LUT University

TRIZ Application for Digital Product Design and Management

Kaliteevskii Vasilii, Bryksin Matvey, Chechurin Leonid

This is a Author's accepted manuscript (AAM) version of a publication

published by Springer, Cham

in Creative Solutions for a Sustainable Development. TFC 2021. IFIP Advances in Information and Communication Technology

DOI: 10.1007/978-3-030-86614-3_20

Copyright of the original publication:

© IFIP International Federation for Information Processing 2021

Please cite the publication as follows:

Kaliteevskii V., Bryksin M., Chechurin L. (2021) TRIZ Application for Digital Product Design and Management. In: Borgianni Y., Brad S., Cavallucci D., Livotov P. (eds) Creative Solutions for a Sustainable Development. TFC 2021. IFIP Advances in Information and Communication Technology, vol 635. Springer, Cham. https://doi.org/10.1007/978-3-030-86614-3_20

This is a parallel published version of an original publication. This version can differ from the original published article.

TRIZ Application for Digital Product Design & Management

Abstract.

In the 20th century, the concept of Product Design was centered on an engineering process aimed at projecting and further developing a technological and as a rule physically tangible product. Thus, to support the heuristic stage of Product Design the TRIZ toolkit has appeared and turned to be an effective tool for engineers and inventors assisted at technological obstacles overcoming process. However, in the 21st century the commercial Product itself changes its forms and a way it's being developed and leads to the market. The main reasons for that are decreased time-to-market, the dynamically changing product requirements, opportunities to effectively test product hypotheses and to use flexible development methodologies. These properties are peculiar for the products that launch in the digital era. Thus, present-day products require more and more design strategy and vision decisions rather than only engineering tricks to successfully meet market needs. With these realities, the User Experience and User Interface of the product, monetization model, the target audience, communication and branding become an integral part of the Product Design and Product Management processes. This article aims to demonstrate on several case studies how appropriately TRIZ methodology is able to support a heuristic stage of the modern Product Design and Management processes.

1. Introduction

1.1 TRIZ as a toolkit for classical Product Design

The Theory of Inventive Problem Solving (TRIZ) was invented by Genrich Altsuller in 1956 and further developed by an engineering community as a toolkit for technological and engineering problems overcoming toolkit [1]. Being originally born from patents analysis TRIZ methodology gathers and systematises a great amount of heuristic and empirical techniques that are effectively applicable for circumventing different engineering obstacles and restrictions. Such a property made TRIZ highly demanded at the conceptual design stage of Product Design and Development during the last half a century and thus, TRIZ was widely recognised in Industry as a product design toolkit [2, 3]. However, the last decades have greatly influenced the Product Design and Development Process. On the one hand, the main reason is that launching products have an increasing digital factor, even so, many of them are completely digital solutions (such as the majority of SaaS platforms), being at the same time accomplished and qualified products. On the other hand, due to dynamic requirements, broader opportunities in terms of testing and product evolution on a live audience, as well as agile development methodologies that have become popular and accessible (incl. information technology possibilities) the design process looks different. Thus, an approach where design is the first or one of the first stages of the product life cycle as on **Fig. 1**, depicting a

Waterfall development methodology, it is increasingly changing to a more flexible sprint-based Agile approach [4]. The modern Agile approach implies that product features are subject to constant rethinking and prioritization, whereas, static product roadmap is progressively being replaced by dynamically generated sprints, which are based on the so-called HADI cycles [5]. HADI cycles is an approach that is based on iterative product development around the continuous construction and testing of product hypotheses. So, within the framework of this methodology, it's settings out with a hypothesis (H - Hypothesis), then there is an action associated with testing the hypothesis (A - Action), collecting data for analysis (D - Data), and finally conclusions or insights, based on which the further development direction is being formulated (I - Insights). This approach has also become possible due to the global digitalization of products, and consequently due to the ability to collect metrics and obtain measurable indicators (confirmations or denials) for the product hypotheses occasionally almost in real time. In such a circumstances, the Conceptual Design stage is not more the initial stage of product development rather the integral part of the entire product life cycle.

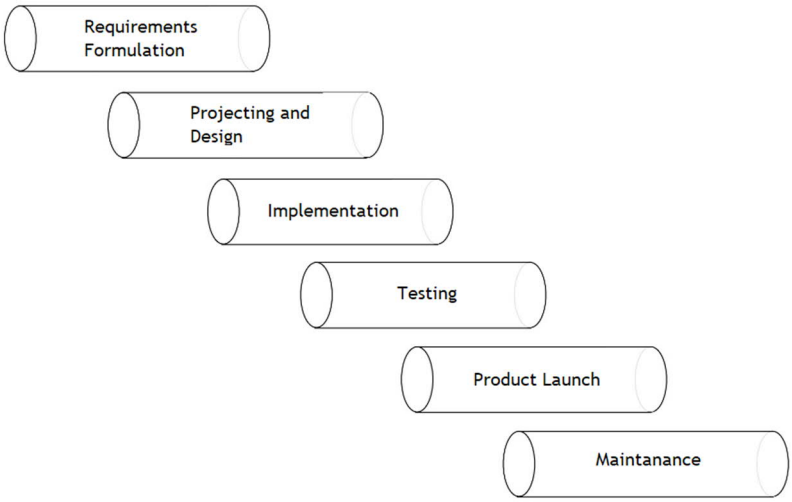

Fig. 1. Waterfall product design model. The model includes all the classical stages of Product Development starting from Market Need (requirements formulation) and Conceptual design stage till product launch and further maintenance and evolution.

1.2 Digital Product Design peculiar properties

Thus, modern product design approach differences are especially noticeable in fully digital products. Those products are characterized by such parameters as: a short time required to formulate and test product hypotheses (as well as the ability to quickly receive feedback on the product); relatively fast search for product-market-fit indicators; flexible and more efficient monetization models; ability to text value proposition[6]; efficient models of user base scaling through digital channels; high UI/UX product requirements:

User Experience. Undoubtedly user experience has always been an integral part of product development, and more advanced technological solutions from the user experience point of view have allowed many companies to successfully bring their products to market.
However, the present reality sets up a higher and higher requirements on how meaningful, relevant and easy is the experience of users on modern digital products.
For example, having dozens or even hundreds of different digital products on their device, the user can close the application within 1 minute and open the competitor's one. Thus, for a digital product, the churn rate can reach from 10% to 40% per month [7].
Not to lose a user fastly, digital interfaces must be highly intuitive and easy to use. Thus, modern product designers have to think about what digital design solutions are in fashion now (which means they will be perceived as natively as possible), what exactly the user of a particular platform or eco-system expects to see, and, depending on this, make UX/UI related design decisions.

Product monetization model. In a classic engineering solution or physical device, the marketing and development processes are generally viewed independently.
Thus, usually within one company, there are engineers who strive to make a product of the highest quality and technology standards, and the marketing and sales teams doing best to deliver the product on the market on a highest possible price (depending on the marketing strategy, the market and competitors' prices and other parameters). Thus, such "non-standard" models as subscription are only at the very beginning of use in the case of physical products. The couple of interesting examples would be Wine by subscription, [8], Stitch Fix, Women and Men Clothes by subscription [9], Hyundai by subscription [10].
Whereas in a digital product, monetization can be at the heart of the product's business model. Due to the huge flexibility in terms of pricing policy (which may be a subject to AB testing as well), the possibility of price diversification, and flexible models such as Freemium, in which we can gradually involve the user in a paid status, starting from free, monetization models become an integral part of product management, including product design.

Go-to-market strategy. The same idea is related to the Go-To-Market strategies. If by the end of the 20th year more and more interesting business models emerged, such as Blue Ocean and other strategies according to Osterwalder [11], the 21st century turns both business models and possible modern go-to-market strategies upside down.
This has become possible due to flexible methodologies for launching today's products to the market, and a large number of marketing and advertising tools, such as targeted and contextual advertising, viral reach of new users, digital referral programs and other digital methods.

The flexibility of digital products is also given by the fact that before risking large advertising budgets without a guarantee of return on investment, modern startups and products usually have the opportunity to find their product-market-fit indicators and only then scale the product with large budget [12].

Despite the fact that the original TRIZ was built completely on technological solutions, and was projected as a tool mainly for resolving engineering and technical contradictions, it contains some basic concepts and rather abstract methods that can be reused and successfully applied also for digital solutions and products design and management.

2. TRIZ for Product Design and Management

Traditional creative methodologies (some of which may resemble trial and error method at conceptual design stage) have a lower efficiency and not that predictable and accurate outcome. Thus, modern digital product design approaches that integrate ideas generation, hypothesis validation, evaluation and analysis may require significant time for each ideation cycle. However, digital products iterate in such small cycles in order to use feedback to grow in the right direction. The slogan of the ideology sounds “Fail fast”. But there are methodologies such as TRIZ that may significantly optimise the amount of cycles and could help product designers to move in a more directed and controllable way.

To achieve that product managers and designers apply many approaches like Human-centered design (HCD), Activity-centered design (ACD), Data-driven design (DDD), Object-oriented design (OOD), Domain-oriented design (DOD), System Engineering, etc depending on a project context. All of them are a toolkit to design systems using different types of structures and basic objects.

The core ideas under the TRIZ is that all technical systems evolve the same principles. TRIZ is used to solve any complex problems using best practises found in various industries. TRIZ can be a valuable approach for a variety of digital products because it provides terminology to describe systems and methodology to design them.

Digital product evolution has the same nature as any technical system and uses the same laws of technical systems evolution. Digital products have business goals to reach the bigger market or improve engagement of the current users. Each cycle of product development can be predicted and evaluated even before hypothesis testing.

2.1 Product Design

2.1.1. IFR applied for User Experience

Both HCD and ACD methodologies are the best choice for designing user interfaces.
The goal of ACD to provide a tool for the user and the tool itself is valuable for the user. The best example is remote control for TV, where the value is measured by the control functions number. Tool becomes better with the variety of settings and options it provides for users.

Ideal final result (IFR) says that system is ideal when there is no system at all, but the final result is achieved. From the digital product design perspective, you can rephase it that there is no user interface and the function is executed. Any user interface in HCD provides no value for the user and complex interfaces can only harm people.
Amazon's ideal final result is a purchased good. Signing up in the online store doesn't make users closer to the result and acts as a barrier. As well as navigation menus through the catalog. It makes us farther from the ideal result, which is to show the user only the products that interest him and he could buy it in one click. But Amazon Go shops are the best example of IFR. There is no need to scan products and pay for the purchase. Just take everything you like from the shelves and leave, and then the money will be debited from the card independently, i.e. "itself".

Apple also applied the IFR principle for their products. AirPods pause the music when you take them out of ear. No need to take out your phone, no need to press anything. Face ID unblocks the phone immediately when you just look at it. Purchasing apps in the Appstore doesn't require the user to do anything rather than tap a button. The card details have already been entered, the personal information has already been filled in, you do not need to make a second purchase, the charge will be made automatically by subscription.

The IFR application to interfaces and digital products increases the usability and ergonomics of user interaction with interfaces. Users spend much less cognitive load and achieve their goals much quicker.

2.1.2. Vepol applied for Product Design

The concept of a vepol is based on the theory of physics. There is a product that cannot be controlled by itself and to control such substances, you need to add the tool and the energy (or field) that is necessary for the impact of the tool on the product. Vepol is a common approach for any complex technical system. And any system can be represented as the combination of the vepoles.

In the case of Amazon, the interacting pair of objects is products and buyers. Without any reason the buyer doesn't feel any interest in a million products available on the service. In order to create a vepol, you need to use a field to enable product impact on the user. This can be an information field like new items, sales hits, discounts, or something that requires an output from the user like personal recommendations in the case of a retrieving history of clicks and likes.

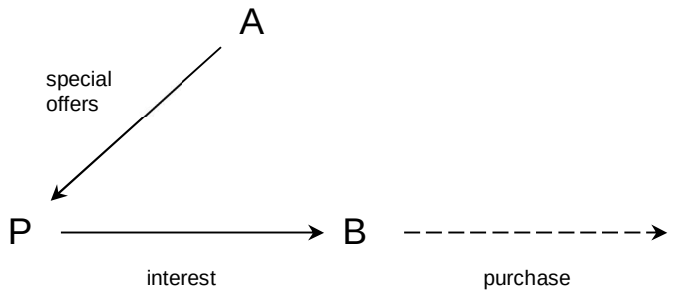

Fig. 2. Example of the Vepol for Amazon. Amazon (A) creates a special offer of Product (P) to interest Buyer (B) for purchasing them.

2.1.3. Vepol applied for Social Networks

The ACD methodology uses job story format to define user needs and context when it's happened: When (situation), I want to (motivation), So I can (expected outcome).

Each job story for the social network case can be visualized as a classical vepol with individuals as an interacting pair of objects. From the social point of view, we can consider this relationship as user-to-user or customer-to-customer (C2C). The energy (field) that enables interaction between two social objects can be considered as a regular motivation of people and IFR or each of them is the expected outcome.

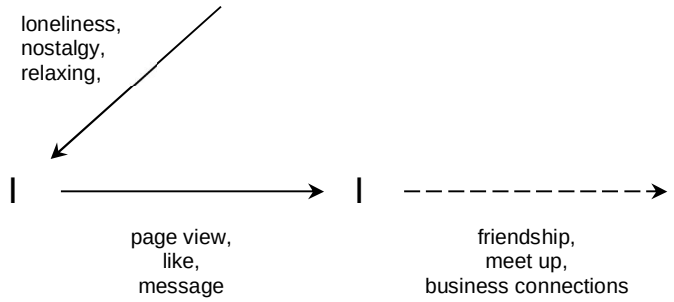

Fig. 3. Example of the Vepol for Facebook. The pair of individuals, interaction between them, motivations and expected outcomes.

Facebook is the best example of the social network. Two random people won't interact with each other without any reason. There is no vepol there. For example, in order for two classmates to meet each other and have a party (IFR), one of them must have nostalgia about school times and childhood (motivation). This is how we can construct the vepol.

The vepol is a very powerful tool to describe relations between different types of objects in the human-centered systems. This tool can be applied for relationship definitions between individuals and items (ex. people watching movies on Netflix) and individuals with individuals as well.

2.2 Product Management

2.2.1. Mini-problem and maxi-problem

In the TRIZ theory there are two types of problems. The maxi-problem requires a fundamentally new technical system for bringing the new value. The mini-problem saves the current system, but provides the missing value. Inventions and new systems that solve the maxi-problem don't make a profit on the early phases, they are unprofitable. The profit comes later, when the new machine receives mass usage.

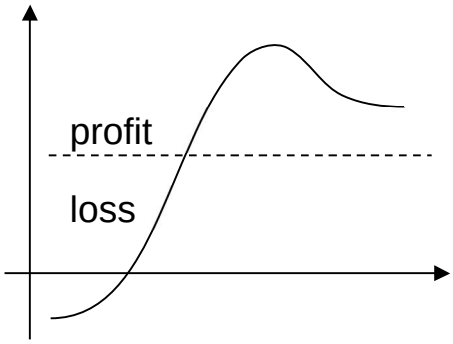

Fig. 4. Profit and losses after launching system solved maxi-problem

Any conceptual redesign or starting a new product from scratch leads to a dramatic value losses for the end user. There are lots of digital products that lost a half of the audience after user interface redesign. But the new maxi-problem system has a potential to grow and allow product managers to get a profit on the long term.

The product manager's job is to apply TRIZ and understand what problem he wants to solve. Do we need to continue optimizing the current solution, which is about to reach its limit or is it time to make a pivot and launch a radically new product.

2.2.2. Monosystem, Bisystem and Polysistem

The law of transition to a super-system says that after exhausting all available resources, the system merges with another system, forming a new more complex one. The simplest mechanism of such transition is that the original monosystem is combined with another, turning it into a bisystem. Or in a polysystem, if more than two systems are combined.

The initial stage of technical systems looks like a zero-coupling system. It becomes possible to combine these systems with some purpose and they become partially collapsed. Further development leads to fully collapsed systems in which a single object performs multiple functions. A fully folded biosystem or polysystem becomes a monosystem and can make the next turn of the spiral.

Many big companies and organizations during their growth use an umbrella brand approach to launch new product lines. For example Google has a variety of applications with sub brands like Google Maps, Google Drive, Google Docs and Google Spreadsheets. Such umbrella brands are just a first step of product evolution. As a polysystem they can be combined together (ex. Google Drive, Google Docs and Google Spreadsheets are merged into one application on the desktop) and the new product can be launched with new additional value.

In the digital product industry such transition from a set of applications to one single product is called superapp. Uber developed Uber Taxi, Uber Eats and Uber Wallet as separate apps, but when they became mature they merged the value proposition into one system. The average American uses one on these applications every day, so it makes sense to integrate all business use cases into the one super app. The same transition made Yandex Taxi, Yandex Food to the one application called Yandex Go.

Product evolution from monosystem to bisystems or polysystems and fold back to the monosystem is a core law of TRIZ and can be considered as a regular product lifecycle. New monosystems can provide additional value for the end user unlike keeping systems separarable. Asian superapps have not only gathered all the important services in one place, they also simplified the process of paying for goods. For example, in China, it is easier to pay via WeChat Pay than cash.

2.2.3. IFR applied for Product Strategy

The law of increasing the ideality of the system is a universal approach for any kind of system. It says that the right evolution of a technical system is focused on increasing the degree of ideality. At the start of the product, you need to formulate an idea of the ideal functional result and how the ideal system looks like. Sometimes it’s called product mission or product vision. In the real world you have to deviate a little from the ideal picture in order to launch an MVP or the first working prototype. This approach helps to deliver products to the customer as soon as possible to gather feedback and make a profit as a business. Further business development decisions should be made based on the ideal answer. It can be a powerful tool to set the right priorities for making the right choices. Any product manager should formulate how the ideal functional result looks like for each brand new product.

2.2.4. Vepol for Business Model

In Chapter 2.1, we considered vepol as a tool for building C2C relationships within the social network. But it was only the point of view from the user angle. Facebook as a business provides an ability

for users to receive better and more accurate content, personalised news feed according to data gathered from user behaviour, like history of views, likes and reposts. This type of communication between platform and user called business to customer (B2C) relationship.

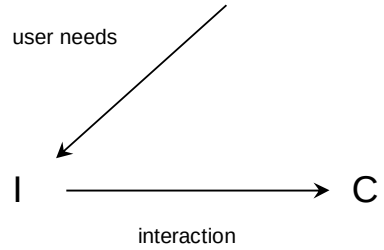

Fig. 5. B2C vepol. Individual (I) and Communities (C) in the social network.

By adding new objects to the social system and making it a bisystem, we increase connectivity between elements inside it. So, using the example of Facebook, we added communities (external businesses) to the system and constructed B2C interaction between person and community. It's also a vepol. But Facebook is a platform for communities that provides B2B capabilities. This forms a triangle and a vepole that describes any platform system.

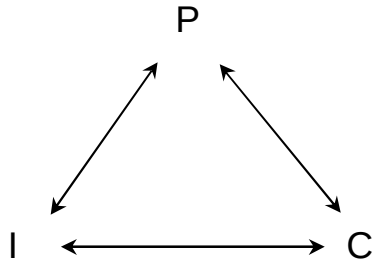

Fig. 6. Platform Velop. B2C and B2B combined. Interaction between Individuals (I), Communities (C) and Platform (P) that brings them all together and enables communication.

Amazon as a platform for businesses (B2B) provides an ability to open a store almost for everyone. Platform connects stores with buyers (B2C) and creates a triangle of vepols.

All big companies and successful digital products are developing themself to the platform functionality. To achieve that they add new objects to the system and create an interaction between them. From the platform business model point of view it creates a triangle from the 3 vepoles with B2C and B2B communications.

Such transition from digital products to the platforms is a natural growth and a law of the TRIZ. Youtube, initially was a video hosting service and eventually changed its positioning. The platform added an ability to create channels for streamers, which created new vepols: viewers–steamers and platform–streamers. This opportunity of growth for a product can be considered as a next step of evolution only in case of successful development one of B2C or B2B relationships. If one of the vepols hasn't formed yet and the product itself is in the development phase, the whole B2C-B2B triangle will never work until each of them will be established.

3. Conclusion

The market share of digital products was growing rapidly during the last decade and continues its steady growth (also supported via pandemic circumstances) [13]. One of the key specificity of digital products is a massive amount of data generated by users, allowing product managers and product owners to harvest the data and to continuously develop a product in a controllable manner basen on the data (the feedback of the system). However, compared to the classical waterfall development methodologies the amount of hypothesis that is usually generated via so called HADI cycles might be much higher than development capacity or requires additional marketing resources what makes ideas (hypothesis) generation stage continuously important. Thus, to make this ideation stage more controllable and predictive, the authors tried to project the TRIZ development methodology to the digital product design and development process. Thus, historically, TRIZ was developed as a tool for idea generation and inventive problem solving and being evolved this way, TRIZ proved itself as part of the product design process when it comes to technical and engineering development. However, in recent decades the TRIZ applications for non technical areas such as business and management have also become popular. With the scope of the present research, authors identified the framework of TRIZ that may be successfully applied in the digital product design and management processes. On the example of the most impactful products of last decade authors demonstrated the toolkit that may lead the product development in a more guided manner, that may save time and resources for decision makers (product owners, product UX/UI designers, product managers and business-analysts) of a product.

References

1. Salamatov, Y. and Souchkov, V., 1999. TRIZ: the right solution at the right time: a guide to innovative problem solving (p. 256). Hattem: Insytec.
2. Wu, Y., Zhou, F., & Kong, J. (2020). Innovative design approach for product design based on TRIZ, AD, fuzzy and Grey relational analysis. Computers & Industrial Engineering, 140, 106276.

3. Sheng, I. L., & Kok-Soo, T. (2010). Eco-efficient product design using theory of inventive problem solving (TRIZ) principles. American Journal of Applied Sciences, 7(6), 852.
4. McCormick, M. (2012). Waterfall vs. Agile methodology. MPCS, N/A.
5. Samoilenko, A. (2019). HADI cycle with examples: how to generate a hypothesis and make your life easier. Medium, 2019. *Available online:* https://medium.com/@ntile/hadi-cycle-with-examples-how-to-generate-a-hypothesis-and-make-your-life-easier-e34a231a9c16
6. Osterwalder, A., Pigneur, Y., Bernarda, G., & Smith, A. (2014). Value proposition design: How to create products and services customers want. John Wiley & Sons.
7. Statista (2020). Customer churn rate in the United States in 2020, by industry. *Available online:* https://www.statista.com/statistics/816735/customer-churn-rate-by-industry-us/
8. Winefamily. *Available online:* www.winefamly.com
9. Stichfix. *Available online:* https://www.stitchfix.com
10. Hyundai subscription system. *Available online:* https://www.hyundai.com/in/en/buy-a-car/hyundai-subscription
11. Osterwalder, A., & Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons.
12. Unilever. (2016). Unilever acquires Dollar Shave Club. *Available online:* https://www.unilever.com/news/press-releases/2016/unilever-acquires-dollar-shave-club.html
13. Digital Transformation Market Size: 2020, 2021, And Beyond (2020). Digital Adoption. *Available online:* https://www.digital-adoption.com/digital-transformation-market-size-2020/