INTERNATIONAL DESIGN CONFERENCE - DESIGN 2012
Dubrovnik - Croatia, May 21 - 24, 2012.

CONCEPTUAL AND PRACTICAL USER INTEGRATION INTO THE DESIGN PROCESS - A FOUR STEP STAKEHOLDER APPROACH

V. Agrawal, A. R. Vaidya, L. A. Shluzas, M. Steinert and R. Katila

Keywords: user centric design, stakeholder ranking, artistry inspired design methods, science inspired design methods

1. Introduction

Complex systems and products involve multiple users and stakeholders, all of whom might not be pertinent to the design process. When designing new products and system in this scenario, identifying and targeting the "real" user among multiple stakeholders becomes a difficult challenge. For instance, in the healthcare field, patients are often considered the "users" of medical technology. However so are doctors, nurses, hospitals, and insurers. Thus, the question remains: Who is the optimal user to target in the design process? The possible continuum may span from early technology adopters to average users, to select user-features or attributes for certain targeted needs.

This paper focuses on examining user interaction for the design and development of complex products and systems. We first present a literature-based comparison between the conceptual notion of "users" and the direct inclusion of "users," within several design methods. The emerging continuum is then broadly segmented into two categories: artistry inspired design methods versus science inspired design methods. Inspired by Donald Schön, the former category focuses on generative metaphors and learning systems [Schön 1983]. Design methods derived from this artistry inspired design understanding are more applicable to fuzzy front-end exploration design tasks. The latter category was inspired by the work of Herbert Simon and focuses on quality and efficiency [Simon 1976]. Methods from this science inspired design approach are generally more applicable to technical design optimization tasks. For sample design methods in each category, we present the types of users involved and their corresponding degrees of user involvement.

After having determined that the user concepts in the various design methods and stages vary greatly, we modify the notion of "the user" in favor of a more balanced, role based stakeholder perspective of the problem. By presenting the roles of users in several design methods, this paper provides a systematic framework for determining which user entities designers should focus on throughout the design process. Contrary to current processes for assessing and prioritizing users and stakeholders that are often fragmented and qualitative, the proposed framework combines several tools into one systematic process. The proposed *Design Stakeholder Identification, Assessment and Ranking Framework* is geared toward the design and development of complex systems, involving an embedded network or ecosystem of users and stakeholders. It intends to provide designers with a comprehensive tool for ensuring that the needs of stakeholders with a high degree of influence over product/system adoption are met.

This paper is conceptual, literature-based and case-based in nature. It aims to generate feedback from the academic and practitioner community for further refinement and application.

2. The conflicting notion of “users” in existing user-centric design methods

The notion of “user” is central to design methods and approaches. According to [Von Hippel 1976] 75% of the commercially successful industrial goods innovation projects were user-driven, rather than technology driven. Depending on the extent of user involvement, there is a continuum of user concepts spanning from a concrete existing user (e.g. lead user [Von Hippel 1976]) to an observable user group we may interact with (e g. participatory designer [Abras et al. 2004]) to an abstract conceptualization of user (e.g. users as customers in axiomatic design [Suh 2001]). Since users play a critical role in determining the success of a product and its impact on a community, the selection of the ‘right user group’ during the design process is critical for the success of any design method. The ‘right user group’ may vary from one industry to another and from one product to another. In fact there might be more than one ‘right user group’ for the same product within the same industry.
Every design method has its own interpretation of user and its own criteria for defining the role of the user. As shown in Table 1, design methods can be broadly separated into two types: artistry inspired design methods that focus on iteratively learning from, interacting with, and reflecting on real users; and science inspired design methods that generally have an abstract, conceptual notion of users. The latter often integrates user aspects in the form of requirements in order to select and optimize the quality and efficiency of designs. Examples of design methods within each category are shown in Table 1, along with their corresponding user types and degrees of user involvement.

Table 1. Artistry and science inspired design methods

<table>
<tr><th>Type of Design Method</th><th>Example Methods</th><th>User Types</th><th>User Involvement</th></tr>
<tr><td rowspan="6">Science inspired Design methods:
Focus on Quality and Efficiency, more applicable to technical/scientific design optimization tasks, promoted e.g. by Simon (1976).</td><td>Lean</td><td rowspan="6">Users as abstract concept of customers and stakeholders</td><td rowspan="6">Limited to no involvement</td></tr>
<tr><td>Six Sigma Process Excellence</td></tr>
<tr><td>Quality Function Deployment</td></tr>
<tr><td>Cost Benefit Analysis</td></tr>
<tr><td>Choice Modeling</td></tr>
<tr><td>Minimum Viable Product</td></tr>
<tr><td rowspan="6">Artistry inspired Design methods:
Focus on generative metaphor, learning systems, more applicable to fuzzy front end exploration design tasks, promoted e.g. by Schön (1983).</td><td>Lead User innovation</td><td rowspan="6">Real users, may be separated into adopter categories (innovators to laggards [Rogers 2003]</td><td rowspan="6">Active involvement</td></tr>
<tr><td>Participatory Design</td></tr>
<tr><td>Inclusive / Universal Design</td></tr>
<tr><td>Usability / Human Factors Design</td></tr>
<tr><td>Experience Design</td></tr>
<tr><td>Crowd Sourcing</td></tr>
</table>

Table 1 represents a continuum rather than an exclusive categorical separation between the notion and integration of ‘user’ in design methods. The next section will examine the different design methods and their ‘user’ concept.

2.1 Artistry inspired design methods

Artistry inspired design methods focus on design usability and the active engagement of users in the design process. Users in this category may be involved at various stages throughout the design process based on their innovativeness and willingness to adopt new products. The user groups may be segmented according to Rogers’ diffusion curve [Rogers 2003]. Examples of design methods in this category include lead user innovation, participatory design, inclusive/universal design, usability/human factors design, experience design, and crowd sourcing.
For instance, ***lead-user innovation*** involves identify the needs of non-existing products and features before the general market, and actively including lead users in the design process. Examples of lead-

user innovations are the World Wide Web, developed by Tim Berners-Lee, and surgical drapes developed by 3M etc. [Von Hippel 1976].

In ***Participatory design,*** which was a Scandinavian centered movement, users are integral parts of a product development team and viewed as "co-designers" [Abras et al. 2004]. This method involves increased engagement and communication with potential users, site visits, and understanding the work context. In participatory design, attention is focused on a target audience, and personas (i.e. fictional people) are used as tools to enhance engagement and reality.

Inclusive or universal design is a process-driven approach by designers and industries to ensure that products and services are accessible to the widest possible consumer base, regardless of age and ability. Emphasis is placed on working with "critical users" to stretch design briefs [Suri 2000].

Experience design involves designing for the users' experience of things, events, and places [Sanders 2002]. This method emphasizes active participation of users in the design and development process. Experience design is a recommended method for design of interactive products. IDEO design projects, "The Patient Experience" and "ROV Pilot Experience," exemplify the experience design method.

Crowd Sourcing is a method also known as 'Democratic Design'. This is the act of sourcing tasks to a group of people through an open call. This is a distributed form of Participatory Design where the users are participating in the design process but are not concentrated at one place. It uses online communities and forums to search for solutions. An early example is the Oxford English Dictionary. Amazon's Mechanical Turk is an example of the Crowd Sourcing method adopted by corporations, as illustrated by Jeff Howe in a June 2006 Wired magazine "The Rise of Crowdsourcing".

2.2 Science inspired design methods

In contrast to the previously presented design methods, science-inspired design methods focus on products, quality and efficiency of design and development processes. These methods are frequently applied to manufacturing processes and to scientific research. In Herbert Simon's words "The engineer, and more generally the designer, is concerned with how things ought to be - how they ought to be in order to attain goals, and to function". In these methods, abstract user concepts such as value creation and market simulation are often employed. Although end users might be indirect beneficiaries of these methods, they are not always engaged in the design process. Instead of interacting directly with users, the inputs may be obtained via secondary means. Examples of science inspired design methods include lean, six-sigma process excellence, quality function deployment, cost-benefit analysis, choice modeling, and minimal viable product.

Lean is a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination. "Value" is defined as any action or process for which a customer would be willing to pay. Thus, the focus of lean design methods is on creating value for the customer; but the user is not directly involved in the process. Lean manufacturing is a continuation of Toyota Production Systems developed in the late 1940's. Poka–Yoke (Error-Proofing) is a Lean manufacturing technique.

Six Sigma was developed by Motorola in 1986. It seeks to improve the quality of process outputs by identifying and removing the causes of defects and minimizing variability in manufacturing and business processes. Six Sigma uses a set of quality management methods including statistical methods, and creates a special infrastructure of people within the organization. The focus here is on manufacturing process and on the people involved in manufacturing.

Quality Function Deployment (QFD) is a method used to determine critical customer attributes and to create a link between customer inputs and design parameters. QFD also includes deploying methods for achieving the design quality into subsystems and ultimately into the specific elements of the manufacturing process. So, the ultimate aim is to design the manufacturing process based on customer attributes. QFD was originally developed by Dr. Yoji Akao in Japan in 1966.

Cost benefit analysis is a process for analyzing benefits and costs of projects for two purposes: to determine their feasibility and to prioritize them. It involves comparing the total expected cost of each option against total expected benefits, to see whether benefits outweigh the costs, and by how much.

Choice modeling is used to model the decision process of an individual or industry segment in a particular context. This method may also be used to estimate non-market environmental benefits and costs. Choice modeling is a general purpose tool currently available for making some probabilistic predictions about certain human decision making behavior. James J. Heckman and Daniel L. McFadden won noble prize for development of theory and methods for analyzing selecting samples and discrete choices.

Minimum Viable Product (MVP) has just those features that allow the product to be deployed. The product is typically deployed to a subset of possible customers, such as early adopters to gain feedback and to grasp the product potential. It is a strategy to maximize the information learned about each customer per dollar spent. Users are not directly involved in the process from the beginning. Instead, the product is designed and then tested on users for feedback. This strategy is mainly used for web-based products where the development cycle is smaller, and tends to be popular among startups.

A graphical depiction of the design methods mentioned above is shown in Figure 1.

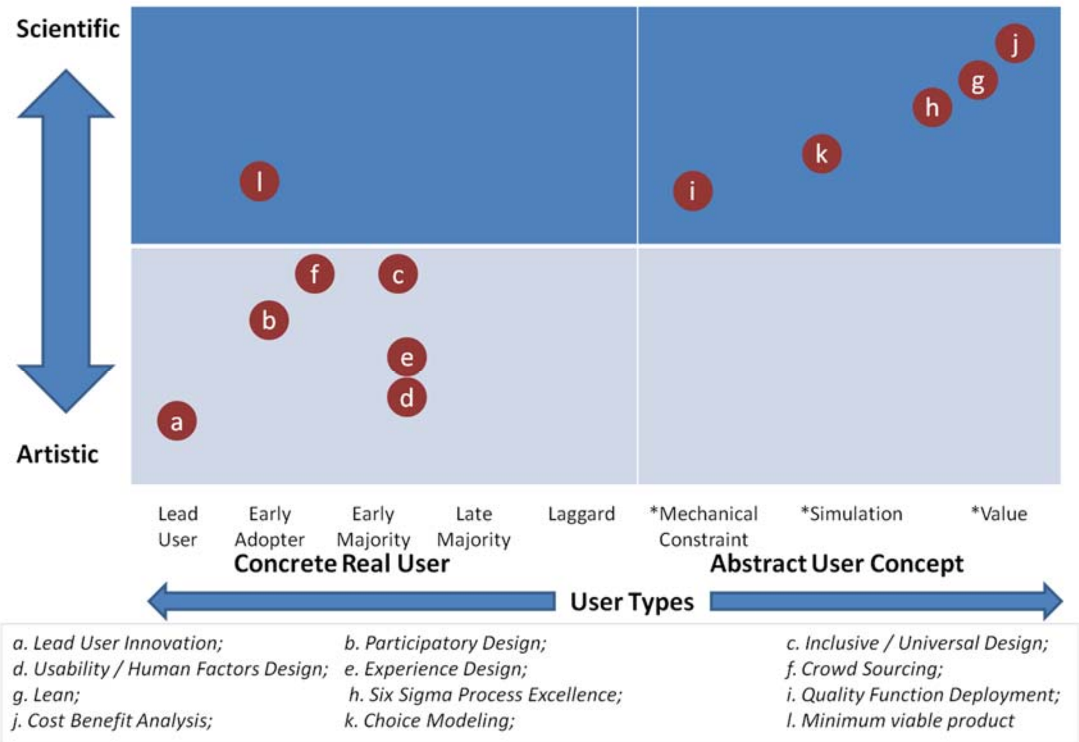

Figure 1. Pictorial view of the artistry inspired to science inspired design methods continuum and the implicit differentiation of what constitutes a user (* indicates abstract user concept examples)

Since the notion of who or what constitutes 'the user' and how and when to integrate and involve 'the user' varies greatly between existing design methods, we propose a more balanced approach to user integration into the design process.

3. Importance of selecting the "right" users and stakeholders in design processes

It is evident from the description of various design methods and different user notions that the target users will vary for the development of the same product, based on the design method chosen. For example, the current development of Boeing's 787 Dreamliner has involved multiple users, including the crew, passengers, airline operators, aircraft manufacturers, regulatory authorities, etc. Though passengers will use the final product, so too will the pilot and the crew, but the choice of buying the product will depend on airline companies. Additionally maintenance is a major factor in determining the actual air time for a plane. Thus, involving the 'right user' in the design process is extremely important for the success and adoption of this product.

Additionally, for simplicity sake but also based on existing teaching dogma, users are quite often seen as individuals; when in reality, the users are part of a complex stakeholder network with delicate and

not always obvious relationships. As per 'Stakeholder Network Theory' [Rowley 1997], each firm faces a different set of stakeholders which aggregate into unique patterns of influence. They respond to the interaction of multiple influences from the entire stakeholder set. In fact, the notion of conducting participatory observations and creating concrete user narratives and personas is gaining ground in design practices. But, there is a danger that designers may focus on the "wrong user," one who may not significantly contribute to the future adoption of the product/service/solution. We therefore propose to *identify and analyze the stakeholder network* as foundation for the user group selection.
Also, the roles of the user groups may vary significantly from one industry to another. For instance, the government may be the end-user for defense products, but it would be a legislative authority for a healthcare product. Thus, understanding the user in terms of stakeholders and their roles in the context of different industries is critical to developing a framework for classifying user-centric design methods. Due to this *context dependability*, each product/system and industry requires an independent analysis to identify each user group's specific role in a particular design situation.
Next, this paper proposes a concrete framework to address this need of design teams.

4. Design stakeholder identification, assessment and ranking framework

We propose a framework to help design teams better understand the roles of different users and stakeholders, and to prioritize their involvement in the design process. The four stages of our proposed framework include the following:

1. Gap analysis (or needs finding)
2. Customer value chain analysis

3a.Cycle of use analysis
3b.Monetary flow analysis

4. Final stakeholder ranking

4.1 Step 1 (pre-step) - Gap analysis

The purpose of the initial step is to identify a potential new product or new features to an existing product that addresses unmet user needs. The outcome of this initial step will be a list of requirements of the new product/features. These could be grouped by functionality or use cases if necessary.
This step is intended to ensure that the team has articulated a clear strategic focus such as a specific industry, specialty or specific need. There should be a good match between the expertise in the product team, the industry or market of focus, and the potential of the market for product adoption.
Once the strategic focus is established, the team needs to uncover problems that users are facing in order to identify ideas for potential new products or features. This can be achieved by observation of users in their natural product use environment, or it may occur through customer feedback, direct interviews, etc. In this need-finding process, it is critical that the team ask questions, watch for latent problems, and observe the verbal and non-verbal signals carefully. All the observations, feedback, observer's thoughts/reactions must be documented in detail. Problem statements i.e. "gaps" will be found in these notes, which will help the team to identify new or additional features required in this product. This list of gaps or problems should then be used to define corresponding requirements that will solve the problem(s). Validating market opportunity by defining the target market and sizing the market are also important at this stage.

4.2 Step 2 - Customer value chain analysis (CVCA)

The purpose of this analysis step is to enable the design team to comprehensively identify pertinent stakeholders, their relationships with each other and their role in the product's life cycle. The outcome of this analysis is a product value net that includes a list of all the parties involved in the product, i.e. stakeholders, their intents and incentives, and their inter-relationships. The value net will show the most important decision making stakeholders.

4.2.1 CVCA Process

This process involves 5 steps [Donaldson et al. 2006], followed with an example value net:

Step 1: Define the initial business model and assumptions:
This is covered in Step 1 – Gap Analysis.
Step 2: Delineate the pertinent parties involved with the product:
In addition to the end user, stakeholders can include business partners, regulatory bodies, specific teams within the organization, etc. All of these stakeholders become customers in the Customer Value Chain.
Step 3: Determine how the parties are related to each other:
This step forms the basic value net and shows the possible interactions between different parties. A firm's stakeholders are likely to have direct relationships with one another. The nature of any existing inter-stakeholder relationships influences a stakeholder's behavior and, consequently, the demands it places on the focal organization.
Step 4: Identify the relationships among the parties by defining the flows between them:
The relationships between the customers are based on the flows or the value propositions to each individual customer.** By analyzing these flows, the team will get a better understanding of each customer's role in the product cycle and their influence on the success or failure of the product.
Step 5: Analyze Customer Value Chain to determine critical customers and their value propositions:
At this stage, the team will have a clear picture of which stakeholders will actually use/handle the product and which stakeholders have a decision making influence on the product adoption. It is important to note that some stakeholders may fall into both categories.
The key result from this analysis is to determine stakeholders with decision-making influence, based on the number of arrows pointing into or away from each stakeholder in the value net. Stakeholders with peripheral influence will less likely be at a focal point in the value net. The design team should make note of these key decision makers in the format shown in Table 2:

Table 2. Stakeholder ranking table for "Decision Making Influence"

	Stakeholder 1	Stakeholder 2	Stakeholder 3…
Decision Making Influence (Based on CVCA Analysis)	1-5	1-5	1-5

**[Typical value propositions are: money or payments, complaints, regulatory influences, tangibles such as hardware, materials, and services or necessary information. The arrows show the direction of the flow accompanied by the appropriate icon or icons. For example as shown in Figure 2, a dollar sign ($) may indicate money whereas an exclamation mark (!) may indicate complaints].

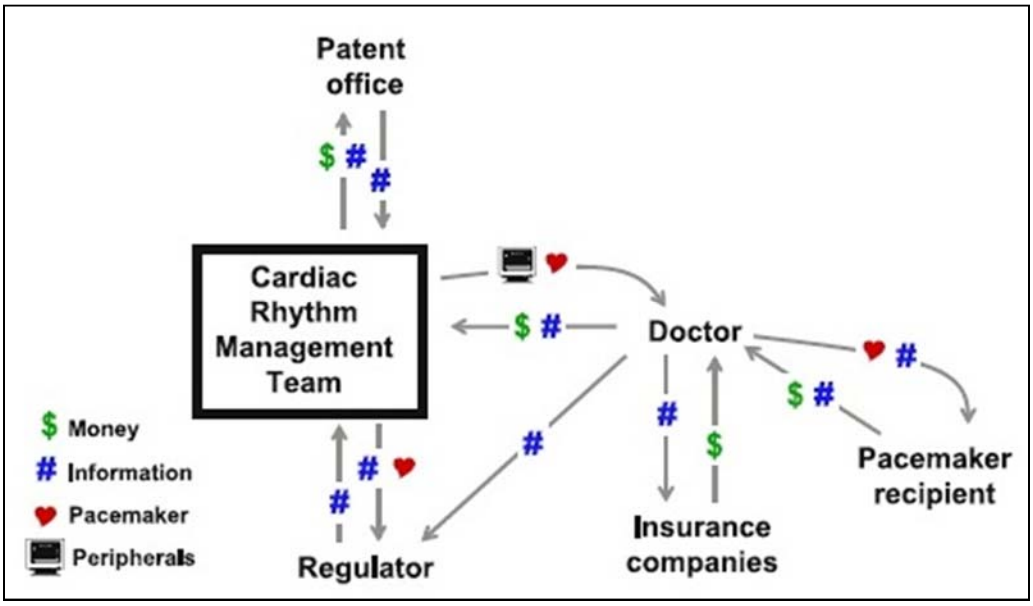

Figure 2. An example of customer value chain analysis for a pacemaker alert system [Donaldson et al. 2006] is shown in the figure above

4.3 Step 3a - Cycle of use analysis

The purpose of this step is to assess different stakeholders' value drivers and incentives with respect to behavioral, technical, and social status interests. This analysis is from the usability perspective.
This step of the analysis will result in a ranked list of stakeholders based on the relationship between the stakeholder and the product features (i.e. based on the way the product affects stakeholders).

4.3.1 Process

As described in section 4.1 of the framework, the team will have a list of desirable product features/requirements and from section 4.2, a list of pertinent stakeholders - ranked by their decision making influence. In this section, we want to find the most important stakeholders from a product-use perspective. A table (Table 3) of the following type can be formed and used for this part of the analysis:

Table 3. General format of table for ranking

Product Usage (or Use Cases)	**Ranking Category**	Stakeholder 1	Stakeholder 2	Stakeholder 3	Stakeholder 4…
Use case 1	R1				
	R2				
Use case 2..	R3…				

Note that the requirements are grouped into different "use cases" or procedural steps that users will perform while using the product. This will allow the team to incorporate the procedural steps and relate them to product requirements.
Three such tables should be created, one for each of the following aspects. Rankings will be given a score from 1-5 along with a "Not Applicable" (or 0) ranking to account for stakeholders who have no direct interest in using that feature. If one use case has a large number of features/requirements, a designer should create this matrix per use case to reduce complexity. In product use or cycle of use analysis, we consider the following 3 factors for ranking:

i. Behavioral/Usability

This aspect considers how much change the user would have to make in using this product feature as compared to his/her existing method(s). As shown in Table 4, the score will be 0 for no change, 1 for minimum change and 5 for a completely new feature or method.

Table 4. Stakeholder ranking table for "Behavioral Factors"

Product Usage	**Behavioral/ Usability Factors**	Stakeholder 1	Stakeholder 2	Stakeholder 3	Stakeholder 4…
Use case 1	R1	0-5	0-5	…	…

ii. Technical/Utility

This aspect considers the purely technical functionality i.e. performance of the product. Per Table 5, the ranking for each feature-stakeholder combination is based on how critical the stakeholder considers this particular feature to be. Another way to look at this is how much value does the stakeholder place on the technical benefit (utility) of this feature. A "must have" feature is scored 5, and "nice to have" is scored 1.

Table 5. Stakeholder ranking table for "Technical Factors"

Product Usage	**Technical/ Utility Factors**	Stakeholder 1	Stakeholder 2	Stakeholder 3	Stakeholder 4…
Use case 1	R1	0-5	0-5	…	…

iii. Social interest

This aspect considers social factors such as power and prestige associated with using a particular product, technology, or feature of a product. The ranking is based on the stakeholder's perception of status associated with using this product or feature. As captured in Table 6, a perceived large increase in social status is scored 5, and minimum or no change is scored 1.

Table 6. Stakeholder ranking table for "Social Interest Factors"

Product Usage	**Social Interest Factors**	Stakeholder 1	Stakeholder 2	Stakeholder 3	Stakeholder 4…
Use case 1	R1	0-5	0-5	…	…

At the end of this exercise, the team will have 3 tables of ranked stakeholders and features, from the usability perspective. The next step is to create a single table by combining the three tables above.

4.3.2 Procedure to combine the three tables

The table format (Table 7) remains the same. The ranking entries in the matrix (of each feature-stakeholder combination) are added up respectively by applying weights and entered in the respective location in the final table.

The weights to be applied to each of the 3 factors are left to the team's discretion and would typically vary according to industry. For example, for consumer goods products the "Behavioral/Usability" ranking would probably have a higher weight, whereas in the healthcare industry, the "Technical/Utility" could have a higher weight. It is also possible, that we select equal weights for all 3 factors.

Table 7. Combined stakeholder ranking table for "Product use incentives"

Product Usage	**Product Use incentives**	Stakeholder 1	Stakeholder 2	Stakeholder 3	Stakeholder 4 …
Use case 1	R1	Weighted* sum (Behavioral +Technical +Social Status) for Stakeholder1 & R1	Weighted* sum (Behavioral +Technical +Social Status) for Stakeholder2 & R1	…	…
	R2				
Use case 2	R3…				
…					

[* Weighting based on design team's discretion]

Now the team will have a final usability focused stakeholder ranking table, with rank scores from 0-5.

4.4 Step 3b - Monetary flow analysis

This analysis will assess stakeholders for financial interests in a product or service so as to identify key decision makers. This analysis is from the financial perspective with focus on product adoption. The analysis results in a ranked list of stakeholders based on the financial effect of the product features or requirements on the stakeholder.

4.4.1 Process

In this analysis, the team will start with a list of stakeholders from step 2 (CVCA), similar to step 3a. From these stakeholders, the team should track the entities that pay for products and services. It is important to keep in mind while ranking that these are the stakeholders that drive product adoption in one way or the other.

For the purpose of ranking, create a similar table (Table 8) as the general format in part 3a. The score will be from -5 to +5. Continue the same order of the table (as in the step 3a ranking), with features along the rows and stakeholders along the columns. Next step is to quantify the financial interests in a product feature – would the stakeholder gain or lose from the introduction of this product or feature? How much would a stakeholder potentially gain or lose from the adoption of a new product or feature ($$ column)? If a stakeholder potentially has a big financial loss (relative to other stakeholders) because of a particular feature, then the score is -5 in the respective entry. On the other hand, if he/she has a big gain, then the score is +5. If a stakeholder is not affected financially then the score is 0.

At the end of this exercise, the team will have a financial-factors-focused stakeholder-product feature ranking table with scores ranging from -5 to +5. Note that, a high absolute value indicates a large financial impact. We can take absolute values of all the ranking values (to eliminate the negative sign), so that the table now shows values from 0-5 (with a higher number showing higher impact which could be positive or negative).

Table 8. Stakeholder ranking table for "Monetary incentives"

Product Usage	**Monetary incentives (+ve or –ve)**	Stakeholder 1		Stakeholder 2		Stakeholder 3		Stakeholder 4…	
		$$	**Abs(Score)**	**$$**	**Abs(Score)**	**$$**	**Abs(Score)**	**$$**	**Abs(Score)**
Use case 1	R1		0 to +5		0 to +5	…	…	…	…
	R2								
Use case 2..	R3…								

4.5 Step 4 - Final stakeholder ranking

This final step helps designers understand which stakeholders need to be involved in the product development/design process, and provides recommended strategies for involving the pertinent stakeholders. The result will be a list of stakeholders that should be involved using user-participatory design methods, and a list of stakeholders that should be involved using scientific design methods.

4.5.1 Process

At this stage, the team has three ranked tables – one from the decision making perspective (Table 2), another from product use perspective (Table 7) and lastly from the financial perspective (Table 8). From these tables, it will be clear which stakeholders are important from the feature development perspective and which stakeholders are important for driving adoption. Some stakeholders may have ranking in all 3 tables. This can be represented with a diagram as shown in Figure 3:

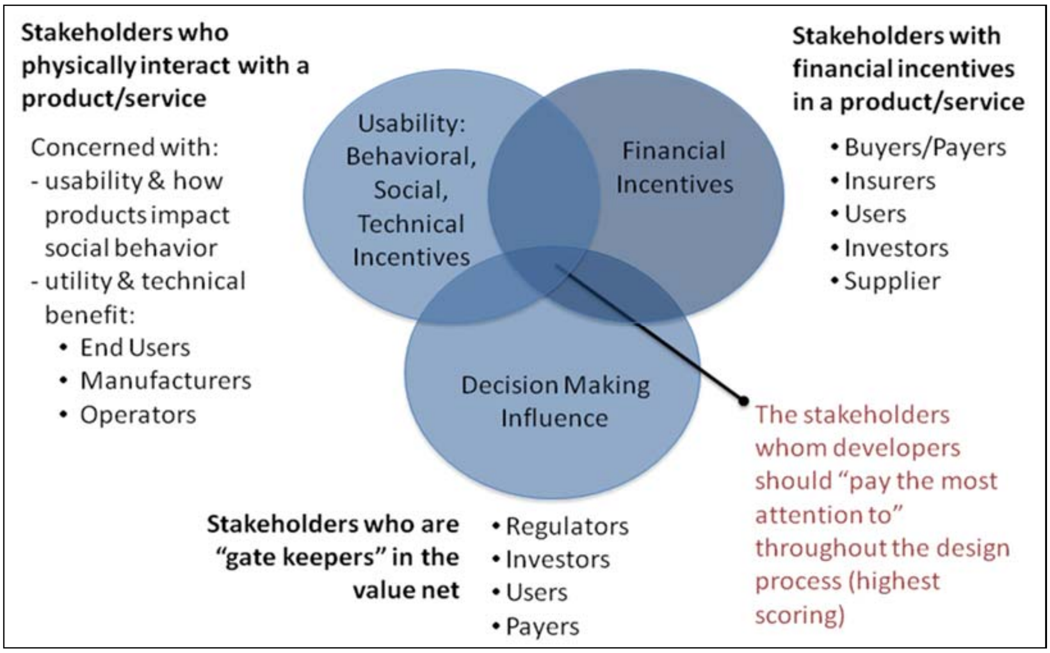

Figure 3. Stakeholder ranking

With the stakeholder ranking information, the team will be able to categorize stakeholders into the following "buckets":

i. High ranking in decision making, usability and financial matrix:

These are the most important stakeholders as they have financial and decision making power that drives product adoption, and are involved in physically using the product. The team should make an effort to involve these stakeholders in the product development process. They should work along with the design team through participatory and iterative design methods (Schön-type) as well as through scientific methods such as focus groups, surveys, minimum viable product strategy (Simon- type).

ii. High ranking in usability matrix:

These are the stakeholders who will be very closely involved in actual usage of the product – either as end users, or intermediate operators, maintenance personnel, etc. These stakeholders will be typically those individuals/groups who physically interact with the product and hence should be actively involved in actual design and development process (abstract - participatory, inclusive, etc.) for enhancing usability and functionality of the product. This process will be iterative.

iii. High ranking in decision making and/or financial matrix:

These are the stakeholders who have a high decision making power and large vested financial interest in the product. But these stakeholders are not involved in using the product at any stage (i.e. they have 0 ranking in the usability matrix). Since these stakeholders have no direct interaction with products but do have control of finances, their inputs should be considered using the scientific/technical methods. This process will be mostly conducted in the early stages of product development (may not be iterative). They do not affect usability.

iv. Low ranking in 2 or all matrices:

These are the lower priority stakeholders. The team does not have to place a great effort in developing products to satisfy their needs.

This completes the stakeholder ranking process, and the team can utilize the framework to include high priority stakeholders in the product development cycle.

5. Conclusions

In summary, this paper examines user involvement for the design and development of complex products and systems. We first present a literature-based comparison of design methods, segmented into Artistry inspired (Schön-type) design methods versus Science inspired (Simon-type) design methods. We then discuss the conflicting notion of users in these various design methods, and the importance of selecting the "right" users. Rather than focusing on users, who are context dependent for each industry, we propose to concentrate on analyzing the various roles and interdependencies of stakeholders. The authors then propose a conceptual framework to aid design teams in understanding the roles of users and stakeholders, and to prioritize their involvement in the design process. This tool intends to provide designers with a comprehensive and systematic process for ensuring that the needs of stakeholders with a high degree of influence over product/system adoption are met.

The proposed *Design Stakeholder Identification, Assessment and Ranking Framework* can be applied to the design of complex systems in a variety of industries such as healthcare, aerospace, energy, etc. We plan to validate and apply our framework through inductive and deductive approaches. For the inductive research, we plan to select an initial group of cases based on companies that used different design methods, with different user types, and experienced different outcomes. In a second group, we will examine cases that used similar design methods, similar user types, and experienced similar product outcomes. Once the process of identifying, assessing and ranking the user/stakeholder groups has been satisfactorily engaged, a second level question emerges: Within each user group, which specific subjects should be involved in the design process? Using a deductive research approach, we intend to examine the pros/cons of lead vs. average user innovation and also document how user types inform the design process in different ways, depending on the amount of skill and training required to use products. This can be achieved through controlled experiments either in an academic or an industrial setup, involving different products and different users.

In the context of user-centric design for the development of complex products and systems, applying our proposed framework will impact design-thinking research in several ways. First, this will provide an improved understanding of user and stakeholder roles within dynamic complex systems. Second, the research outcomes will be able to provide recommendations regarding which users to target as primary, depending on the contextual situation in each industry sector. Third, this research will provide a more clearly defined user concept as a foundation for future research on the user centric design process.

Acknowledgement

This research has been graciously funded by the Hasso Plattner Design Thinking Research Program (HPDTRP). It is part of the “User-centered innovation for the design and development of complex products and systems” project.

References

Abras, C., Maloney-Krichmar, D., Preece, J., "User-centered design", Bainbridge, W. Encyclopedia of Human-Computer Interaction, Thousand Oaks: Sage Publications, 2004

Donaldson, K.M., Ishii, K., Sheppard, S.D., "Customer Value Chain Analysis", Research in Engineering Design, Vol 16, Year 2006, pages(174-183)

Hippel, Eric Von, "The dominant role of users in the scientific instrument innovation process", Research Policy, Vol 5, Issue 3, Year 1976, pages (212-239)

Rogers, E. M, "Diffusion of innovations", Fifth edition, The Free Press, New York, 2003

Rowley, T.J, "Moving beyond dyadic ties: A network theory of stakeholder influences", Academy of management Review, Year 1997, Pages (887-910)

Sanders, Elizabeth, "Design and the Social Sciences", Taylor & Francis Books Limited, 2002

Schön, Donald , "The reflective practitioner", Basic Books Inc, USA, 1983

Simon, Herbert A., "Administrative behavior: A study of decision-making processes in administrative organization", Third edition, The Free Press, Collier Macmillan Publishers, London, UK, 1976.

Suh, N. P, "Axiomatic design: advances and applications", Oxford University Press, New York, 2001.

Suri, Jane Fulton, "Inclusive design through individual Insight", Proceedings of the IEA2000/HFES 2000 Congress, Year 2000, Pages (897-900)

Martin Steinert, Ph.D.
Deputy Director, Center for Design Research
Stanford University, Mechanical Engineering Design Group
Building 560, office 203, 424 Panama Mall, Stanford, CA 94305-2232
Telephone: +1 (650) 862 2996
Telefax: +1 (650) 493
Email: steinert@stanford.edu