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USING SECONDARY VIDEO MATERIAL FOR USER OBSERVATION IN THE NEEDFINDING PROCESS FOR NEW PRODUCT DEVELOPMENT AND DESIGN

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1. Introduction

Founding on human or user-centered design [Norman and Draper 1986] the process of studying people to identify their unmet needs is termed needfinding and is an essential foundation for a successful product development project. Although needfinding has been a formal step in numerous design processes for almost fifty years, there are still only few tools available for identifying unmet needs. For the sake of simplicity, aspirations and wants are included in the more general term needs in this paper. The traditional methods of discovering user needs have been market research methods, such as surveys and focus groups. These are methods that work well in determining users preferences among existing solutions, but they are not able to identify those needs the users are not yet aware of [Patnaik and Becker 1999]. Eppinger and Ulrich [1995] list identifying customer needs as a step in their design process, and suggest gathering data by interviews, focus groups, and observation. Design thinkers usually suggest that the needfinding consists of a combination of interviews and direct observation [Brown 2008]. Patnaik and Becker [1999] state that one limitation of user interviews is that users are not able to tell the design team what a product should look like because they are poor reporters of their own needs and behaviour. Users can easily express their preferences among a set of known options, while solutions that are not immediately apparent can go unnoticed. Interviews and observations should thus go hand in hand.

This paper suggests doing user observations based on secondary video material from video sharing websites such as YouTube and Vimeo. Both are good sources for both professional and hobbyist high quality video material of users in action. During the last years, video sharing websites are used by thousands of people. As camcorders have become something each and every one owns - huge amounts of video material have become freely available.

2. Needfinding

The term needfinding was coined in the 70'ties by McKim, Faste and Kelley. The essence of needfinding is to identify what a user or stakeholder needs or wants [Leifer and Steinert 2011]. The user doesn't necessarily know what these needs are, as they can be latent or hidden [Aldaz et al. 2013]. Faste [1987] defines a need as a lack, something that is missing. He further states that a well-defined need is paramount to making a successful product or service. A product or service based on an uncovered need will most likely be something that users want, and should therefore have a market.

Needfinding draws heavily on the traditions of ethnography [Jorgensen 1989]. Tools used in needfinding processes are observation, participant observation, interviews, but also picture analysis and video observation.

2.1 Classical observation

Observation is repeatedly named as an important activity during the early stages of several human centred design processes. The success of major design firms such as IDEO has led to the widespread adoption of observation in the needfinding process [Aldaz et al. 2013]. Observations can produce unadulterated, direct and potentially very rich descriptions of events and their context, because data is captured while the phenomena occurs [Blessing and Chakrabarti 2009]. This allows the needfinder to collect data that will help in the identification of needs that are not possible to extract by talking to users. Users are not always able to pinpoint their own needs or pains due to the fact that they are operating inside their own paradigm, and do not see the alternative to their own situation.

There are some limitations to observation in needfinding processes. Practical considerations may prevent the direct observation of many important behaviours [Patton 2002]. This could be the case of trying to observe a firefighter going inside a burning house to evacuate people. Even though direct observation is possible, it does not provide insights towards what the user is thinking or why the user is behaving in a certain way. Patnaik and Becker [1999] refers to the Hawthorne effect – How studying user's activities might change their behaviour. This bias is something that should be kept in mind when doing observation work, and strategies to counteract this should be deployed. The quality of observation data is largely dependent on the know-how of the observer [Patton 2002]. By increasing the needfinder's knowledge about the studied situation, deeper insights can be leveraged due to the needfinder's ability to ask the right questions. Due to resource constraints in product development and the time consuming, and potentially expensive, nature of observation the number of cases that can be studied are limited [Patton 2002]. Doing observations is a large investment and it is therefore important to be sufficiently prepared beforehand in terms of case selection and prior knowledge.

2.2 Participant observation

Empathy is the foundation of a human-centered design process, and is about understanding the user and its environment. The ability to imagine the world from multiple perspectives, and to empathize with the user and the users' environment opens for great innovations. Brown [2008] explains that: "By taking a "people first" approach, design thinkers can imagine solutions that are inherently desirable and meet explicit or latent needs. Great design thinkers observe the world in minute detail. They notice things that others do not and use their insights to inspire innovation."

The methodology of participant observation, also called immersion, aims to generate practical and theoretical insights about human life grounded in daily life experiences [Jorgensen 1989]. Participant observation, sometimes called immersion, can lead to deep insights towards uncovering needs. Without the user's or insider's perspective, it is difficult to comprehend the reason and meaning of user's actions and behaviours [Jorgensen 1989]. Here, the needfinder is stepping into the role of the user in an attempt to gain the inside perspective in order to uncover needs and pains. By actually doing the work, learning about how it feels physically and mentally, the needfinder should be able to further empathise with the user. Many of the limitations to observation are also applicable to participant observation, especially having access to a limited amount of cases due to resource constraints. Practical considerations preventing the needfinder from stepping into the role of the user can also be an issue, especially with extreme users such as firefighters or surgeons. Needfinders doing participant observation are often limited to layman or novice experience levels. This will most likely not give the same insights as an expert user would provide. This is in line with the quality of observation data being connected to the know-how of the observer as discussed above.

2.3 Interviews

A drawback with needfinding through observations is that it focuses on external behaviour, and that limited information is gained toward how people are experiencing activities [Patton 2002]. Observations are therefore usually followed up with an interview.

Interviews in the needfinding process attempt to generate in-depth knowledge about the user and use context. By having an open-ended approach to the interviewing process, interesting insights can be followed up and captured in a semi-structured interview. Where other tools only gain information about the external behaviour of users, interviews allow the needfinder to learn about users' motivation and reasoning for the way they act and behave [Patton 2002]. As for observation, know-how is core to extract relevant and in-depth knowledge when conducting an interview. A limit for interviews is that users cannot explain or describe what they are not aware of. This can be circumvented by the interviewer asking deep reasoning questions [Eris 2003], forcing the user to reflect on their answer. Interviews are along with the other real time tools time consuming, requiring the needfinder to spend considerable time preparing and conducting the interview.

2.4 Picture analysis

The use of pictures is also possible in the needfinding process. In addition to capturing the intended subject in a picture, there is an abundance of contextual information in the picture frame. This is highly beneficial for the needfinder, as the goal of the process is to provide an as good as possible understanding of the observed context, allowing the needfinder to immerse [Wulvik et al. 2015]. Pictures can either be captured during fieldwork or found online, depending on the resources available and what the needfinder is looking for. This tool is limited to capturing a split second in time, making it difficult or impossible to deduct the chain of events. This is one of the greatest limitations of pictures. At the same time this allows the needfinder to thoroughly study this split second in detail, potentially coming up with insights impossible to see in a rapidly changing real-time situation. Pictures are inherently limited in scope since there is only one point of view of a split-second in time.

2.5 Classical video observation

Classical video observation is usually done by reviewing material that the product development team has captured while deploying real time observations in the field [Heath and Hindmarsh 2002]. As opposed to picture analysis, video provide information about chains of events along with audio.
Analysing video subjectively or via predetermined or emerging coding schemes after an observation session has been carried out, allows the researcher to repeat the observation multiple times, and makes it possible to study specific views in detail over and over again [Tang and Leifer 1991]. The information is however limited to image and audio captured from the cameras point of view, and within the limited angle of view. Limitations of the actual observation setup will also be reflected in the video analysis. If the reviewer of the video observation has questions to a user involved in the observation it will usually be possible to access the user to discuss with the user.

2.6 Secondary video observation

During the last decade we have seen video sharing websites being established, allowing users to upload and make their video material available for everyone. This material can be a valuable source for doing user observation. The main advantage with using secondary video is the amount of data freely accessible. In some cases it is not possible to access the users' surroundings because of extreme contexts or security issues. Using secondary video material can address this problem given that suitable video material is made available online. Videos from sharing websites are also valuable in letting the design team gather knowledge of the activity and users they are going to investigate, and can in all cases be used as a preparation before user interviews or as a supplement to traditional observations.
In the case of using secondary video material it is difficult to get in touch with the filmed user, and even though it may be possible to actually talk to the real user there is a chance that the user has already forgotten his emotions or thoughts during the recording session. A way to make up for this can be to use the video material as a part of an interview. In this way the interviewed user should be able to give reasonable assumptions on why the observed user acted in a certain way. Still it will only be a good guess - the immediate emotions and experiences by the observed user will not be accessible. The way the video has been edited will also affect the output of the video material. Scenes that reveal problems or things that are done in a bothersome way are likely to be cut when video is edited. In this way some unmet needs might be impossible to reveal. However, the abundance of available videos will to some

degree counteract this effect. The Hawthorne effect might also be reduced to some degree due to the fact that the user does not know that the video is going to be used for research studies. Even though the users are not directly observed by the design team they are still being observed by the ones recording the video. It is therefore likely to assume that they are somewhat affected by the Hawthorne effect too. One should also take into consideration why the video was made. A professional video aimed at selling a product is less likely to reveal any weaknesses and pain point for the user involved. On the other hand it is possible to find amateur videos which is not edited at all - where the filmmaker is more interested in telling the story of an adventure, and where all the pain points are a part of the story. Efficiency and costs are also variables that should be taken into consideration when doing user observations. Setting up a user observation can be both time consuming and expensive - while lots of high quality video material is available for free through video sharing websites. The amount of secondary video material available and the geographic variety of the movies is likely to generate the necessary insights in the early product development phases.
In this paper we want to focus on the use of secondary video material for observation in need finding. In later phases of a product development project, like testing of prototypes the traditional observation is highly relevant. However, for initial observations for needfinding and ideation purposes we suggest the use of secondary video material. In the following section we will present a case study where secondary video material has been used as the main source for needfinding.

3. Case study - alpine climbing boot

A team of mechanical engineering students was given a design challenge; to rethink boots used for alpine climbing. The design topic for this case study was first identified from personal experience from one of the students. The pre-identified need was to develop a boot that could be used for both skiing and climbing. To truly identify and verify the needs associated with it, the design team carried out observations and did interviews among external users.

3.1 Introduction to alpine climbing and ski touring

To allow the reader of this paper to better understand the design challenge, a brief introduction to alpine climbing and ski touring is included:
Alpine climbing, also known by the term alpinism, is climbing in alpine terrain; consisting of both rock, snow and ice, using specialized equipment. The climber wears boots to protect the feet from snow, cold, water, sharp rocks, etc. The boots are designed to give some ankle support to avoid twisting of the foot, while still not compromising the need for sufficient ankle movement as is required for climbing. The boots are equipped with rubber soles for friction when used on rock surfaces, and the sole is lugged to give additional traction. The sole is made with interfaces for attaching crampons.
Ski touring, or more specific, alpine touring or randonnée, is the use of alpine skis for the ascent and descent of mountains. The skier uses a boot and binding system which can be switched between walk mode and ski mode. When in ski mode the boots are rigid and the boot is fixed to the skis similar to alpine skis used at ski resorts. In walking mode the ski boot allows forward and backward flex in the ankle joint, and the heel is released from the ski, allowing the boot to pivot around the front part of the boot. Skins can be attached under the skis to give traction for the skier to walk uphill. The lugged soles of the boots are made of rubber, and are also designed to hold a crampon when used for climbing.

Figure 1. How can the stiff alpine ski boot be merged with an flexible alpine climbing boot?

When climbing a remote peak during wintertime, skis can make for an easier approach and allow a fast descent after finished climbing. Bringing skis however requires the climber to have two pair of boots; ski boots and climbing boots, adding weight to the backpack. To avoid this, some climbers choose to

modify their climbing boot, allowing it to be attached to a ski. Still, the flexible ankle joint of the climbing boot will not provide the support needed to give sufficient control for fast skiing. Others choose to bring only the ski boots. This makes for good skiability, but the ski boots having too much sideways support results in lack of control while climbing.

3.2 Accelerated empathizing through video immersion

Half of the students in the design team had no prior experience with skiing or climbing, while the remaining part of the team had some experience from these activities. To maximize the project outcome the first step in the design process was to make the whole team understand what the users find important, how they feel and think, and how they interact and behave in their environment.

Alpine climbing involves moving in different types of terrains, and with different kind of equipment depending on the terrain and how accessible the climbing route is. Due to this complexity it turned out it was quite difficult for the experienced team members to explain and transfer their knowledge to the rest of the team. Consequently, rather than making up different scenarios to illustrate all sides of a climbing trip, the product development team turned to video sharing websites to find videos telling the different stories. Immersing in this secondary video material really accelerated the empathizing process. When having the overview of what a climbing adventure might involve, the design team made a problem summary to visualize the multiple scenarios involved in alpine climbing.

Figure 2. Problem summary evolved from needfinding

Figure 2 shows the six different stages of an alpine climbing trip. The merged boot should handle all six of these stages. 1: Approach, walking on muddy trail. 2: Skinning, walking on skis with skins. 3: Scrambling, easy climbing on dry rock. 4: Climbing, harder vertical climbing, crampons attached to boot. 5: Ski down, boot needs to provide support in all directions. 6: Walk home. These steps were used as reference for the design team during the rest of the project as a guide.

3.3 Deeper immersion through participant observation

For the design team to get increased understanding of the problem, participant observation activities were set up. At this stage the design team already had a basic understanding of what is involved in alpine climbing from immersing in secondary video material.

Rather than arranging participant observations on an ice and snow covered climbing route in the mountains, a local crag could be used. This allowed the team to test different kind of equipment and get to experience the difference between regular mountaineering boots and ski boots, with and without crampons attached to the sole. Even though the test climbing was not performed in an alpine environment, the team members were able to relate the experiences from climbing to a real context due to the initial immersion from watching secondary video material.

3.4 User observations from secondary videos

Moving from the empathizing step, the design team did more detailed video observations using secondary video material. The team was looking for videos capturing all elements of a climbing trip as depicted in Figure 2.

Two different videos from the same area in the French Alps showed how two different teams of climbers approached the climb using different equipment setups. Common for both teams were that they used skis to get to the route, and strapped their skis on their backpacks while climbing. This allows a fast descent down from the mountain, and seems to be a common way to climb less challenging routes in the Alps. From the videos the design team could see how one of the climbing teams had modified their flexible climbing boots to allow for better support while skiing. The other climbing team, however, preferred to do the climb wearing ski boots.

On the other hand, looking at videos from more challenging climbs it was not possible to find any videos showing climbers wearing ski boots. When studying videos from climbs on dry rock with climbers wearing traditional climbing boots the design team could find some scenes showing the climber bending the ankle join sideways while traversing. Such movements is not possible in ski boots as they do not have sideways flexibility in the ankle joint. As can be seen from the two screenshots included in Figure 3, the climber moves his foot to the left while keeping the sole of the boot in the horizontal plane - when the foot is placed on the rock the climbers moves the rest of the body to the left. This move would be impossible to do if the user was climbing in ski boots.

Figure 3. Two frames from a video with an alpine climber moving sideways [Youtube 2013]

3.5 Classical observations and picture analysis

Initially the design team had planned to do classical user observation, observing skilled climbers to see in detail how they move. However, when watching secondary videos the team realized that the climbing moves are highly dependent on what type of route and terrain is being climbed. Finding a route that would trigger as many different moves as possible would be a challenge. And at the same time it had to be possible to observe and capture video material. In this case secondary video material provided the observation data the team needed without doing classical observation.

Picture analysis was also considered, but the dynamic nature of climbing favoured the videos ability to show the chain of events over static pictures.

3.6 User interviews

A selection of alpine climbers and skiers were asked to participate in interviews. The group consisted of both professional mountain guides and weekend warriors. Based on the knowledge gathered from empathizing, and video observations all team members were confident with conducting interviews and communicating with the users.

When doing interviews it is important to make the user reveal as much as possible about the activity being studied. The user knows everything, however it is not possible to communicate everything. The user has to filter out what he thinks the interviewer is not concerned about. If the interviewer is too confident in the activity it is a risk that the user assumes the interviewer already knows, and thus leave out certain core parts when answering questions. On the other hand if the interviewer does not

understand the terms and language of the user there is a chance that the user simplifies the actual presentation too much, thus hiding relevant information.
Interesting feedback from the first interviews were that the users did not admit that they needed better climbing boots. Like Faste [1987] says: "Above the basic need level, needers seldom admit that they have a problem. In fact, they will often insist that they do not have a problem". The climbers claimed that they already had good solutions to the problem.
When asked about using skis for approaching the climbing route, most users did not see the need for skis. This may be due to the easy access of good roadside climbing areas in Norway. Others explained that if the snow is deep and access to the climbing route seems strenuous they would wait for the snow to transform to crust so that the approach becomes an easier walk. However, when being presented with observations from videos, climbers admitted the problem existed, and when presented a solution to the problem in the form of a prototype the climbers started to buy into the proposed development direction. The design team could clearly see the need for a combined climbing and ski boot from their observations. However, based on the initial feedback from the interviews it is reasonable to assume that the need would not have been admitted by the user. Neither would it have been discovered by arranging an experimental observation of climbers in action as it possibly would not involve skiing.
When doing interviews the design team also learned that showing secondary videos as a part of an interview can act as a checklist. The video forces the interviewer and the user to go through the same topics as the scenes in the video without the users filtering what would be relevant or irrelevant information for the needfinder.

3.7 Other experiences

When ideating and discussing solutions the design team experienced that they often referred to actual scenes from videos they had seen. An often-used tool to test solutions is the use of personas. Personas are composite character profiles based on characteristics from multiple users [Pruitt and Adlin 2010]. By focusing on meeting the needs of personas, the design team can then concentrate on one all-containing user rather than many different users. The experiences from the case however show that secondary video material can also substitute the need for personas.
In addition to getting user input from interviews and observations the design team also used online forums to get valuable user opinions. When looking at how climbers modify climbing boots to be able to attach them on skis, online forums revealed many insights, and thereby stating the user pain points and need for better boots.

3.8 Design output

Through needfinding activities the design team was able to come up with multiple solutions. Prototypes were continuously shown to users to get feedback, and the design team was able to come up with a final solution to solve the problem. Some of the prototypes built during the project are shown in Figure 4. However, the design of the final solution is not presented here for patentability reasons.

Figure 4. Some of the low resolution prototypes built during the case study

4. Comparison of observation tools

Through the case discussed in the previous section we have seen some of the observation tools applied to a design project. In this section we discuss the pros and cons of the observation tools summarised in Figure 5. The different observation tools are compared to each other, and a recommendation towards where and when to apply them are given.

	CLASSICAL OBSERVATION	PARTICIPANT OBSERVATION	CLASSICAL VIDEO OBSERVATION	SECONDARY VIDEO OBSERVATION
ADVANTAGES	Deep knowledge Indirect context awareness Primary data Access to user for follow up	Deep knowledge Direct context awareness Primary data Insider perspective Access to user thoughts and emotions (your own)	Deep knowledge Some context awareness Primary data Detailed and repeated study of phenomenon via video coding Inter coder reliability Quantitative analysis May be related to insights from field observation	Large amount of available data/subjects Inexpensive Balance of expert and novice users Easy, immediate access to material Geographically independent Potential to do rough coding and analysis Use as persona
DISADVANTAGES	Very expensive and time consuming Limited subject number Limitations to what is feasible to observe Outsider perspective Limited access to user's immediate thoughts	Very expensive and time consuming Limited subject number Limitations to what is feasible to observe Limited competence	Very expensive and time consuming Coder training Limited subject number Limitations to what is feasible to observe Outsider perspective Limited access to user's immediate thoughts Limited to camera point of view Limited to coding scheme	"Rough" data Outsider perspective Limited access to user's immediate thoughts Limited to camera point of view Secondary data Low context awareness WYSIWYG – can't choose point of view

Figure 5. Comparing the different observation tools

4.1 Classical observation

Classical observation done in the field allows the needfinder to get an understanding towards how the observed user is connected to his or her context, providing a good system understanding. By being in the field, seeing everything from a fly-on-the-wall perspective, the needfinder is able to take it all in. This freedom of observing while not introducing noise through personal interaction is the great strength (and weakness) of observation and actually the origin of participant observation. Performing a classical user observation requires the researcher to have access to the user's environment. This can be a challenge where the activity is happening on locations not accessible by the observer. Observing an advanced climber on a long climbing route will e.g. require the researcher to have the climbing skills to get access. Also certain insights are highly dependent of the specific user, and the actual context. Different users may have different habits, and geographic variations and local habits may vary. Setting up multiple observation setups to make up for these differences can be both time consuming and expensive.

4.2 Participant observation

The main goal with participant observation is to let the needfinder immerse into the tacit knowledge domain of the subjects in order to uncover implicit and hidden needs and pains. By actually doing the work, learning about how it feels physically and mentally, the needfinder ought to be able to empathise deeper with the user. However, occasionally practical considerations may prevent the needfinder from stepping into the role of particular users, e.g. extreme users such as firefighters or surgeons. Needfinders doing participant observation are often limited to layman or novice experience levels. This will most likely not give the same insights as an expert user would provide. This is in line with the quality of observation data being connected to the know-how of the observer as discussed above.

Both classical observation and participant observation are inherently time and resource intensive and generate very specific, qualitative and often subjective insights. They are thus not suited for quantitative analysis or statistical comparison – the latter are in the domain of video capturing, coding and analysis. They are however excellent tools for generating deep insights and first hypotheses about potential product features, as they allow direct interaction with the user and the potential application of follow up methods such as interviews.

4.3 Classical video observation

Classical video observation is building upon video material captured during classical user observation. The main advantage being that the researcher has the opportunity to go through scenes multiple times, highlight insights and use emergent or predefined coding schemes to analyse for example interactions. It may even be combined with previously captured interviews. Today´s coding schemes like SPAFF [Gottman and Krokoff 1989] or FACS [Ekman and Friesen 1977] allow for example the capturing of a precise emotional state of users through a picture by picture coding of e.g. facial muscle movement [Balters and Steinert 2015]. However all video observation is limited by the chosen point of view, i.e. camera lens perspective. The person recording the video has made decisions on what to film, and the

needfinder analysing this video is constrained by these choices. The overall context may thus remain unknown to the coder. Overall video observation is a powerful tool for in-depth analysis and even testing. It is however very expensive and time consuming and rather limited and static in terms of context.

4.4 Secondary video observation

Especially in the product development application, analysing secondary video material from video sharing websites is a new and very useful tool for the design team to gather basic knowledge and insights in the early phase of product development projects fast, cheap and broadly. It is possible to access multiple users and comparable use cases often in surprisingly large numbers and from varying geographical locations. Thus the development team is able to identify and maybe even verify the existence of specific unknown needs or hidden requirements, even on a global scale.

5. Recommendations on how to use secondary video material for needfinding

The application of needfinding through secondary video material has been shown through the case study presented in section 3. From the positive experience gained during the case study, we would like to recommend this tool in any early phase product development project involving needfinding.

In the presented case, addressing needs through observation of secondary video material made it possible for the design team to identify and verify user needs. The video material was first used to empathize and gather knowledge about the activity and later for identifying and addressing needs. The amount of secondary video material available and the geographic variety of the movies is likely to generate more insights than conducting classical observations.

Secondary video material was also used as replacement for personas. Rather than spending time creating a fictive persona, trying to satisfying their arbitrary needs, scenes and people from selected videos were used to evaluate concepts during the design challenge.

Similar to using online video material we also suggest the use of online forums to browse for user opinions and pain points, and to interact with users. This allows for a better geographic representation of user opinions. The use of forums and comments sections on video sharing sites also allow the design team to get in touch with users worldwide, and get valuable design input.

Finally a step-by-step proposal on how to implement secondary video material in the design process is included. The steps should be considered as iterative.

1. Decide what to look for: Before beginning the research, decide on the goals of the observation. Even though there are many potential unmet needs, one might not be able to see them if not focusing. Formulate questions that the observations should answer before observation starts.
2. Video immersion: Browse through YouTube, Vimeo and similar sites. Search for the chosen activity and topic to discover videos capturing scenes that might be of interest. Watch the video with the predefined goals in mind when trying to identify unmet needs.
3. Ideate: Use the data collected from watching videos and ideate around unmet needs. If any unmet needs are discovered; make rapid prototypes to learn for yourself and present tangible solutions when talking to real users.
4. User interviews: At some point real users have to be involved. From the video observations you should have gotten some understanding, and many questions. Share experiences, show prototypes and discuss with the real users.
5. Personas: Some videos might capture a setting that describes the user and scenario better than others do. Choose subjects in a video that can act as personas in your project. When ideating and building prototypes, test your concepts against your video personas.

Understanding the user is a key point when designing something for a user. Using video material from sharing websites can act as a free ticket to gather this understanding. Amount of data available, time and cost efficiency and access to data from multiple geographic locations are some of the key advantages of including secondary video in the design process.

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