ISSN: 2582-8304

FLEXIBILITY IN USE

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Abstract

Flexible design is a form of design that allows for interim feedback that may change the course of a trial or experiment. It's sometimes used synonymously with adaptive design. Flexibility in design can allow a building to evolve over time as the user needs change. The flexibility of a building or elements of its design can allow it to be used efficiently despite changes in operational requirements, whereas an inflexible building might become obsolete. The study elaborately explains the types of flexibility such as adaptability, transformability and convertibility. It also lights on various examples which are available in our surroundings and designed using the flexibility principle

Key *Words:* *Product Design, User Research, Methodology, Adaptability, Transformability, Convertibility, Flexibility*

1. Introduction

1.1 What if flexibility isn't there?

People always tend to look for change. No one can live with the same scenario, same habits, same body for so long. In this world, everything is changing at every microsecond. And I feel this is very essential to grow as a part of nature. Flexibility is not only about materialistic things; it could be anything from mental flexibility, physical flexibility to emotional flexibility.

Freedom also can come under flexibility. If we consider life without flexibility; that is everything around us feels rigid. Trees that are naturally growing towards sunlight only because of flexibility might look like rigid linear statues. Considering life without 'flexibility' itself gives the feeling of

goosebumps. Flexibility can help improve every aspect of your life – your work, relationships, health, family, creativity, success, and more.

Even in the human body, decreased flexibility may also lead to abnormal stress on structures and tissues distant from the initial site of inflexibility. One example of this is that tendonitis in the knee can be related to calf tightness.

In terms of design, flexibility can be defined within three broad types- Adaptability Transformability, Convertibility, relating to the amount of change that occurs and the degree of permanence of that change.

1.2 Product Flexibility

Product flexibility can be defined as the amount of responsiveness (or adaptability) for any future change in a product design, including new products and derivatives of existing products.

A flexible design will reduce redesign costs and allow quicker response to customers with increased performance. Many manufacturers offer products that are specifically designed to present additional flexibility for the end consumer and product lines that can serve their entire market base.

1.3 Flexibility in Automotive Design

Even in automobile design, a flexible approach is essential. The automobile body shop is currently facing an accelerating process of change caused by shorter product life cycles, increasing customization, and the co-existence of electric and combustion engine vehicles. High automation and rigid production systems prevent cost-efficient responses to changing boundary conditions. This paper presents the results of a comprehensive study across the automobile industry, analyzing obstacles and approaches to handle the challenges faced. An approach for a fixtureless body shop, increasing flexibility and reducing costs, is described. The approach is based on part-integrated fixture functions, enabling fixtureless assembly, and joining of the body parts.

2. Types of Flexibility

2.1 Adaptability

Adaptability is a measurement of how well a design handles change. A static design is incapable of handling change while a fully dynamic design gracefully handles any change within anticipated limits.

There is often some cost associated with making a design adaptable. In some cases, this cost isn't warranted if there is a low chance of occurring. This trade-off doesn't always exist. In theory, a design can be both inexpensive and adaptable. (Andreasen, 1988; Kahler, 1988; Swift, 1988; Lund, 1988)

Embracing change and a future of infinite possibilities, though daunting, will inevitably strengthen your ability to adapt — and in turn, design. The ability to adapt can arguably lead to success in any field, but it has multifaceted importance for designers. Beyond adapting to ever-changing tech specs, rotating team members, and the demands of clients and users, designers can set themselves up for success by learning to remain flexible cognitively, emotionally, and situationally.

Examples:

- A dynamic website that displays content from a variety of data sources.
- Rooms that can be joined and reconfigured for multiple purposes.

2.1.1 Cognitive Adaptability

To adapt well, it's important to understand the value of progress and react accordingly by trying to keep up with the changing world around you. Designers do this by not only being competent in art and visual communication but also by becoming fluent in coding and knowledge of relevant software and technologies. Your clientele will also expect you to anticipate, understand, and design for the wants and needs of their business stakeholders. While wearing multiple hats can be undeniably challenging, well-rounded designers are better equipped to succeed professionally.

The constant evolution of technology also requires a certain level of adaptability from designers. Twenty years ago, you could only design handheld 3D games and augmented reality experiences in your dreams. On the flip side, designers may notice a rise in seemingly inconceivable jobs like gamification designer, chief drone experience designer, and human

DNA and organ designer sooner than you'd think. We can't predict the future, but we can welcome it — and that makes all the difference.

2.1.2 Emotional Adaptability

Creating a design that enriches the end user's experience necessitates putting yourself in the shoes of your client and their audience and learning to overcome your own confirmation bias. This can require a level of emotional intelligence that transcends everyday empathy.

"If a company is using new tech but only the engineers are working on it, then it's missing those touches that designers [have to] give it — the human element, the emotional element, the user experience," explains Krista Van Guilder, a senior UX designer. "We as designers are doing more than just dressing something up and making it look cool. We understand how to use the tech in a meaningful way, not just adding all of the bells and whistles because we can."

This isn't likely to change anytime soon, either. It's becoming common knowledge that creating for human beings is a more effective strategy than focusing on mastering metrics. As the ubiquity of personalization increases, so will the amount of emotion be informing the development and design of user experiences. The more memorable and meaningful the design is, the more it will resonate with users.

2.1.3 Situational Adaptability

Rather than letting challenging circumstances control you, a flexible worldview is fundamental for designers. Approaching change as an opportunity rather than a threat can positively influence both the way you work and your work itself.

Because the realm of tech is constantly evolving, it's important that designers can stay both optimistic and realistic during times of adjustment or transition. Good leaders can acknowledge shaky situations and plan for a better future by demonstrating confidence, and this applies to design as well.

For example, a designer who invested hours in a project only to be told by their team leader that they need to start over with new data. Rather than focusing on the amount of time and effort lost, a flexible team member would likely confront the challenge head-on. The same goes for designers working in a team with revolving members or facing a finicky client. This

kind of adaptability increases productivity and helps keep teams stable through times of change.

Becoming an engaged part of the design community is an easy way to anticipate and keep up with technological trends and working alongside your peers and predecessors can help you learn from their trials and tribulations.

Challenging yourself to try new things can help keep you on your toes, too. "Today's designer needs to pivot quickly as things move fast, industries transform, and start-ups go belly-up overnight," says Van Guilder. "Don't let yourself become stagnant… [and] don't get comfortable."

Paying attention to the style and success of your peers' responses to various scenarios can help you to become more situationally adaptable; whenever you find yourself faced with a similar set of circumstances, you can draw on your observations for reference.

Designers can also work on increasing their emotional flexibility by recognizing and understanding the restrictions of their preconceptions and biases, whether that includes assumptions about their audience's abilities or opinions on user experience. Working on the development of certain soft skills such as conflict resolution also helps you to become more emotionally and situationally adaptable — and manage your client's expectations, too.

While adaptability is a critical quality, there's something to the adage that there can be too much of a good thing. This is especially relevant when it comes to cognitive adaptability, as no one wants to be a jack of all trades but a master of none. We delve further into this issue here.

2.2 Transformability

In the field of design, transformability is an important way of actively responding to ambient conditions while also meeting the needs of users and addressing issues of user experience. Within contemporary design, there is a growing interest in motion; products and their parts are gradually shifting from static to dynamic. However, contemporary activities in design education are evidence of a lack of a holistic approach to the study of motion in design, and the design of motion as an alternative mode of design thinking is still in its infancy.

2.2.1 Transformable Design

Transformable design, though it is not a newly coined design term, has rarely been acknowledged as a critical component of design pedagogy. Due to a relative lack of history regarding transformable design resulting from the dominant tradition of understanding design as a collection of static artifacts, motion study has not progressed to a place within the pedagogy of architecture, and the impact of transformable design on pedagogy has predominantly been underestimated. The pedagogy of transformable design is founded on a pervasive design language called the Language of Motion Formation. The language of motion, as an integrated learning framework, offers a common foundation for the design of transformable architecture.

A recent studio-based course offered at Virginia Tech became a testing ground for the pedagogy of transformable design, bringing forth the opportunity to examine the concept of transformable design pedagogy within the context of an accredited design program. In the spring of 2014, by engaging the vocabulary and syntax of motion language and manipulating their bounds and constraints, design students examined the potential of motion language by designing and making different mechanisms in a variety of shape-shifting forms that offered the possibility of change. By inspiring new avenues in the exploration of transformable design pedagogy, this design studio attempted to expand the current domain of transformable design to a broader perspective of design pedagogy and contributed toward adding value directly into the content of the curricula, and thus into the field of design education. For the sake of better understanding the design process and the relationships among internal and external factors that craft dynamic and responsive products, this studio presented a sequential design development of different mechanisms from a seed idea through the fabrication phase in which motion evolved into physical models. The studio aimed to be a mediator between ideas and reality. In this studio, the making of a series of iterative models, as a way of knowledge gathering and design thinking, was integrated into the design intent. Therefore, different models, ranging from small to full-scale mock-ups, were made to thoughtfully engage motion design principles and manipulate their bounds and constraints.

2.3 Convertibility

Convertibility is defined as the capability of a system to adjust production functionality or change from one product to another. End-users of manufacturing systems are struggling with the issue of how to measure and quantify convertibility. Metrics for convertibility are proposed in this paper so

that different manufacturing systems can be compared concerning this area of performance. These metrics are based on assessments of the configuration itself, and the system components such as machines and material handling devices. Metrics for quantifying convertibility are useful for comparing system configurations during the early phases of design, without requiring detailed product or process plan information.

With increased consumer demands for a wider variety of products in changeable, unpredicted quantities, manufacturing system responsiveness has become increasingly important for industry competitiveness. Manufacturers need systems that can be rapidly adjusted regarding both functionality and throughput capacity over the lifetime of the system.

2.3.1 System Convertibility

System convertibility includes contributions due to machines, their arrangements or configuration, and material handling devices. One important factor in system performance that has not yet been included in flexibility or convertibility metrics is the nature of the material handling devices that are used.

When companies design and install new systems, they must be concerned not only with the products being manufactured today, but also those that will be made throughout the lifetime of the system. Thus, the ability to respond to future market conditions is important. By measuring the convertibility of the configuration, machines, and material handling elements, the convertibility metrics defined here provide a quantitative assessment for characteristics of manufacturing systems that make certain design alternatives inherently better than others in terms of responsiveness. (Van Wie, 2002)

Intrinsic metrics of convertibility are particularly useful during the early phases of design, when detailed product and process plan information may not be known. These assessment techniques can be used to compare candidate systems and configurations. It is often the case that more flexible and convertible systems require a higher initial investment. Intrinsic convertibility metrics can be used to justify the purchase of these systems, particularly for manufacturers who deal in highly volatile markets or have products that require frequent design changes (Bischof,2007, Blessing, 2007).

3. Examples of flexibility

3.1 Flexibility in products

3.1.1 Mobile phone

Mobile phones are used for a variety of purposes, it shows flexibility in use and purpose, such as keeping in touch with family members, conducting business, and having access to a telephone in the event of an emergency. Some people carry more than one mobile phone for different purposes, such as for business and personal use.

3.1.2 Nail cutter

A nail clipper (also called nail clippers, a nail trimmer, a nail cutter, or nipper type) is a hand tool used to trim fingernails, toenails, and hangnails. It provides flexibility to the user to use it in different ways.

3.1.3 Walking cane

Fig 1. Different types of walking cane

(https://www.seniority.in/blog/senior-safety-what-s-better-walking-canes-or-walking-sticks/)

One can improvise a walking stick from nearby felled wood. More ornate sticks are made for avid hikers and are often adorned with small trinkets or medallions depicting "conquered" territory. Wooden walking sticks (Fig.1) are used for outdoor sports, healthy upper-body exercise, and even club, department, and family memorials. This product talks about flexibility in users according to the flexibility in use.

3.1.4 Swiss knife

Fig 2. Swiss knife
(https://uniortools.com/eng/product/1655EURO17-multitool-euro17)

Swiss knife (Fig.2) a versatile tool that you'll find will often be your "go-to", all-purpose fix-it tool. From cutting to scraping, sawing, or sanding, the convenience of a multi-tool often wins out over more specific power tools.

3.1.5 Scissor

Fig 3. Scissor design considering left-handed as well as right-handed users
(https://www.designideas.pics/carpal-tunnel-special-designed-handles/)

The primary difference between left- and right-handed scissors is the way the blades are connected. The special thing about scissors (Fig. 3) for left hands is that when you open them, the blade on the left-hand side goes to the top. This means the blade on the right sits on the bottom. This provides flexibility in users solving the purpose of universal design (Ulrich, 2003).

3.2 Flexibility in Surroundings

3.2.1 Flexibility in Spaces

In architecture, the flexibility of space use is the space character that probably can change to various functions according to the activities even without changing the order of the

spaces.

3.2.2 Flexibility in Nature

Fig 4. Different types of eggs in one nest
(https://avianres.biomedcentral.com/articles/10.1186/s40657-020-00220-x)

Photos of blue model egg (Fig. 4) in the nests of the four species (a. Chestnut Thrush, b. Chinese Thrush, c. Elliot's Laughingthrush and d. White-bellied Redstart). A cuckoo bird lays its eggs in the nests of other birds, which act as foster parents for the young cuckoos. This shows how nature adapts flexibility.

3.2.3 Flexibility in Trees

Fig 5. Different shapes of trees of the same type
(https://www.pxfuel.com/en/free-photo-jgiwb)

Trees (Fig 5) are flexible. When subjected to a force due to the wind, or a force applied artificially, they bend. What is less obvious is that the bending is not merely a curving of the stem. The base of the stem inclines also because the roots flex so that the attachment to the ground is not rigid. The rotation is assumed to be about the point where the stem center line intersects the ground plane and the elasticity of it is described here by the term root-anchorage stiffness.

3.3 Flexibility in Technology

3.3.1 Alexa

Alexa is a virtual assistant technology developed by Amazon. It is capable of voice interaction, music playback, making to-do lists, setting alarms, streaming podcasts, playing audiobooks, and providing weather, traffic, sports, and other real-time information, such as news. Alexa can also control several smart devices using itself as a home automation system. Users can extend the Alexa capabilities by installing "skills" (additional functionality developed by third-party vendors, in other settings more commonly called apps) such as weather programs and audio features. It uses automatic speech recognition, natural language processing, and other forms of weak AI to perform these tasks.

3.3.2 Personal Care Robots

A personal robot is one whose human interface and design make it useful for individuals. This is by contrast to industrial robots which are generally configured and operated by robotics specialists. A personal robot enables an individual to automate the repetitive or menial part of the home or work life making them more productive.

3.3.3 Smart Home

Home automation is building automation for a home, called a smart home or smart house. A home automation system will monitor and/or control home attributes such as lighting, climate, entertainment systems, and appliances. It may also include home security such as access control and alarm systems. When connected with the Internet, home devices are an important constituent of the Internet of Things.

3.4 Flexibility in the Automobiles

3.4.1 BMW Gina

Fig 6. BMW Gina car offers flexibility to transform its shape
(https://www.bbc.com/future/article/20120206-have-concept-cars-lost-their-way)

The GINA (Fig. 6) Light Visionary Model is a fabric-skinned shape-shifting sports car concept built by BMW. GINA stands for "Geometry and functions in 'N' Adaptations". GINA allowed his team to "challenge existing principles and conventional processes." This beautiful vehicle gives itself the flexibility to change its emotions by moving its stretchy skin.

3.4.2 Tesla Pods

Fig 7. Tesla's interchangeable travel-pod system shows modularity in transportation
(https://www.yankodesign.com/2019/01/22/teslas-interchangeable-travel-pod-system-shows-modularity-in-transportation/)

Tesla pods (Fig 7) give flexibility to users to use the same frame with different vehicle categories assembled on it according to need (Stone, 1997).

3.4.3 The Flying Car

Fig 8. The hybrid car-aircraft, Aircar
(https://www.bbc.com/news/technology-576518403)

The new era of dual mobility vehicle; the automatic transition from a road vehicle to an air vehicle and vice versa, including deploying/retracting wings and tail.

The flying car (Fig 8) made its successful landing, and the flight represented a significant development milestone. The aeroplane transformed into a sports automobile in under three minutes with the push of a button, and it was piloted by its inventor.

4. Conclusion

In fast-changing environments, systematic product development must be extended from the classical approach. Flexibility is often proposed for product developing companies to stay competitive under these conditions. The development of flexible products is one form of the proposed flexibility. In this paper product development, guidelines were presented, which can be used by product designers as a supportive tool to develop these flexible products.

To achieve more unambiguous results and create a better too for the product development process, the guidelines must be revised. A first step to simplify understanding and remembering was taken by visualizing the textual guidelines. It must be investigated if this visualization supports the product developers' work without restricting the solutions. Additionally, the research will be continued to identify further flexibility guidelines to be integrated with the existing set.

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ISSN: 2582-8304

FLEXIBILITY IN USE – *part 2*

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Abstract

Universal Design is the design and composition of an environment so that it can be accessed, understood, and used to the greatest extent possible by all people regardless of their age, size, ability, or disability. Universal design encompasses flexible design of the system so that designed objects can have a certain degree of flexibility in use to accommodate for a wide range of individual preferences and abilities. Flexibility allows for compactness, space-saving, creative use, extended use, jugaad thereby leading to longevity and enhanced engagement. The study elaborately outlines approaches to improve flexibility in products.

Key Words: *Flexibility, Adaptability, Design, Inclusive, Multipurpose, Modular*

1. Introduction

The Disability Act 2005 defines Universal Design as the design and composition of an environment so that it may be accessed, understood, and used, 1) To the greatest possible extent, 2) In the most independent and natural manner possible, 3) In the widest possible range of situations, and 4) Without the need for adaptation, modification, assistive devices, or specialized solutions by any persons of any age or size or having any particular physical, sensory, mental health, or intellectual ability or disability.

In relation to electronic systems, this means any electronics-based process of creating products, services, or systems so that they may be used by any person (Center for Excellence in Universal Design, n.d.).

The application of universal design principles minimizes the need for assistive technology, results in products compatible with assistive technology, and makes products more usable by everyone,

not just people with disabilities.

The 7 Principles of Universal Design were developed in 1997 by a working group of architects, product designers, engineers, and environmental design researchers, led by the late Ronald Mace in the North Carolina State University. The purpose of the Principles is to guide the design of environments, products, and communications. According to the Center for Universal Design in NCSU, the Principles "may be applied to evaluate existing designs, guide the design process and educate both designers and consumers about the characteristics of more usable products and environments" (Center for Excellence in Universal Design, n.d.).

The purpose to incorporate flexibility in usage aligns with the intent of the universal design objective. Flexibility in use allows for a wide range of individual preferences and abilities. It also allows for the compactness and space-saving nature of products with the trade-off with complexity. Thus, a flexible design is one, which adapts to the needs of the users, and if implemented thoughtfully, it also eliminates the use of additional assistive devices. Proper application of flexible design eventually leads to inclusive design.

The definition of flexibility can be as:

noun
the quality of being easily adapted or of offering many different options
the ability to bend easily or without breaking
the ability and willingness to adjust one's thinking or behavior (Dictionary.com, n.d.)

synonyms. *noun*

Pliability, suppleness, pliancy, malleability, mouldability, stretchability, workability, limberness, ductility, plasticity, elasticity, stretch, stretchiness, whippiness, springiness, spring, resilience, give, bounce, bounciness, bendiness, tensility, adaptability, adjustability, open-endedness, openness, openness to change, changeability, freedom, latitude, mobility, variability, fluidity, versatility, wriggle room, willingness to compromise, accommodation, amenability, cooperation, tolerance, forgivingness.

2. Understanding the aspects of flexibility

2.1 Story

Last summer, before the pandemic, I was traveling from Kolkata to my home. I took a train from

Howrah railway station in the evening. This train used to be fairly crowded as there were not many trains running on this route. I was sitting on my window seat listening to the band "One republic", and taking a view of the outside. After passing a few stations, it turned dark eventually. I could hear some faint noise from the next coach. I guessed it might be some person taking tobacco or beggars. As I guessed, it was a group of beggars. So, I gave away a 10 rupee note like always. Just when the group went past, I saw a blind man right behind them. He was playing this small drum, and he was good at it. It felt wrong to me to give 10 rupees to a person begging and not to a specially-abled person who was actually trying to make his living. So, I reached into my pocket to give him another 10 rupees but all I had were coins. I counted the coins, it was some 13-14 rupees, and I gave him all of them. He took the coins, thanked God, blessed me, and walked away from playing his little drum. Sitting idle, it got me thinking, what if someone cheated on the blind guy? One can easily cheat on them if they want to, isn't it? Not really.

That day I realized why someone designs the coins to be of different shapes and sizes. Although it would be much more economical to make them all of the same size. Coins as a product are to be used by every person in every little corner of this vast country. The diversity of audience it needs to cater to is enormous. Making coins of different sizes is one aspect of adding value to the system to make it inclusive. Making design accessible to a wide range of audiences is one of the core principles of universal design. It demands flexibility in the system to be a universal design. As in the previous example, if we see the transaction system as a whole, the system loosens up to incorporate flexibility in size and accommodates all specially-abled users under its domain.

2.2 The Spectrum of Flexibility (Relativity and Scale)

Flexibility in use can be gauged on a spectrum that ranges from exclusive to inclusive design. Flexibility is also dependent on the scale of the context. For example, consider a steel pipe and a gardening pipe. The gardening pipe has an inherited property of flexibility by virtue of its material, whereas the steel pipe is rigid. But multiple steel pipes can be assembled to form different architectural structures as per the needs. Thus, it becomes extremely important to talk about scale and context when we consider flexibility.

2.2.1 Examples of a Flexible System

A flexible system provides a choice in the way a user uses it. Like a mobile phone one can use it for a great camera also one can use it for his business purpose. Each user uses it as per his taste and need. A flexible system Is inclusive and non-discriminatory like a public bus. The same bus suits the requirements of an old man and a young man. The public bus is

flexible enough to accommodate an entirely different set of people. Also, a flexible design allows flexibility and room for user accuracy and precision like a pencil, it writes for a child and even an artist. Finally, flexible design should be able to adapt to the user's learning curve like a game has multiple modes easy, medium, difficult.

2.3 The Indian Context

Following are a few aspects that showcase flexibility in usage in an exemplary way in the Indian context.

2.3.1 Jugaad

In the Indian context, a shortage of resources and poverty drive the indigenous people's inherited creative mindset to explicitly use things in ways other than what they are intended to be. Jugaad is a colloquial Hindi term that refers to a non-traditional, frugal innovation, often known as a "hack." It could also refer to a creative solution or a simple workaround, a remedy that deviates from the mainstream, or a resource that can be exploited in this manner. It is also frequently used to symbolize creativity: making existing things work or creating new things with little resources.

Jugaad is increasingly accepted as a management technique and is recognized all over the world as an acceptable form of frugal engineering at its peak. Jugaad also applies to any kind of creative and out-of-the-box thinking or life hacks that maximize resources.

2.3.2 Indian Clothing

The simplicity of Indian clothing allows the user to use the fabric as per their needs. Thus, simplicity is one of the key drivers to attain flexibility in usage as well.

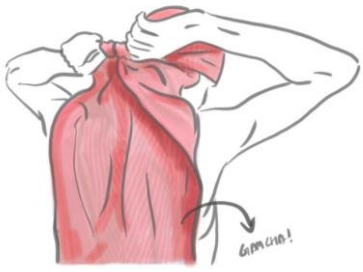

Fig. 1. Gamcha

Fig. 2. Saree

Gamcha: It is a small piece of fabric that is popular in the dressing culture of the state of

Bihar. It is made up of cotton and is a very versatile piece of clothing (Fig 1). People use gamcha in various ways as per their needs. For example, they wear it as a lungi, use it as a towel, blanket, and also as a mat. People also use it for carrying food items or fold it and use it as a pillow while traveling.

Saree: It is another piece of fabric that is worn by women in different parts of India. It is a long piece of fabric that is worn by women by wrapping it around (Fig 2). The absence of any stitching makes it extremely flexible to be worn by women with varied orientations and body sizes.

3. Guidelines and Elaborate Examples

Taking care of the following guidelines while designing accommodates a wide range of individual preferences and abilities. This contributes to an inclusive and flexible system.

3.1 Provide Choices in Methods of Use

3.1.1 Multipurpose Products

Multipurpose products are artifacts with more than one intended or realized purpose. Having one product that can perform multiple functions can eliminate the need for additional products (Viswanathan et al., 2016). These products are typically seen as "all-in-one solutions". It also allows for the compactness and space-saving nature of products with the trade-off with complexity. However, if the "feature focus" aspect of products is pursued very aggressively, the essence of the product might get lost in the process (Fig 3).

A Swiss army knife is a great example of remarkable design. It comes in different sizes and shapes, but always with a good set of tools that can help you in a variety of situations, from scissors to knives, everything presented in a compact package easy to carry with you everywhere. The most common of these knives usually come with around fifteen tools. The average user uses around two to four tools max from the whole package. This means that around seventy five percent of what comes with the product gets wasted or in the best-case scenario, it is used on very rare occasions (Upadhyay, 2020).

So, when we end up focusing on building and releasing features because 'that's where the value is, we are on the way to losing focus on other important tasks. This could act as a barrier to thinking outside of the box while designing an artifact.

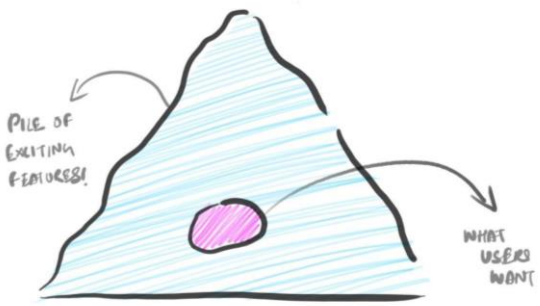

Fig 3. Adding features on top of features consistently for a prolonged period will end up in a mountain of legacy code

3.1.2 Modularity in Products

A modular design is an approach for product designing which is used to produce a complete product by integrating or combining smaller parts that are independent of each other. With the modular design approach, a complex product can be broken down or divided into smaller and simpler components that are independently designed and manufactured. Each of these individual components is then integrated to form the final product. Modular design allows one to customize, reuse, upgrade, and maintain product designs. Additionally, the modular product's independent parts follow a standard interface to easily fit into each other as a finished product. A famous example of modularity is LEGO. These plastic toys contain elements that can easily be assembled and reused as per the creativity level of the users. Modular design products are easier to customize and adapt according to individual customer needs or preferences or catering different customer personas (Yllobre, 2006).

3.1.3 Adaptable Design

The adaptable design aims at developing adaptable products that can be changed, adapted, reconfigured, and upgraded, during the product operation stage to satisfy the various requirements of customers. New adaptability evaluation measures, include extendibility of functions, upgradeability of modules, and customizability of components, to evaluate different design candidates and to identify the optimal one. This definition focuses on changes made to existing entities that make them accessible to people with disabilities or different orientations (Zhang et al., 2014).

3.2 Accommodate Right- or Left-handed Access and Use

3.2.1 Handedness

In human biology, handedness is an individual's preferential use of one hand, known as the dominant hand, due to it being stronger, faster, or better in dexterity. On the other hand, the non-dominant hand is comparatively often the weaker, less dexterous, or simply less subjectively preferred. Right-handedness is by far more common; about ninety percent of the human population are right-hand dominant. Handedness is often defined by one's writing hand, as it is fairly common for people to prefer to do some tasks with each hand. There are examples of true ambidexterity (equal preference of either hand), but most people prefer using one hand for most purposes.

Since the vast majority of the population is right-handed, many devices are designed for use by right-handed people. Left-handed people have either had to adapt or suffer in silence. However, through proper design it is possible to reduce these problems. A task analysis approach, based on force utilization, overcomes many of these obstacles by considering in detail the way tasks are performed. In a systems approach, the required actions and the ways they can be performed by both the right-handed and left-handed are defined ("Handedness," 2021) (Laveson et al., 1976).

3.2.2 Ergonomic and Anthropometric Consideration in Handedness Neutral Design

Ergonomics is the science of fitting workplace conditions and job demands to the capabilities of the working population. Effective and successful "fits" assure high productivity, avoidance of illness and injury risks, and increased satisfaction among the workforce. The level of risk depends on the intensity, frequency, and duration of the exposure to these conditions and the individuals' capacity. Experimental study proves that left-handed and right-handed users interact differently with the objects in the space. Thus, it is important to consider both the ergonomic as well as anthropological aspects of the users to prevent them from being subjected to fatigue and muscular disorders (Hanford, 2021).

3.2.3 Handedness Inclusivity in UI/UX

Computer interfaces are designed from the ground up for right-handed people. Most mice are ergonomically designed for right hands. Control keys (arrow keys, insert, delete, page up, etc.) are on the right side of keyboards so they can be accessed by the right hand while

both hands are typing. Keyboard shortcuts are clustered to the left of the keyboard so the right hand doesn't have to leave the mouse. The software has hundreds of controls designed for right-handed people (including the right-click menu, designed to follow the natural movement of the right wrist). It makes it difficult to learn to use a computer any other way. According to UX design experts, usability patterns, finger and thumb patterns change when it comes to right or left-handed use (Ullinger, 2018). Babu (2019) suggests the following guidelines to design an inclusive experience:

1. Ask your users: good design practice is to conduct some form of user survey or field research where they try to understand the user's world.
   Layout of the control surfaces: the safest zone for ambidextrous use is seemingly the bottom center area. In addition to the surface area coverage, we can also see that the angle of the swipe also differs.

2. When in doubt, align it centrally: Often, products fail that fail their users. If the user cannot approach your product quickly enough or has to go through self-training to use it due to their handedness

3. Test with both hands: try to use your product with both hands separately. Because we have one side dominant, we are likely to use our favorite side and not test for this usability.

3.3 Facilitate the User's Accuracy and Precision

Design should be such that it facilitates the tolerance for inconsistencies in human accuracy which can happen due to various reasons. Any physical disability, impairment, or aging can cause a lack of agility leading to a lack of precision to complete a given task.

Also, the design should facilitate the time-independent quality of output along with easy access in emergencies minimizing hazards and the adverse consequences of accidental or unintended actions.

3.4 Provide Adaptability to the User's Pace

A learning curve is a graphical representation of the relationship between how proficient people are at a task and the amount of experience they have. Proficiency of performing a task usually increases with increased experience of doing the task. The common expression "a steep learning curve" is a misnomer suggesting that an activity is difficult to learn. In reality, people co-exist on

either side of the curve simultaneously. We will always have an expert and an amateur for any given task. This difference is due to the experience level and familiarity with the task that varies with each individual. However, other factors such as age, agility, mental comprehension affect the pace with which one pursues the task.

One of the fundamental issues to tackle in the design of video games is mostly referred to as creating a well-shaped difficulty curve. This means that one of the core elements of a good game design is to make the game just as difficult as it has to be so that the player feels challenged enough, but not too much.

YouTube includes a "Playback speed" feature that allows you to select a speed anywhere between a quarter times and two times the normal speed, with "one" being normal speed.

This allows the users to speed up a video that they feel is too slow, like perhaps a long presentation, interview, or podcast where everyone is speaking slowly. Likewise, users can slow the video down if they have trouble understanding or if things are moving too quickly (Aponte et al., 2011).

Thus, to make the design usable for users, it should adapt to the learning curve and the pace of the users without overwhelming and frightening them away. Also, design should promote easy access and use for newcomers to get more people on board.

3.5 Design for Newcomers

As design professionals, we must consider design through various lenses to ensure we design for target audiences. If design relies on users' mental models formed by their perceptions and past experiences, are we inherently missing a critical lens? What if an experience is altogether new to a user? What if they're a first-time user, a "newcomer".?

A design lens can work as a mental device for thinking about your design differently. It focuses attention on a single design principle, illuminating issues that may have been invisible before.

Designing for newcomers is good practice as it ensures you are considering the first-time experience, where introducing essential elements of your product or service helps overcome initial friction. Newcomers can represent a large user group for a business. Taking their challenges into consideration is important to business success.

Barua (2020) suggests that by anticipating the needs of newcomers and meeting them, you create happy customers that return and remain loyal. Designing with newcomers in mind can help avoid errors too.

Important Tools when designing for Newcomers:

- Ethnographic research
- Mental models
- Empathy map
- Journey map
- Service blueprint and touchpoint orchestration
- Writing for the layperson
- Transformation and change
- Business model canvas

4. Conclusion

As we are moving toward a more inclusive society, having equal opportunities for all is a must. A designer should be sensitive to user needs and should incorporate flexibility in the design of an artifact to ensure effective usability and user experience. This paper explores guidelines with help of examples to provide a template for adding flexibility in a product or a system.

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