ERP system for 3D printing industry

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Abstract. GOCREATE is an original cloud-based production management and optimization service which helps 3D printing service providers to use their resources better. The proposed Enterprise Resource Planning system can significantly increase income through improved productivity. With GOCREATE, the 3D printing service providers get a much higher production efficiency at a much lower licensing cost, to increase their competitiveness in the fast growing 3D printing market.

1 Introduction

Enterprise Resource Planning (ERP) packages are information systems that automate the business processes of organizations thereby improving their operational efficiency substantially. ERP projects that involve customization are often affected by inaccurate estimation of efforts [1]. Complex information systems like the ERP integrate the data of all business areas within the organization. The implementation of ERP is a difficult process as it involves different types of end users [2, 3].

Enterprise resource planning systems are extensive software systems that integrate a number of business processes, such as manufacturing, supply chain, sales, finance, human resources, budgeting, and customer service activities.

Various studies have asserted that ERP systems can increase competitive advantage in the Information Technology (IT) era. Particularly in the e-business era, there has been a global trend to integrate business processes based on the company's strategic implementation [4, 5]. A review of the potential benefits from ERP implementation can be classified into tangible and intangible benefits [4].

Tangible benefits include reduction of inventory, reduction of personnel, increased productivity, improvements in orders management, quicker closing of financial cycles, increase of 'on-time' deliveries, improved customer service, reduction in IT and procurement costs, improvement of cash flow management, increase of revenue and profits, reduction in transportation and logistics costs and reduction in the need for system maintenance [1-4].

Intangible benefits refer to the increased visibility of corporate data, new or improved business processes, improved responsiveness to customers, improved communications, unanticipated reduction in costs, better integration between systems, standardization of

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computing platforms, increased flexibility, global sharing of information, improved business performance and improved visibility into the Supply Chain Management process [5,6].

2 GOCREATE – General presentation

GOCREATE is a cloud-based production management and optimization application which helps 3D printing service providers' use their resources better to significantly increase the income through improved productivity.

Fig. 1. GOCREATE Login page.

GOCREATE (Figure 1.) is a cloud-based application offered as Software as a Service (SaaS). It helps 3D printer hubs (small and big) with automatic scheduling, material consumption tracking and forecasting and by improving the communication with their clients.

2.1 Information flow

GOCREATE is built with FIWARE technology. The FIWARE mission statement is “to build an open sustainable ecosystem around public, royalty-free and implementation-driven software platform standards that will ease the development of new Smart Applications in multiple sectors”, For more please refer to [x]

[x] FIWARE, “About us”, <https://www.fiware.org/about-us/>

The information flow between the various GEs (Generic Enablers) and our own systems in GOCREATE is shown in Figure 2.

Fig. 2. Information flow diagram (GE-Generic Enabler).

2.2 FIWARE technology usage

The FIWARE Enablers used by GOCREATE are presented in Table 1 [7].

Table 1. FIWARE tools.

FIWARE tools	Function	Observation
Keyrock	- implementation of the FIWARE Identity Management Generic Enabler - account management and authentication and token/user validation for security	Keyrock Open Specification
Orion	- stores all the context data - used everywhere where context data is involved	exception: payment transactions
Object Storage	- stores the files (binary STL or other formats) in the FIWARE cloud	
Wirecloud	- generate customizable dashboards (for our own use)	
CEP	- generate alerts based on complex events.	recognizing started but failed payments
Cosmos and SpagoBI GE	- identify the trends and create valuable reports	Big Data
EXTRA: 3D-UI-XML GE	- displaying the uploaded 3D models	STL files

3 GOCREATE – ERP system functions

Some individual characteristics of information system users have been shown to be associated with different levels of information system usage.

GOCREATE 3D Printing-provides the following facilities for the Customer (Table 2):

There were two Service Maturity Levels in the FABulous accelerator’s 2nd open call. Bluemind Software was selected to complete both SLM1 and SML2. At the moment of writing this paper, it is completing SML2.

Table 2. Facilities provided by the system for the customer.

Facilities for the customer	SML1	SML2
– viewing the Factory data/capabilities and its Machines	✓	✓
– sending Orders directly	✓	✓
– sending Orders directly via third parties	x	✓
– checking order status	✓	✓
– checking personal order history	✓	✓
– having a dialog with the Factory	x	✓

GOCREATE provides the following facilities for the Factory (Table 3).

Table 3. Facilities provided by the system for the factory.

Facilities for the factory	SML1	SML2
- defining the Factory data	✓	✓
- defining the available Machines and Materials and their associations	✓	✓
- factory presentation page	✓	✓
- receiving Orders and setting Order status	✓	✓
- saving the objects to be printed and adding new parameters to the Order model for additional optimizations	x	✓
- having a dialog with the Customers	✓	✓
- scheduling recurring events and customer orders to machines	✓	✓
- schedule visualization	✓	✓
- alerts (related to deadlines, machine load limits etc.)	x	✓
- visualizing Order statuses and Order history	✓	✓
- connecting to other systems which facilitate other aspects of the business - by providing interfaces as web-services/APIs, to having orders placed	x	✓
- information offer as open data	✓	✓
- computation of monthly material consumption and forecasts	x	✓
- adding other operations to the manufacturing process (e.g.	x	✓

finishing operations)		
- customizable dashboards	x	✓
- access to selected relevant Big Data Analysis and BI process results	✓	✓

GOCREATE interface samples are shown below.
One of the useful features of GOCREATE is an automatically generated and updated public webpage, where the 3D printing service providers can start receiving orders.

Wellcome to HUB UnitBv

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Additive technologies for public use: Rapid prototyping, Rapid manufacturing, Rapid Tooling.

Place an order

Our printers

LulzBot TAZ 5

LulzBot Mini

Ultimaker 2

Our materials

Conductive PLA

Unleash your inner electrical engineer with this exciting new premium 3D printing filament. Since 3D printed objects have varying structures within them, the resistance across the 3D printed object varies as well! The resistance of the 3D printed object can be different when measured across the width of the object than the resistance when measured from the top to the bottom.

bambooFill

bambooFill combines recycled bamboo fibers with premium color-fast PLA to create natural looking, light-weight 3D printed objects.

HIPS

High Impact Polystyrene (HIPS) - Is an easy, low cost, and widely used 3D printing filament. HIPS comes in a wide range of colors and because it is so easy to print with it is recommended for beginners.

Magnetic Iron PLA

This iron-bearing premium 3D printing filament is attractive to magnetic fields. The finely ground iron particles also allow a distinctive look to 3D printed objects. On average they will weigh 30% more than a comparable item printed in PLA.

n-vent

n-vent is a premium polycarbonate 3D printing filament that allows for a combination of strength and detail when 3D printed. This makes n-vent a premium alternative to ABS, the versatile filament for beginners. When 3D printed, n-vent has a glossy surface finish, is strong and dimensionally accurate due to its low shrinkage and excellent layer adhesion.

NinjaFlex

NinjaFlex performs with an excellent combination of elongation, elasticity, and strength. Tangle free, it is the ideal filament material we have ever tested. NinjaFlex comes in many colors that have a beautiful, strong sheen after being 3D printed. Like SunFil, NinjaFlex is a premium and high-quality filament material capable of opening the door to a wide range of new applications for your LulzBot desktop 3D printer.

t-glass

This amazing filament is known for the gorgeous finish of 3D printed objects. Available in multiple eye-catching colors, you will be surprised at how well it prints while maintaining a high degree of translucence. Black printed in light has a great surface finish, can reflect light well, and depending on the part geometry, even shines and glows. One of the most exciting characteristics of this new filament is its ability to act as a light pipe to transmit light.

Polycarbonate

Polycarbonate is strong and resists deforming at higher temperatures unlike other more common 3D printer filaments. Parts 3D printed in polycarbonate will be strong, stiff and rigid.

Nylon 645

Not only is 645 nylon stronger than PLA and ABS, it is more precise, lighter and has a lower coefficient of friction.

Fig. 3. Public Page

Orders can be submitted by clients from the public page, but also by the factory. This way, the Factory won't be stuck when a client places an order by phone.

Fig. 4. A new order submission.

One of the important differentiators of GOCREATE is the automation of the order scheduling process. It not only saves time but it also very easy to use (maximum one click).

Fig. 5. Automatic order placement in the schedule of the appropriate 3D printer.

4 Conclusion

Enterprise resource planning systems are different from other innovations of IT because of the socio-technical challenges due to the complexity involved in the implementation process and the different types of end users [9].

In general terms, GOCREATE ERP aims to provide the following benefits:

- give a global, real-time view of data that can enable companies to address concerns proactively and drive improvements;
- improve financial compliance with regulatory standards and reduces risk;
- automates core business operations such as lead-to-cash, order-to-fulfilment and procure-to-pay processes;
- enhances customer service by simple embedded dialog elements.

GOCREATE is the first step in addressing the whole 3D printing industry. Besides the needs of 3D Printing service providers, it already takes into account the needs of the 3D printer and material manufacturers.

GOCREATE addresses a geographically dispersed market. The sales strategy aims to get GOCREATE into the market through partners who already sell to our clients. Most of them are 3D printer and material manufacturers.

The advantages offered by GOCREATE for partners are:

- their sales are boosted by added value and features like automatic material ordering;
- they gain a new direct advertising and sales channel, using the various forms of communication of the new market;
- they receive access to market information based on real-time and accurate data.

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References

1. T. Chandrakumar, S. Parthasarathy, *Comp. Stand. Int.* **47**, 100 (2016)
2. C. A. Rajan, R. Baral, *IIMB Manag. Rev.* **27**, 105 (2015)
3. K. I. Weinrich, N. Ahmad, *Int. J. Ent. Inf. Sys.* **5(1)**, 55 (2009)
4. Y. C. Shen, P. S. Chen, Wang, C. H. *Comp. Ind.* **75**, 127 (2016)
5. K. Bokovec, T. Damij, T. Rajkovic, *Comp. Ind.* **73**, 93 (2015)
6. D. Jain, Y. Sharma, *Annual Res. J. SCMS* **4**, 140 (2016). Available at SSRN: <http://ssrn.com/abstract=2755457>
7. FIWARE Catalogue, FIWARE (Core Platform of the Future Internet), <http://catalogue.fiware.org>, Accessed July 2016
8. R. Buican, Gh. Oancea, C. Lancea, A. Pop, *App. Mech. Mat.* **760**, 515 (2015)
9. J. Sujanova, P. Gabris, M. Licko, P. Pavlenda, R. Stasiak-Betlejewska, *Proc. 13th Eu. Conf. Knowl. Manag.*, **1-2**, 1135 (2012)