International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Design Thinking as an Adaptive Disruption During Automobile Product Development

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Abstract

This essay proposes applications of design thinking in automobile product development from the perspective of adaptability, which in term enhances capabilities to fix info structure, opening up a set of alternatives to design improvements that are game changing. Case study on the design of Ford Motor Company focused on its capabilities for the development of in-vehicle features which are instrumental in the customer experience that is delivered by Ford automobiles. This case provided explanation on a systems thinking approach for large complex systems and is aligned to Ford Motor Company objective of changing the way the world moves. Besides, methodologies on how design thinking can be utilized for this disruptive adaptation are elaborated in later paragraphs. It aims to explain a desired future state of the capabilities to develop an unparalleled customer experience in Ford vehicles.

Keywords: Design thinking; adaptive disruption; automobile.

1. Introduction

Design thinking is an approach that focuses on fully understanding the user experience. The innovation is produced by centering in the user and deeply understanding his needs, tastes, passions, problems, et cetera and from them creating designs that not only satisfy the needs or solve the problems but that also deliver an experience that connects with the user. In this proposal, the end product that the feature owner creates it the feature design intent.

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The Inspiration phase is about getting insights around the experience to be delivered, in this stage the feature owner should lead the generation of the ideas and collect data to build the knowledge about the feature. In order to create concepts, he should employ all kind of resources available which include participation in customer clinics, socialization of proposals with colleagues from all areas within the company, intensive discussions and analysis in cross team design reviews as well as contact with real customers in order to empathize and fully understand what the type of the experiences they like and expect around a vehicle.

During the ideation phase, alternatives for the design intent are explored and tried out. This stage is about prototyping solutions rapidly and identifying the best one with the certainty that is obtained after experimentation. During this phase the feature concepts should be communicated with compelling demos that engage all audiences and invite them to contribute or challenge the concepts in order get them even better.

In the implementation phase the feature owner delivers the selected design intent that is clearly expressed and documented. He works with the stakeholders involved in the implementation of the feature throughout the entire system and across components. The final deliverable -the design intent-is a solid document that is complete, accurate, and most importantly-correct.

The cyclic nature of the design thinking strategy -as proposed here-is meant to represent the fact that the feature is in constant innovation, and it's intended that for every car line in which the feature is implemented the feature owner goes thru the three phases to ensure that result is a better experience that is enriched with new information from customers in the field and by the creative work to bring something new in every car line [1].

Now it is time to comment on the proposed method that will enable a nimble execution of the design thinking strategy for the development of in-vehicle features, specifically its deliverable; the design intent.

2. Background

2.1 Adaptability concepts

Depending on the context the term "Adaptability" might have slightly variations in its conception. Since the property of a system that can change its structure, processes and behavior to meet changing requirements in its environment; the changes under adaptability may be more complex than is available from flexibility. While in the context of mechanical design, the capability of an existing design to be adapted to create a new or modified design based on the changed requirements [2].

From these two definitions it is necessary to distinguish a difference between the property or capability and the process. From a system thinking perspective adaptability is an emergent property. The concept of adaptation refers to the action of adjusting to changes in the environment conditions, in which the individual, product, system or organization is immersed. Also, it is important to highlight that these definitions associate adaptability to adjusting due to a changing environment, that is to say, both definitions assume that the environment changed first and now it is the system or entity the one that adjust to that change.

2.2 Adaptability of Organizations

The adaptation of organizations is an extremely interesting topic, several many publications have been devoted to the analysis of how diverse corporations have gone thru the adaptation process and as usual the outcomes range from failure to success. During the literature review I was able to consult different sources and summarize the common concepts about the adaptability of organizations. In particular, there were two references that I consider important to highlight: " In his book "Only the Paranoid Survive: How to exploit the crises points that challenge every company" Andy Grove describes his experience at Intel Corporation while he was Chief Executive Officer (CEO) and led the company through what he called an "inflection point".

According to Grove, an inflection point occurs when the business environment is disrupted dramatically causing the need for the company to re-invent itself in order to cope with new challenges and survive. Grove states that inflection points have always existed and they will continue to occur and highlights the main characteristics that an organization should possess or acquire in order to successfully adapt [3]. He also emphasizes the importance of being aware that inflection points will occur sooner or later and that is better to always be prepared to read and understand their signals.

In "Adaptability: The art of winning in an age of uncertainty", Max McKeown presents his research about the key principles of adaptation and provides multiple examples at many levels, from individuals to corporations and even civilizations. He presents baseline definitions for the steps to adapt (recognize, understand, do) and for the outcomes of adaptation (Collapsing, Surviving, Thriving and Transcending) [4]. With plenty of examples for each step of adaptation, where he compares the different outcomes of individuals and organizations, he describes the key characteristics needed to adapt successfully and also highlights the main barriers that have historically led both individuals and organizations to failure. One of his concepts that I found to be very interesting is his point about lessons from the past where individuals or organizations have reached the maximum outcome (transcending) by creating a whole new game. He points that as the ultimate level of adaptability.

Every process of adaptation is unique. Even organizations, doing the same business and facing the same challenges adapted differently. This is not only because the starting point structure and operation of the organization-is different, but also because the end point of adaptation might vary. While some organizations just survive others transcend.

What follows is a list of the key takeaways that I learned during the literature review that I carried out about adaptability of organizations, Hacking HR to Build an Adaptability Advantage (2014)]: "When adapting, time is a very valuable asset. If the aggregate time of the steps to complete the adaptation takes too long, the likelihood of failure increases. It is possible to read and understand the signs that reveal the need to adapt but if the decision to act delays this will result in failure to adapt.

Typically the bottle neck is at the stage of action. Factors like bureaucratic heritage, cultural barriers to embrace change, discomfort with instability, and a large hierarchy can contribute to slow the modifications and execution

of adjustments [5].

Former success may be your obstacle to implementing changes. When a person in the organization has achieved success in the past, sometimes they tend to keep things as they were. When modifications needed involve re-shaping former practices or methods or even getting rid of them to bring new ones, these people focus on adjusting by using the old practices. They lock into what they call "best practices" and end up impeding a successful adaptation.

Imagination and creativity to spur forward thinking. In order to create a larger number of possible actions for a solution-then increasing the possibilities to succeed in the adaptation-organizations can promote looking at the challenges from different perspectives and not only within the conventional ways of how things are done. Embracing diversity can help on generating fresh ideas. Listening to people outside the organization that also pursue the same or similar interests also helps in expanding the horizon. A good example is what Microsoft is doing with its "Future Visions" project in which they invite today's greatest science fiction authors to use leading-edge work developed at Microsoft's research labs, in order to craft compelling science fiction stories about what this technology might bring in the future as science fact.

Rapid experimentation for fast learning. Forecasts are not created by traveling to the future and reporting what was seen there. With high levels of uncertainty, forecasts might help to prepare alternatives and strategies; however, fear to failure may inhibit the organization to try new things out. Learning from experimentation allows the organization to determine the right course or confirm whether the modifications really conduct to the targeted course. Learning rapidly enables the organization to act on time, avoiding realizing the needed actions late.

2.3 Design Thinking

Introduced by Tim Brown, the founder of the consultancy firm IDEO, the design thinking paradigm for innovation focuses in the customer experience. It is by the full understanding of customer needs and experience that key insights are gained and are used to drive the ideation of proposals. In this paradigm, experimentation is crucial since iterating the proposals provide the refinement needed to create provocative products that connect with the customer [6]. But in contrast to the conventional conception of exploration in the product development firms, what design thinking proposes is that the experimentation should be focused on exploring the experience of the user with the product in all contexts.

While the 3 main stages of the design thinking paradigm are: inspiration, ideation and implementation. Ideation is when deep observation of customer happens in order to understand what he struggles with, or even interim solutions that they have come with to fulfil their own needs. Implementation - Once prototypes have shaped the final concept is when the serious step towards production occurs, in this stage, support is provided to marketing areas in order to communicate the design effectively.

In all stages there is a constant focus in the customer experience and this is why this widely followed not only in the innovation of products but also in the invention of services. In the end, the primary objective of design

thinking is to connect with the user by providing a superior experience that can come from a product or from a service.

3. Case study

3.1 Customer Experience Development -Current State

Ford PDP follows the conventional sub-systems-to-components partitioning which at the bottom level encompasses physical components of all kind. However, given the growth in the complexity of the automobile's functions, the concept of "feature" was incorporated to the design process for a better management of the complexity from the integration standpoint. Ford uses a "feature-based" plane of decomposition, to partition the amenities and functionalities that build the experience of vehicle's occupants. Ford's library of features contains 371 features but the specific number that a particular vehicle contains varies depending on the type of vehicle and the version. For instance, features like smart trailer tow are only available for trucks and still only on high end versions. This feature shows the driver which lights on a trailer connected to the truck aren't working so the driver or passenger doesn't have to get out of the truck and walk around the trailer [7].

Decomposing a vehicle into features, helps to identify the value creation in the development of the customer experience, however, while this is a convenient approach, it is also true that requires integration tasks between the different owners of the components that conjugate in the feature execution. Therefore, it is important to understand the strategy that is followed for the development of features.

3.2 Platform-based business model

In its business strategy Ford Motor Company points to a business model in which the platform is the vehicle and the mobility solutions are enabled by a strong connectivity with the automobile. The options for connectivity are various being the most evident, the connection with cloud-based services but it can also be anticipated the connectivity with other vehicles and public infrastructure -specifically for autonomous driving-but specially with other products such as mobile phones and tablets.

One key element for a platform business model to be successful is the attraction and consolidation of large number of users because this will position the platform as dominant and the effect will be the attraction of more services. To achieve this, it is essential to focus on the customer experience because, the winners in the digital economy will put the people first and this means to exceed customer expectations not only with the benefits of a good product but with a continuous experience derived from it. This is to be central for the platform dominance.

In order to develop an unparalleled customer experience, it is necessary to design it following a holistic perspective. Focusing only in how the customer experience is delivered through the automobile (the platform) is not sufficient in this context.

Thus it is imperative to address the customer experience development with an integrated approach that considers what is delivered in the vehicle and how the features at the vehicle can be mapped to services or other products.

Also, it requires including smart strategies to connect both domains efficiently. What follows is the breakdown of the key characteristics in the development process of the customer experience that point to be instrumental in attracting platform adopters.

3.3 Nimble software development

Updatable products demand a superior development of software, basically in an IoT ecosystem, which is where platform-based business models thrive, every industrial company must become a software company. For Ford it will be necessary to develop software that is not only updatable but also lean, efficient and with top level of security to avoid the flaws that could cause a deterioration of the platform's reputation (in this case the automobile). As new applications and electronics products will be generated constantly, it will become instrumental to be capable to add new functionalities to vehicle's ECUs in a fast and precise fashion [8].

3.4 Relationship with suppliers

Companies looking to play in the automobile platform-based business model will have to be held accountable for the security of applications (highly software-based) and for the compliance with all regulations. It is envisioned that companies looking to position their vehicle platforms as dominants will have to establish and maintain a solid reputation that will generate the trust of users

4. Methodology

Given the current complexity that will reign in the platform-based business model, and considering the need to communicate the feature design intent in a precisely fashion across different layers of Ford's PDP the proposal is to work with model-driven methods in order to address the following tasks:

4.1 Clear communication of proposals

From the forecast described earlier, it is expected that the number of stakeholders to be involved in the development of in-vehicle features will increase as and will demand a scheme of communication way better than text-based documentation and free of ambiguities that static diagrams fail to prevent. The creation of the mobility experience will start with the in-vehicle experience but will extend to other services (apps or connection with other products) added on top of the platform -the vehicle-that completes the experience. The winners will be those ones who seamlessly couple the platform and the services. Clear communication with stakeholders either at the vehicle level or at the services level will be instrumental to achieve this smooth integration [9].

During the ideation phase it will be necessary to go thru iteration loops in order to craft better proposals and this will occur with stakeholders with multiple backgrounds and perspectives, so in order to promote the iterations to occur quickly and precisely, all stakeholders shall speak a common modeling language.

4.2 Rapid prototyping

In-vehicle features will be prototyped by running executable models for all proposals. Multiple experiments with varied conditions or settings will be analyzed with these virtual prototypes in order to find better solutions faster. As features will be software-driven and creating more mature prototypes -such as mock ups for clinics- will require fast cycles of software development. Working with a model-based method will allow a streamlined specification of requirements for software prototypes by avoiding the reworks due to misunderstood requirements.

4.3 Robust verification

The completion of the feature development will end once it is completely verified. This includes the confirmation that all possible scenarios where the feature may operate are detected and covered with valid actions. To achieve this, it is necessary to execute a solid analysis of requirements to verify that there is not any conflict among them and that there is no missing requirement at any scenario. Using a model-driven approach for the validation of the feature will be the right practice to execute this analysis robustly and in a timely manner. Once verification is complete, the feature owner will have been finished his development work and will hand off the model of the feature which represents the design intent and will become the master reference for any stakeholder. This does not mean that the feature has been implemented already across all involved components but is just the kick-off to cascade the feature development to lower levels of decomposition, to the specific functions each component perform are developed [10].

4.4 Modeling

4.4.1 SysML (System Modeling Language)

In order to develop the feature in a model-centric paradigm, it necessary to use tools for modeling requirements, scenarios, events and states because at the moment of creating the experience, these are the elements that are used to describe it in relation to the customer. In this regard, the proposal is to employ SysMLTM as the language to express the in-vehicle feature design intent. Proposing this language obeys to the fact that its utilization has spread in other industries such as aerospace -in which the complexity of the projects is tremendous and as a result, there exist today several companies that offer commercial tools for modeling in SysMLTM. This growing adoption, suggests that SysMLTM is becoming the standard modeling language for complex systems, and thus it will be the common communication language among the different players in the platform-based ecosystem [11]. It is important to recall that in this proposed model-centric development of features, the feature models (expressed with SysMLTM) should be managed with a strategy that emulates the same paradigm that is practiced in the design of the mechanical hardware of the vehicle, where 3-Dimensional models of all components are assembled virtually. Put it simple, the "in-vehicle feature design intent" is virtually created in a model. This means that every stakeholder or team member of the PD organization should be able to access it for any particular interest he might have. For instance, some team members will access it to learn the engineering direction that applies for the design that their respective components should meet, while

others will access it to get executable representations of what the feature does and how it works and then communicate the design intent across other teams.

4.4.2 CAD modeling

In the case of CAD models, they contain the exact information of the spatial distribution of the components within the vehicle. Every stakeholder that needs to verify a dimension of a part, or maybe perform an assessment of the roominess of the vehicle will access the CAD model to obtain that information. There is no ambiguity in the CAD model; any available space existing in the model will exist if all components are built to print and the assembled.

Every team member knows that any proposal that is compatible in the CAD model is geometrically buildable. If someone wants to package a component, he can directly work on the model with the certainty that what fits in the model will fit once the components are assembled.

The 3-Dimentional model presents the complete information of the spatial distribution of the parts and this allows cross-functional team members to work independently with no need for the CAD author to tell them what they can or cannot propose.

Of course, understanding CAD models does not represent a big challenge because the geometric information expressed in those models requires the use of the visualization capabilities that humans use every day. However, the relevance of this paradigm becomes more important when translated to the domain of in-vehicle features (experiences). In this domain the information is more complex to process. In some cases, capturing the entire mode of operation of an in-vehicle feature could be very challenging since this implies to describe behaviors under multiple scenarios and circumstances. Thus, communication with SysMLTM models demands the understanding of a language that certainly has a graphical syntax but whose semantics is not obvious [12].

A central element of the model-centric paradigm is that the revisions of the models are arbitrated and tracked rigorously in order to ensure full control of design changes. Certainly every stakeholder can work over a published model but only in a "read mode", since only the owner of the model shall revise it and thus ensures feature governance. In the case of the in-vehicle features models the proposal is the feature owner to be the only one with the authority to revise the design intent and then update the model.

5. Conclusion

The new business dynamic brought by the digital era is characterized by three main components: "A shift in paradigms in almost all aspects of the business; talent management, complexity schemes for value creation and value capture." Unparalleled uncertainty. Knowing what is coming next is hard to anticipate * The winners in this age are those who take the risk and perform bold actions.

However even in this rapid-changing environment and high levels of uncertainty is still possible to deliberatively change the game. But for doing so, organizations should exercise three main capabilities;

adaptability, creativity and imagination.

Imagination is clue to understand future scenarios and should be practiced deliberatively. Organizations should invest and nurture it as part of organizations culture. Moreover should be seen as a dedicated activity and not as something that enhances daily tasks.

Imagination is the only weapon corporations have to risk safely and act when there is still time and resources. If well exercised, it will provide the vision of the future of the game.

The next step is to be creative and act with what exist and add what needs to added. With enough creativity it is possible to rearrange ordinary resources and take them to do extraordinary actions which are the result of a superior level of integration rather than the collection of the best resources available. Understanding and deciphering the best way to execute and play demands high levels of creativity and the latter is facilitated when multiple persons participate. Diversity spurs creative solutions but requires people engagement.

Thus, to engage them it is vital to communicate the vision as bold as it is; changing the game, and provide an environment where all ideas are welcome. It is unusual that someone refuses to participate in an endeavor that is meant to change the game but if that happens then it is very likely that the vision was poorly communicated.

Finally, adapting the organization and the strategies to change the game requires good experimentation within a punishment-free environment. It is important to keep in mind that every trial will deliver value as long as the organization is willing to learn from them. However, it is still possible to experiment multiple times and learn nothing. It is not about just experimenting; every trial should be well planned and well executed.

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