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IMPACT OF DIGITAL TWIN ON THE DIGITAL TRANSFORMATION OF PRODUCT MANAGEMENT PROCESS

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ABSTRACT

Better understanding is provided by the digital twin about the performance of your product. With the help of advanced simulations, Manufacturing, Development and Design can be enhanced. For securing the future profitability and also for avoiding risks, your business must be transformed. Daily increment is observed in the amount of data that businesses have to act. Reports, statistics, feedback, product performance reviews, trends, customer/user feedback. The significant success factor is interpreting and sharing of data.

For the digital transformation of product management process, various different aspects are reviewed in this paper. In this paper, the aspects are also observed as well as studied.

INTRODUCTION

In today's highly competitive environment, mass product customization and the growing value of products of software bring additional challenges: for attaining higher level of productivity, digitalization is seen as opportunity in the manufacturing. Industry 4.0 technologies are the other name for digital technologies which allows inside the shop floor easy integration of interlinked intelligent parts. devices and cyber physical production elements are allowed by these technologies to be remotely sensed, monitored and managed in real time through network infrastructures and thus provide synchronization and more direct integration from the physical world to the digital world. (Liu et al., 2020)

In the last decades, considerable values are brought through digital manufacturing to the entire industry. Procedure developments, simulates products and models are built by digital manufacturing with the help of resources, representing factories, workforces and their skills. The development of manufacturing greatly promoted the progress in information and communication technologies (ICTs). (Abdilahi, 2019)Quick development and more and more typical as well as critical roles are played by Computer aided technologies in industries. PDM, CAM, CAD, FEA and CAE are some of the computer aided software. In every aspect of the industry field, rapid

development as well as big potentials are observed in edge computing, wireless sensor networks, 5th generation network (5G) , AI and Internet of Things (IoT).

DIGITAL TWIN

For living as well as non-living physical entities, digital twin is considered as the digital replica. Physical assets, public, places, system as well as devices which can be utilized for various purposes and digital replica of potential are referred as Digital Twin. Both dynamics as well as elements are provided for the method of operation of Internet of Things and lives in their complete life cycle. In recent researches, 2 significant characteristics are used for defining the digital twin technology. Firstly, the connection between the physical model as well as the corresponding virtual model is emphasized by each definition. And the other, through generating real-time data these connections is established by using the sensors. Co-space and mirror models or cross-reality environments are some of the type of concepts which are compared with the concept of the digital twin which aims with, by and large, physical world's synchronization with its cyber representation. (Ma et al., 2020)

The operations are optimized by using the twins in different industrial sectors and it also helps in maintaining the physical assets, systems and also manufacturing processes. The Industrial internet of things (IIoT) uses it as the formative technology in which the physically present objects can interact and live with people virtually. "Digital avatars" and "Cyber objects" are the other ways in which they are referred. (Kritzinger et al., 2018) In cyber-physical systems, digital twin is also the other component used.

For testing, data is collected and computational models are created for the production of digital twin design. An interface is included in between the actual physical object and digital model for real-time data and for transfer and receiving of feedbacks.

DEFINITIONS OF DIGITAL TWINS USED IN LITERATURE

Various researchers defined digital twin in their own language. Few of these definitions are presented below:

(Grieves, 2016)– "The Digital Twin is a set of virtual information constructs that fully describes a potential or actual physical manufactured product from the micro atomic level to the macro geometrical level. At its optimum, any information that could be obtained from inspecting a physical manufactured product can be obtained from its Digital Twin."

(Glaessgen & Stargel, 2012): "A Digital Twin is an integrated multi-physics, multi-scale, probabilistic simulation of an as-built vehicle or system that uses the best available physical models, sensor updates, fleet history, etc., to mirror the life of its corresponding flying twin."

(Qi et al., 2018): "In the product life cycle, digital twin is considered to be the real mapping of all the components in which virtual data, physical data as well as interaction data is used in between them".

(Schleich et al., 2018): "For performing real-time optimization, a digital copy of the physical system is used."

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(El Saddik, 2018): "For the living as well as non-living physical entity, digital twin is considered as the digital replica. The transfer of data is seamless which permits the digital entity to exist at the same time with physical entity by bridging the physical as well as virtual world."
(The Gemini Principles, 2018): "In the built or natural environment, digital twin is the realistic digital representation of systems, procedures or assets".

TYPES OF DIGITAL TWIN

There are 4 types of digital twins:

- Component Twins / Parts Twins
- Asset Twins
- System or Unit Twins
- Process Twins

Component Twins / Parts Twins

From its name, it is suggested that in the entire system, this is considered as the twin of a single component. Now how? For making the predictions about service life, is every screw is virtually reproduced in a car? The answer is No, not actually. They are the real significant components which directly influences the performance as well as functionality of the car. The components which are not that important but they constantly influence the jerks, is the second application.

Asset Twins

In the field of digital twins, Asset Twins are the next upgraded level. They describe the way in which every single component work together as a complete asset. For the better understanding, engine or pump is a good example for this. With the help of Component twins, information can be received by the Asset Twins or can also be obtained from the collection of Component Twins themselves. Entire system can be explored with the help of Asset Twins as component twins are more concerned with the durability and stability of every single part. The working of individual part can be checked how they work together as well as discover potential for the improvements. So you can virtually as well as consequently real, mean time is reduced in between the mean time and failures as well as while increasing factors such as performance for the fuel consumption.

System or Unit Twins

Unit twin is the other name for system twin which works on a higher level. In comparison with the asset twins, they combine individual asset twin and gives opportunity to check the performance of the individual assets. Let's come back to the example of Car: The system twin combines with all the necessary assets for electricity, with all the assets for the bodyworks and with all the assets which are important for the propulsion. The System twin is a type of system which can be utilized by all the different types of applications.

For making it clear, car factory is the example which is a bit simpler: All the units are brought together with the System twin for making the parts of the finished car. The collaboration is improved in between the individual assets is also considered as system twins which provides the maximum performance at the end of the result with least wear and tear or time consumption.

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Process Twins

Complete production facility as well as insight is provided for the collaboration of over all units by the Process Twin when the production unit for single part of the car is represented by the System Twin. And timing is the factor which becomes significant. Quick production of individual units is done in the closed-loop of complete procedure which leads to extreme individual components therefore results to logistical challenges and high storage costs.

The complete complexity of monitoring becomes clear with the help of digital twins at this level. After fulfilling the objectives of units, assets and components, the procedure becomes functional and effective.

DIGITAL TRANSFORMATION IN PRODUCT MANAGEMENT PROCESS

In the digital era, the major change program that helps the company in achieving is a Digital Transformation. Implementation of new technologies such as big data, machine learning and Internet of Things (IoT) is part of that change. As it includes Scrum, Kanban, self-organizing teams as well as cross-functional which are included in the introduction of agile practices. After the digitalization of the companies, business models also requires changes in pricing models, cost factors, customers as well as partner and supplier relationships and various other aspects which are likely to get affected. (Zhang et al., 2019)

The meaning of digital transformation is the development of new smart products, mainly the products with in-built digital technologies features; such as combination of hardware and software from providing new functionality to the customer.

The product management role is viewed by many organizations as the tactical role which aims to listen to the stakeholders as well as customers; it also aims to grow revenue as well as the number of customers. But product management disciplines go well beyond managing everyone's wish list. For achieving their goals, the product managers drive changes in tiering, discounting, enhancement and sales process. In various key disciplines, the product management function is generally broken down (Starcio, 2016):

- Identification and qualification of target markets, opportunities and demand of the markets, sizing of the market, and factors such as geopolitical, legal as well as economical which determines the primary opportunities for growth. It simplified the prediction of products and their behavior under several conditions. The gap left by sensor a system is filled with the digital twin that understands the numerous factors which affect the performance after interacting which each other. The challenge of manually combining the data together to identify relationships by simply diverting cheaper and quicker computing resources to the problem was eliminated by getting all the data centralized and time-synchronized. The issues related to addition of more data into the mix dynamically are also solved. In comparison to data, teams spend more time in trading insights that is employed with digital twins (Bevilacqua et al., 2020).
- In agile practices, product ownership is the role as well as it is responsible for the enhancement of the products or development, evaluating customers' satisfaction and also

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the involvement of internal stakeholders. The virtual replica of products, interface mimicking, qualities, settings as well as dynamics which means creating a digital twin. In the cloud-based systems, all the data is collected with individual sensors which are integrated into the real products. Just like the real ones, this digital twin is a 3d model with same metrics. The data can vary and may differ in size, but the procedure remains constant depending upon the capacity of the Internet of Things (IoT) device as well as objectives which are laid out before the model. (Tao et al., 2019)

- Disciplines in product management supervise the P/L of a customer group, product family, or single product as well as drive sales, development, productivity, reliability, and service quality priorities. In manufacturing, the DTPMS (digital twin-driven production management system) can dynamically optimize the manufacturing and simulate the results. In cyber-physical production, they can achieve real-time synchronization, real-virtual fusion and high fidelity.
- The skill of defining, execution, measurement and modification of go-to-market strategies with respect to their product's lifecycle is considered as product marketing. For the analysis of market as well as in designing the strategies, the digital twin helps. These methods are structured by keeping the product and target audience relationship in one picture.

In the field of new-product development, large benefits are promised with the digital transformation. But there are various challenges mainly in manufacturing of physical products. The field of new product development is affected by the Digital Transformation for traditional manufacturer in significant ways such as: The new-product landscape of the firm is changed dramatically- mainly its products, organization, procedures, methodology and even the mindset (Lim et al., 2020):

- With the help of new methodology which is different from the traditional processes which have been in use for decades, smart products can be developed with the help of embedded software.
- New digital tools are employed more making the procedure more effective and efficient as per the users demand, predictable lab test results and through inventing new materials.
- In comparison to old traditional products or technologies, development of new digital technology platforms.

BENEFITS

Benefits of digital twin in product management:

- For product management, potential is provided through digital transformation.
- For each of the phases, cost as well as time can be saved.
- Enhancement in efficiency and effectiveness is realized.
- Benefits such as better customer acceptance or the ability to be more sustainable can also be achieved.

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Benefits of digital twin in product development:

- The technology essentially provides a real-time look at how a physical asset is performing in the product development.
- It gives organizations a powerful analytical method that can analyze key performance metrics extensively and provide insights into where changes can be made.
- In multiple real-time applications and environments, enhanced observation into the performance and improvement in the product quality.
- It increases the speed which leads to faster the production times.

The benefits that digital twin technologies offer your business include:

- Improved reliability of tools as well as production lines;
- Improved OEE by reducing downtime and enhanced performance;
- Growth in productivity;
- Reduced risk in several areas, such as product availability, marketplace reputation, and more;
- Lower maintenance costs by calculating maintenance issues before breakdowns occur;
- New business opportunities such as mixed manufacturing, bulk customization, and small-batch manufacturing;
- Improved customer service as customers can remotely arrangecustomized products;
- More efficient supply and delivery chains

APPLICATIONS

These are four key ways smart manufacturers will leverage digital twins to achieve a product-centric and model-based enterprise(Nadkarni & Prügl, 2020):

1. Engineering

By tradition, virtual representation is created for the product design and for the enhancement of the products through the use of digital twins by the engineers. Before the existence of physical counterpart, the digital twin actually exists which starts from the vision that what product must do. From the deployed products, it became possible for capturing the data by the IoT innovations. For the constant product enhancement, this data can be applied to the digital twin.

2. Design customization

Various permutations are modeled after the permission of digital twin for design and engineering as per the consumers demand for customized products. Earlier, for incorporating the best ways, manufacturers have struggled for customer input into the manufacturing process. The customization options will be enhanced by the integrated data usage and fulfilling customer demand with the help of Digital Twins.

In order to appreciate the full influence of digital twins on product customization, imagine your company sells high-end custom bikes for a while. Various colors, wheels, and some other configurations may be selected by clients. A complete picture of customer demand trends of your business is obtained by capturing the customer preferences in the digital twins. The effects of custom configuration on product performance can be better understood by capturing customer

usage data. The most reliable options for the business are allowed by this and on the basis of performance attributes, it allows customers to configure the products. Moreover, it will make the business to visualize lightweight representation instead of the burden of heavyweight design as well as the parameters.

3. Production

It becomes easy for the manufacturers to attain "single version" of the truth with the help of Digital twins. Preferably, a single set of digital twin master data will be provided by the manufacturer which resides in the mid location as it will provide the manufacturers one new version of the truth. Manufacturer will be able to evaluate and visualize the data rapidly after combining with "in-memory" computing-based networks. The quality data can be compared with using digital twins across multiple products. Deeper understanding is provided to look into the quality issues and also permit the manufacturers to take quick actions against the "single source truth" model.

4. Operations

For digital twins, enhancement in operations is the best-understood applications. A virtual representation is first created by the manufacturers in the field with the help of lightweight model visualization. Secondly, from the smart sensors the data is captured by the manufacturers in the asset which gives the clear picture of operation condition and real-world performance. For the predictive maintenance of the real-world environment, manufacturers can simulate them.

CONCLUSION

The future of product management in digital twin is unquestionable. Digital twin plays a significant role starting from the product manufacturing to the product marketing. In short duration of time, for preparing the target audience it helps in the market assessment. Certainly, it is impossible with the conventional product management system. However, there is much more demand in the digital twin technology as the demand of data is growing every day.

FUTURE SCOPE

The complete life cycle of process, physical system or product can be covered with the technology named as Digital twin. More powerful tools are provided by this to the companies which can significantly improve the performance and also provides better view where it can grow. The lessons and limitations of digital twin will bring the opportunities for growth and innovations.

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