ad text is compiled, the time

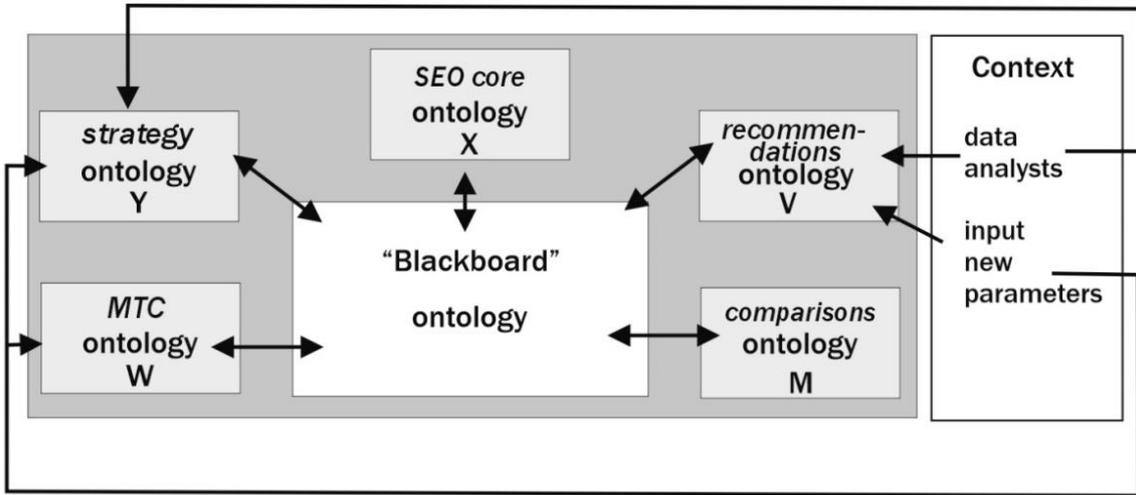


Fig. 2. Conceptual model

period of impressions is added, the geography of ads, and restrictions on the age and gender of visitors.

3. Choice of strategy. Strategies can be mixed or divided by the frequency of user requests, by the type of promotion: online, search, and there, and there.

4. Compliance with the matrix of targets and constraint.

5. Visualization of data in the panel with the ability to adjust parameters. After entering new data, the strategy is checked for compliance, ads, and the site.

Based on the scenario of the promotion process, we constructed a conceptual model using the "blackboard" architecture described earlier [13, 14]. The online promotion ontology was constructed based on the data types involved in the process [15]. Information flows were formed from site parameters, ad data, strategy parameters, statistics results, Analytics, target indicators and restrictions, and input data on the panel. The ability to enter the necessary data allows the

digital twin to work in the prediction mode. Ontological modeling provides a clear structuring of information flows, successful logic of processes and their relationships, and thus is a guarantee of data quality. The ontology specifies the relationships between concepts, but does not define the nature of these relationships [16]. A conceptual model of online promotion is shown in Figure 2.

The Ontology (O) in relation to the online promotion process under study consists of a set of ontologies and has the form:

$O = \{W, Y, X, V, M\}$, where W is the ontology of the matrix of the targets, Y – strategies ontology, X ontology SEO-nucleus, V-ontology recommendations, M–ontology comparisons. Using software products for managing intellectual space, the ontological model is digitized [17] and digital twin is formed [18]. The interface of the virtual copy concept is shown in Figure 3.

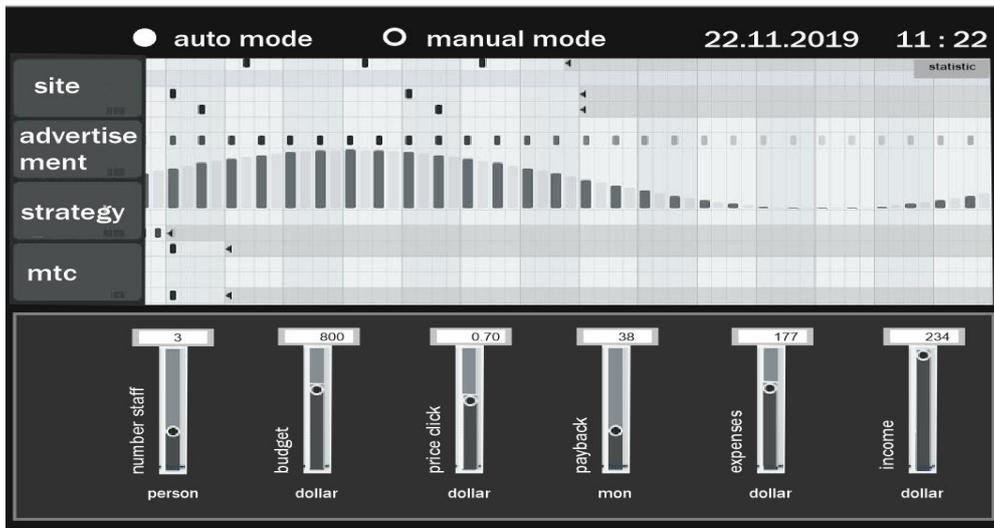


Fig. 3. Interface of the DT

The digital twin can operate in two modes:

1. Automatic mode. A mode that uses dynamic resources that change in real time.

2. Manual mode. One can change these key parameters manually in the panel. This mode helps to predict the process and results, and can also be used as a training system.

As shown in figure 3, real-time input data can be displayed as a graph and simultaneously as numeric values under the graph. Tabs for online promotion processes are displayed on the left, where one can also see real-time data and make changes if necessary.

IV. DISCUSSION

The aim of this work was to create a universal tool for digital visualization of the process of promotion on the Internet. This allows you to demonstrate the company's capabilities and focus on development. Application example: an entrepreneur has one employee and a profit that barely meets the needs of the company. At some point, there are more orders, and the co-worker can't cope with the volume of tasks, customers complain, and you may lose them. On the DT control panel, a restriction is set corresponding to the capabilities of one employee. One co-worker can process a certain number of orders, so the online advertising campaign will be stopped when the number of orders exceeds the norm. Thus, DT can contribute to the proper management of the company and not create conflict situations.

Further work will focus on other small business development strategies. The prospect is to create a digital model that can recommend a specific strategy depending on current data. The accuracy of DT depends on the incoming information, which largely depends on the human factor. The human factor affects the reliability of the results. There is a method for constructing the ontological specification of trust [19] in social networks using graphs and nodes. In the future, a similar methodology should be developed for digital twin.

V. CONCLUSIONS

An algorithm for the process of Internet promotion was formed, its ontology was created. All this was done to more accurately design the digital twin from a strategic point of view. The digital twin concept for online small business promotion can work as a dynamic intelligent software product, as a program for developing strategies, forecasting scenarios, and as a product for education. Visualization of the concept of the DT interface facilitates understanding of its essence and shows its readiness for implementation. The proposed algorithm for modeling a digital analogue of the online promotion process is universal. Generated tools can be used to create digital duplicates of other processes, and can also be used in various business areas.

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