5. NPD strategies #2 and User-centered design

5.1 Phase–gate model

A Phase–gate model, also referred to as a phase–gate process, is a project management technique in which an initiative or project (e.g., new product development, process improvement, business change) is divided into stages or phases, separated by gates. At each gate, the continuation of the process is decided by (typically) a manager or a steering committee. The decision is based on the information available at the time, including the business case, risk analysis, and availability of necessary resources (e.g., money, people with correct competencies). The Phase–gate model may also be known as stage-limited commitment or creeping commitment.

5.1.2 History

Phased scope development and investment decision is a fundamental concept of chemical engineering and engineering economics, particularly since the 1940s as chemical complexity and scale of chemical processes grew. One source describes 8 phases in the development of a chemical product starting with research, economic study, scale-up (pilot plant) and design leading to full funds authorization. In 1958, the American Association of Cost Engineers created four standard cost estimate type classifications to match these development and approval phases. Other industries with complex products and projects picked up on the process. For example, NASA practiced the concept of phased development in the 1960s with its phased project planning or what is often called phased review process. The phased review process was intended to break up the development of any project into a series of phases that could be individually reviewed in sequence. Review points at the end of each phase required that a number of criteria be met before the project could progress to the next phase. The phased review process consisted of five phases (Preliminary Analysis, Definition, Design, Development, Operations) with periodic development reviews between phases. NASA's phased review process is considered a first generation process because it did not take into consideration the analysis of external markets in new product development.

The Phase–gate model refers to the use of funnel tools in decision making when dealing with new product development. "Gates" or decision points are placed at

places in the product development process that are most beneficial to making decisions regarding continuance of product development. These production areas between the gates are idea generation, establishment of feasibility, development of capability, testing and validation and product launch. At the conclusion of each of these areas of development of a new product, it is the responsibility of senior management to make a decision as to whether or not the product should continue to be developed. The passing of gate to gate can be accomplished either formally, with some sort of documentation, or informally, decided upon based on the preferences and culture of the organization.

In the chemical engineering world, and engineering and construction industry, phase-gate processes are often called front-end loading. Phase–gate is the particular version and terminology elaborated in the following discussion.

5.1.3 Phases

A common model is composed of the following phases: ideation, preliminary analysis, business case, development, testing, launch.

A Phase–gate model is a conceptual and operational road map for moving a new project from idea to launch – a blueprint for managing the new-product process to improve effectiveness and efficiency.

The traditional phase-gate process has five phases and five gates. The phases are:

1. Scoping

2. Build business case

3. Development

4. Testing and validation

5. Launch

Ahead of this process there is often a preliminary or ideation phase called discovery, and after the 5th phase the process ends with the post-launch review. Major new product projects go through the full five-phase process. Moderate risk projects, including extensions, modification and improvements, use the short XPress version. Very minor changes (e.g. sales force and marketing requests) may

be executed using a lighter process (Phase–gate lite).[citation needed] Each phase consists of a set of prescribed, cross-functional, and parallel activities undertaken by a team of people from different functional areas. Phases have a common structure and consist of three main elements: Activities, Integrated Analysis, and Deliverables. Activities consist mainly in information gathering by the project team to reduce key project uncertainties and risks. An integrated analysis of the results of the activities is undertaken by the project team. Deliverables of phases are the results of integrated analysis that are used as input for the next Gate.

5.1.4 Gates

Gates provide various points during the process where an assessment of the quality of an idea is undertaken. It includes three main issues:

Quality of execution: Checks whether the previous step is executed in a quality fashion.

Business rationale: Does the project continue to look like an attractive idea from an economic and business perspective.

Action plan: The proposed action plan and the requested resources reasonable and sound.

A gate meeting can lead to four results: go, kill, hold, recycle, or "Conditional go".

Gates have a common structure and consist of three main elements:

Deliverables: What the project manager and team deliver to the decision point. These deliverables are decided at the output of the previous gate, and are based on a standard menu of deliverables for each gate.

Criteria: Questions or metrics on which the project is judged in order to determine a result (go/kill/hold/recycle) and make a prioritization decision.

Outputs: Results of the gate review—a decision (go/kill/hold/recycle), along with an approved action plan for the next gate, and a list of deliverables and date for the next gate.

5.1.5 Phases in detail

Phase 0: Discovery

Deciding what projects the company wants and is capable to pursue. During this phase it is common for companies to take part in idea generation activities such as brainstorming or other group thinking exercises. Once the idea generation team has selected a project that they would like to go forward with, it must be passed on to the first gate and therefore screened by the organization's decision makers.

When searching for new product ideas it is beneficial for an organization to look to the outside world to suggest business opportunities. Using methods such as those found in empathic design can be quite helpful. Communicating with customers to understand how and why they use products can produce great strides in idea generation. Specifically, communicating with lead users can provide great feedback to the developers, as these customers are most likely to feel most passionately about the product. In addition to communication with lead users, it may be helpful for developers to communicate with suppliers. By understanding all of the types of business that their materials are being used for, developers may be able to act upon previously untapped possibilities.

Phase 1: Scoping

The second phase of the product development process is scoping. During this step the main goal is to evaluate the product and its corresponding market. The researchers must recognize the strengths and weaknesses of the product and what it is going to offer to the potential consumer. The competition must also be evaluated during this phase. It is important for the researchers to understand who and what is already in the market as well as what can potentially be developed. By determining the relative level of threat from competitors, the management team will be able to recognize whether or not they should go forward with the production of the product.

Phase 2: Building the business case and plan

Once the new product passes through the gate at the end of the scoping phase, the next phase in the phase-gate model is building the business case and plan. This is the last phase of concept development where it is crucial for companies to perform

a solid analysis before they begin developing the product. This phase is generally difficult, complex, and resource-intensive. However, companies must put forth a strong effort in this phase for it is directly related to the success and development of a new product. There are four main steps that comprise this phase: product definition and analysis, building the business case, building the project plan, and feasibility review.

Product definition and analysis

The first step, product definition and analysis, is composed of a series of activities that will provide the information to define and justify the development of a new product. One of the first of these activities is the user needs and wants study where customer value is determined. This addresses questions about the product such as what benefits does the product provide and what features should the product have. During this time the company should conduct surveys and interviews with existing and potential customers, along with staff members. Next, the company must conduct a market analysis. They must determine the market size and segmentation, rate of growth, customer trends and behavior, and what channels reach these customers. Once the market analysis is complete the company must then conduct a competitive analysis. It is important to know how your competitors operate in addition to their strengths and weaknesses. This will not only help you build a great product, but will also help in determining how and where to launch your new product. Together these activities will help define the product and provide a foundation for the marketing strategy. Next, the company must build a technically feasible product concept, which includes the substance and methods needed to produce the new product. Once this is completed the company can then produce a production and operations cost analysis along with a market and launch costs analysis. Next, the company can begin to test the concept they have developed. This is when early prototypes are developed and presented to staff and consumers to gain feedback and gauge customer reaction. From this the company can make the necessary changes and see the sales potential of the product. This feedback will also help the company build a solid product definition. Lastly, the company will then conduct the business analysis, risk analysis, and financial analysis of the new product.

Building the business case

The business case is a document that defines the product and provides the rationale for developing it. This document will vary in format amongst companies, but the primary components are the following: results of the activities of product definition and analysis; legal and regulatory requirements; safety, health, and environmental considerations; assumptions needed to draw the conclusions made, and why it is believed they are valid and reasonable; and out-of-bounds criteria that indicate certain changes/events which will mandate an emergency business case review. This document will be referred to throughout the development process and edited when necessary.

Building the project plan

The project plan includes: a scheduled list of tasks and events along with timelines for milestones throughout the development process; the personnel, time, and financial resources needed to complete the project; and an expected launch date for the release of the new product.

Feasibility review

The last step of building the business case and plan is the feasibility review. This is when management, along with other departments of the company, reviews the rationale for pursuing the product. They analyze the information provided by the previous steps in this process to decide whether or not the product should move forward. If it is decided to be pursued then it passes through gate two and moves on to the product development phase.

Phase 3: Development

During the development phase, plans from previous steps are actually executed. The product's design and development is carried out, including some early, simple tests of the product and perhaps some early customer testing. The product's marketing and production plans are also developed. It is important that the company adheres to their overall goal of the project, which is reflected in these production and marketing plans. Doing this will allow them to definitively decide who they will market their product to and how they will get the product to that target audience. The development team maps out a realistic timeline with specific

milestones that are described as SMART: specific, measurable, actionable, realistic, and time-bound. The timeline is frequently reviewed and updated, helping the team stay on task and giving management information about the product's progress. In the development phase, the product builds momentum as the company commits more resources to the project and makes full use of cross-functional teamwork as the marketing, technical, manufacturing, and sales departments all come together to offer their expert opinions. Having a diversified and parallel development phase ensures that the product continues to meet the company's technical and financial goals. A diverse team allows specific roles and leadership positions to develop as team members make contributions using their strongest attributes. With members having clearly defined roles, tasks can be performed concurrently ensuring a much more efficient development process. The ultimate deliverable of the development phase is the prototype, which will undergo extensive testing and evaluation in the next phase of the process.

Phase 4: Testing and validation

This phase provides validation for the entire project. Areas that will be evaluated include: the product itself, the production/manufacturing process, customer acceptance, and the financial merit of the project. This phase includes three types of testing: near testing, field testing, and market testing.

Near testing

The main objective of near testing is to find any bugs or issues with a product. A key point to remember here is that the product is no longer a prototype and that it has almost all the features of the commercial model.[citation needed] Testing will be done initially by in-house staff, and customers and partners who are close to the firm. It is important to ensure that those testing have an understanding of how the product should perform, so they know what it should or shouldn't be doing. Members of the research and development team are usually present to observe the participants using the product and take any notes or data that may be useful.

Field testing

Field testing, or beta testing, is done by those who can provide valuable feedback on the product. This usually lasts a long period of time and the participants can

include customers, partners, or anyone who is not familiar with the producing company. At this juncture the product fully resembles its planned launch model in all aspects; therefore the participants' interaction rate will be higher because they know all the features and benefits. During this phase there are three primary objectives to be achieved. The first objective is to see how much the participant is interested. It is also worthwhile to note which individual attribute they prefer and if they would buy the product. Next, determine how the customer uses the product and evaluate its durability. Confirm the environment in which the customers will be using the product. Recording and analyzing customer feedback is the final step in the field testing phase. This feedback may be used to help inform any minor design improvements that need to be made. The sales and marketing team will also be a beneficiary of field testing feedback; they can use this information to help focus their sales presentation.

Market testing

Unlike the other two test activities, market testing is considered optional. A solid marketing and launch plan along with confidence in the product's ability to sell helps to inform the key decision makers at the test and validation gate. If there is any uncertainty in the marketing or launch plans there are two options to consider. First, a simulated market test may be run, in which customers will be exposed to new products in an advertising and purchasing situation. The goal of this test is to obtain an early forecast of sales and make any necessary adjustments to the marketing plan. The second test involves trial sales, and is done through specific channels, regions, or consumer demographics.

Phase 5: Product launch

The product launch is the culmination of the product having passed all previous gates. The producer must come up with a marketing strategy to generate customer demand for the product. The producer must also decide how large they anticipate the market for a new product to be and thus determine the size of their starting volume production.[citation needed] Part of the launch phase is training sales and support personnel to be familiar with the product so that they can assist in sales of this product. Setting a product price is an aspect of the product launch that the producer must consider. They should avoid either undershooting or overpricing the

potential market. Finally, distribution is a major decision making part of the launch process. Selecting a distributor or value-added reseller for a product must be done with careful thought and potential sales in mind.

Having a smooth launch process that includes effective marketing and a knowledgeable and prepared sales force may result in faster time to profit due to early customer acceptance.

Effective gating

Most firms suffer from having far too many projects in their product development pipelines, for the limited resources available. "Gates with teeth" help to prune the development portfolio of weak projects and deal with a gridlocked pipeline. Also, a robust innovation strategy, coupled with strategic buckets, refocuses resources on high value development initiatives.

Note that gates are not merely project review points, status reports or information updates. Rather, they are tough decision meetings, where the critical go/kill and prioritization decisions are made on projects. Thus the gates become the quality control check points in the process ensuring that you do the right projects and also do the projects right.

Gates must have clear and visible criteria so that senior managers can make go/kill and prioritization decisions objectively. Most importantly, these criteria must be effective—that is, they must be operational (easy to use), realistic (make use of available information) and discriminating (differentiate the good projects from the mediocre ones). These criteria can be:

Must meet: Knock-out questions in a check list, designed to kill poor projects outright

Should meet: Highly desirable characteristics which are rated and added in a point-count scheme

A sample list of criteria is shown below, from which a scorecard can be developed that can then be used to score projects at a gate meeting.

Must meet (checklist – yes/no) Strategic alignment (fits business unit strategy)

-Reasonable likelihood of technical feasibility

-Meet EH&S policies

-Positive return versus risk

Should meet (scored on 0–10 scale) Strategic Degree to which projects aligns with business unit strategy

-Strategic importance

-Product advantage Unique benefits

-Meets customer needs better than existing or competing product

-Value for money

Market attractiveness Market size

-Market growth

-Competitive situation

Synergies (leverages core competencies) Marketing synergies

-Technological synergies

-Manufacturing / processing synergies

Technical feasibility Technical gap

-Complexity

-Technical uncertainty

Risk versus return Expected profitability (e.g., net present value)

-Return (e.g., internal rate of return)

-Payback period

-Certainty of return

If the answers were "no" or "low" to any of these questions, the decision certainly would not be to kill the project – hence they're poor go/kill criteria.

5.1.6 Advantages and disadvantages

There are a number of advantages to using the phase-gate model for product development, which typically result from its ability to identify problems and assess progress before the project's conclusion. Poor projects can be quickly rejected by disciplined use of the model. When using the phase-gate model on a large project, the model can help reduce complexity of what could be a large and limiting innovation process into a straightforward rule-based approach. When a phase-gate model incorporates cost and fiscal analysis tools such as net present value, the organization can potentially be provided with quantitative information regarding the feasibility of developing potential product ideas. Finally, the model is an opportunity to validate the updated business case by a project's executive sponsors.

One problem with the phase-gate process is the potential for structural organization to interfere with creativity and innovation, as overly structured processes may cause creativity to be reduced in importance and to hinder the largely iterative process of innovation.

5.1.7 Opportunity management

The opportunity management funnel is a visual representation of phase-gate decision making. Opportunity management has been defined as "a process to identify business and community development opportunities that could be implemented to sustain or improve a local economy." The components of opportunity management are:

1. Identifying opportunities.

2.Evaluating and prioritizing these opportunities - This may involve developing criteria, deliberating, and ranking the alternatives.

3.Driving opportunities - Involves assigning leads, accountability, action plans, and project management

4.Constant monitoring - May require one of the following actions: Advance –

-Commit additional resources to move the idea forward

-Rework - More investigation/ rethinking

-Kill - Stop working on the idea and move on

The goal of the opportunity management funnel is to eliminate weak or bad ideas before money or resources are contributed to realize these opportunities. The benefit if the opportunity management funnel when utilizing phase-gate decision making is that the funnel generates efficiencies where weak ideas are efficiently eliminated leaving a strong set of viable alternatives. To fulfill its mandate, the opportunity management funnel filters the broadest range of opportunities and ensures that all priority sectors are represented. When selecting which opportunities to filter through the process, economic developers should be aware that initially, there are no bad ideas or limits. The unviable alternatives will be filtered out throughout the process using phase-gate decision making process.

5.2 User-centered design

User-centered design (UCD) is a process (not restricted to interfaces or technologies) in which the needs, wants, and limitations of end users of a product, service or process are given extensive attention at each stage of the design process. User-centered design can be characterized as a multi-stage problem solving process that not only requires designers to analyse and foresee how users are likely to use a product, but also to test the validity of their assumptions with regard to user behaviour in real world tests with actual users. Such testing is necessary as it is often very difficult for the designers of a product to understand intuitively what a first-time user of their design experiences, and what each user's learning curve may look like.

The chief difference from other product design philosophies is that user-centered design tries to optimize the product around how users can, want, or need to use the product, rather than forcing the users to change their behavior to accommodate the product.

5.2.1 UCD models and approaches

For example, the user-centered design process can help software designers to fulfill the goal of a product engineered for their users. User requirements are considered right from the beginning and included into the whole product cycle. These requirements are noted and refined through investigative methods including: ethnographic study, contextual inquiry, prototype testing, usability testing and other methods. Generative methods may also be used including: card sorting, affinity diagraming and participatory design sessions. In addition, user requirements can be inferred by careful analysis of usable products similar to the product being designed.

Cooperative design: involving designers and users on an equal footing. This is the Scandinavian tradition of design of IT artifacts and it has been evolving since 1970.

Participatory design (PD), a North American term for the same concept, inspired by Cooperative Design, focusing on the participation of users. Since 1990, there has been a bi-annual Participatory Design Conference.

Contextual design, "customer-centered design" in the actual context, including some ideas from Participatory design.

All these approaches follow the ISO standard Human-centred design for interactive systems (ISO 9241-210, 2010).

The ISO standard describes 6 key principles that will ensure a design is user centered:

1.The design is based upon an explicit understanding of users, tasks and environments.

2.Users are involved throughout design and development.

3.The design is driven and refined by user-centered evaluation.

4.The process is iterative.

5.The design addresses the whole user experience.

6.The design team includes multidisciplinary skills and perspectives.

5.2.2 Purpose

UCD answers questions about users and their tasks and goals, then uses the findings to make decisions about development and design. UCD of a web site, for instance, seeks to answer the following questions:

Who are the users of the document?

What are the users' tasks and goals?

What are the users' experience levels with the document, and documents like it?

What functions do the users need from the document?

What information might the users need, and in what form do they need it?

How do users think the document should work?

What are the extreme environments?

Is the user multitasking?

Does the interface utilize different inputs modes such as touching, spoken, gestures, or orientation?

5.2.3 Elements

As examples of UCD viewpoints, the essential elements of UCD of a web site are considerations of visibility, accessibility, legibility and language.

Visibility

Visibility helps the user construct a mental model of the document. Models help the user predict the effect(s) of their actions while using the document. Important

elements (such as those that aid navigation) should be emphatic. Users should be able to tell from a glance what they can and cannot do with the document.

Accessibility

Users should be able to find information quickly and easily throughout the document, regardless of its length. Users should be offered various ways to find information (such as navigational elements, search functions, table of contents, clearly labeled sections, page numbers, color-coding, etc.). Navigational elements should be consistent with the genre of the document. 'Chunking' is a useful strategy that involves breaking information into small pieces that can be organized into some type meaningful order or hierarchy. The ability to skim the document allows users to find their piece of information by scanning rather than reading. Bold and italic words are often used.

Legibility

Text should be easy to read: Through analysis of the rhetorical situation, the designer should be able to determine a useful font style. Ornamental fonts and text in all capital letters are hard to read, but italics and bolding can be helpful when used correctly. Large or small body text is also hard to read. (Screen size of 10-12 pixel sans serif and 12-16 pixel serif is recommended.) High figure-ground contrast between text and background increases legibility. Dark text against a light background is most legible.

Language

Depending on the rhetorical situation, certain types of language are needed. Short sentences are helpful, as are well-written texts used in explanations and similar bulk-text situations. Unless the situation calls for it, jargon or technical terms should not be used. Many writers will choose to use active voice, verbs (instead of noun strings or nominals), and simple sentence structure.

5.2.4 Rhetorical situation

A user-centered design is focused around the rhetorical situation. The rhetorical situation shapes the design of an information medium. There are three elements to consider in a rhetorical situation: Audience, Purpose, and Context.

Audience

The audience is the people who will be using the document. The designer must consider their age, geographical location, ethnicity, gender, education, etc.

Purpose

The purpose is what the document targets or what problem the document is trying to address.

Context

The context is the circumstances surrounding the situation. The context often answers the question: What situation has prompted the need for this document? Context also includes any social or cultural issues that may surround the situation.

5.2.5 Analysis tools used in user-centered design

There are a number of tools that are used in the analysis of user-centered design, mainly: persona, scenarios, and essential use cases.

Persona

During the UCD process, a Persona of the user's need may be created. It is a fictional character with all the characteristics of the user. Personas are created after the field research process, which typically consists of members of the primary stakeholder (user) group being observed on their behaviour, and additionally answering questionnaires or participating in interviews, or a mixture of both. After results are gathered from the field research, they are used to create personas of the primary stakeholder group. Often, there may be several personas concerning the same group of individuals, since it is almost impossible to apply all the characteristics of the stakeholder group onto one character. The character depicts a "typical" stakeholder, not an "average" individual in the primary stakeholder group, and is referred to throughout the entire design process.[5] There are also what's called a secondary persona, where the character is not a member of the primary stakeholder group and is not the main target of the design, but their needs should be met and problems solved if possible. They exist to help account for

further possible problems and difficulties that may occur even though the primary stakeholder group is satisfied with their solution. There is also an anti-persona, which is the character which the design process is not made for. Personas usually include a name and picture, demographics, roles and responsibilities, goals and tasks, motivations and needs, environment and context, and a quote that can represent the character's personality. Personas are useful in the sense that they create a common shared understanding of the user group for which the design process is built around. Also, they help to prioritize the design considerations by providing a context of what the user needs and what functions are simply nice to add and have. They can also provide a human face and existence to a diversified and scattered user group, and can also create some empathy and add emotions when referring to the users. However, since personas are a generalized perception of the primary stakeholder group from collected data, the characteristics may be too broad and typical, or too much of an "average joe". Sometimes, personas can have stereotypical properties also, which may hurt the entire design process. Overall, personas are a useful tool that can be used since designers in the design process can have an actual person to make design measure around other than referring to a set of data or a wide range of individuals.

Scenario

A scenario created in the UCD process is a fictional story about the "daily life of" or a sequence of events with the primary stakeholder group as the main character. Typically, a persona that was created earlier is used as the main character of this story. The story should be specific of the events happening that relate to the problems of the primary stakeholder group, and normally the main research questions the design process is built upon. These may turn out to be a simple story about the daily life of an individual, but small details from the events should imply details about the users, and may include emotional or physical characteristics. There can be the "best case scenario", where everything works out best for the main character, the "worst case scenario", where the main character experiences everything going wrong around him or her, and an "average case scenario", which is the typical life of the individual, where nothing really special or really depressing occurs, and the day just moves on. Scenarios create a social context to which the personas exist in, and also create an actual physical world, instead of imagining a character with internal characteristics from gathered data an nothing

else; there is more action involved in the persona's existence. A scenario is also more easily understood by people, since it is in the form of a story, and is easier to follow. Yet, like the personas, these scenarios are assumptions made by the researcher and designer, and is also created from a set of organized data. Some even say such scenarios are unrealistic to real life occurrences. Also, it is difficult to explain and inform low level tasks that occur, like the thought process of the persona before acting.

Use case

In short, a use case describes the interaction between an individual and the rest of the world. Each use case describes an event that may occur for a short period of time in real life, but may consist of intricate details and interactions between the actor and the world. It is represented as a series of simple steps for the character to achieve his or her goal, in the form of a cause-and effect scheme. Use cases are normally written in the form of a chart with two columns: first column labelled actor, second column labelled world, and the actions performed by each side written in order in the respective columns. The following is an example of a use case for performing a song on a guitar in front of an audience.

Use cases are useful because they help identify useful levels of design work. They allow the designers to see the actual low level processes that are involved for a certain problem, which makes the problem easier to handle, since certain minor steps and details the user makes are exposed. The designers' job should take into consideration of these small problems in order to arrive at a final solution that works. Another way to say this is that use cases breaks a complicated task into smaller bits, where these bits are useful units. Each bit completes a small task, which then builds up to the final bigger task. Like writing code on a computer, it is easier to write the basic smaller parts and make them work first, and then put them together to finish the larger more complicated code, instead to tackling the entire code from the very beginning. The first solution is less risky because if something goes wrong with the code, it is easier to look for the problem in the smaller bits, since the segment with the problem will be the one that does not work, while in the latter solution, the programmer may have to look through the entire code to search for a single error, which proves time consuming. The same reasoning goes for writing use cases in UCD. Lastly, use cases convey useful and important tasks

where the designer can see which one are of higher importance than others. Some drawbacks of writing use cases include the fact that each actions, by the actor or the world, consist of little detail, and is simply a small action. This may possibly lead to further imagination and different interpretation of action from different designers. Also, during the process, it is really easy to oversimplify a task, since a small task from a larger task may consist of even smaller tasks. Picking up a guitar may involve thinking of which guitar to pick up, which pick to use, and think about where the guitar is located first. These tasks may then be divided into smaller tasks, such as first thinking of what colour of guitar fits the place to perform the piece, and other related details. Tasks may be split further down into even tinier tasks, and it is up to the designer to determine what is a suitable place to stop splitting up the tasks.[8] Tasks may not only be oversimplified, they may also be omitted in whole, thus the designer should be aware of all the detail and all the key steps that are involved in an event or action when writing use cases.

5.2.6 User-centered design, needs and emotions

The book "The Design of Everyday Things" (originally called "The Psychology of Everyday Things") was first published in 1986. In this book, Donald A. Norman describes the psychology behind what he deems 'good' and 'bad' design through examples and offers principles of 'good' design. He exalts the importance of design in our everyday lives, and the consequences of errors caused by bad designs.

In his book, Norman uses the term "user-centered design" to describe design based on the needs of the user, leaving aside what he considers secondary issues like aesthetics. User-centered design involves simplifying the structure of tasks, making things visible, getting the mapping right, exploiting the powers of constraint, and designing for error. Norman's overly reductive[citation needed] approach in this text was readdressed by him later in his own publication "Emotional Design."

Other books in a similar vein include "Designing Pleasurable Products" by Patrick W. Jordan, in which the author suggests that different forms of pleasure should be included in a user-centered approach in addition to traditional definitions of usability.

5.2.7 User-centered design in product lifecycle management systems

Software applications (or often suites of applications) used in product lifecycle management (typically including CAD, CAM and CAx processes) can be typically characterized by the need for these solutions to serve the needs of a broad range of users, with each user having a particular job role and skill level. For example, a CAD digital mockup might be utilized by a novice analyst, design engineer of moderate skills, or a manufacturing planner of advanced skills.