Customer Feedback System
Evolution towards Semantically-enhanced Systems

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Abstract: The digital economy requires services be created in nearly real time – while continuously listening to the customer. Managing and analysing the data collected about products and customers become very critical. Successful companies must collect data regarding customer behaviour in a sensible manner, understand their customers and engage in constant interaction with them. Nowadays, having a huge data storage capacity, everyone collects data and hopes that it will be useful someday. But, it is frustrating when you do not know whether something useful will come out of it. It is not a problem to collect data, but it is very difficult to analyse it. To utilize the data they collect and analyse customer feedback quickly, companies require automation of customer feedback processing. To hear a real voice of a customer, companies are trying to engage customer to the feedback provisioning process. Therefore, the paper reviews digitalized customer feedback strategies, highlights challenges of a feedback gathering and further computation. As a result, paper presents an approach for semantic enhancement of a customer feedback system.

1 INTRODUCTION

To create successful innovative business and succeed with new product or service, company must listen to customer feedback. Customers can help to develop a better product, to provide a better service, to bring purpose to the product or valuable service offering, to tell how they really feel about a product or service and provide the best advice. By having customer insight, listening to customers and making them happy, company can create strong and long-term relationships with customers getting lifetime revenue, because people do business with people they like, know and trust.

There are a number of actionable strategies to get feedback from customers. There are some old fashion approaches such as: quarterly business reviews, paper-based customer surveys, telephone surveys, personal emails, etc. In some cases, these strategies give higher survey response rate because they are more personalized. From other side, these methods are quite expensive, because they usually require human involvement and further adaptation for automated machine processing. For example, hard copy customer feedback forms might be a good way to be used during business meetings or exhibitions. But, further computation and processing of the feedbacks will require a lot of manual work from experts, unless some more advanced tools and techniques (e.g. Digital Pen and Paper) are used.

We are living in a digital era when business and social life more and more adopt solutions and tools of digital world. Therefore, in this paper, we will concentrate on digitalized strategies for customer feedback gathering and analysis. Nowadays, many companies apply digitalized methods to collect customer feedback themselves or request corresponding service from third-party companies. Among various digital strategies that support customer feedback gathering and analysis, we may highlight such strategies as: website feedback tools, crowdsourcing feedback tools, online survey tools, social web based feedbacks, website activity and in-app feedbacks, etc. Generally, feedback tools allow creation customized feedback forms for surveys, polls, quizzes and ratings, using multiple-choice questions, ranking lists, votes, matrix forms and open free-text response areas. Some of the tools (for example UserSnap, Bugmuncher, etc.) use visual features to provide visual feedback (highlights and selections of webpage elements) along with associated comments/annotations. Dashboards give

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access to ratings and comments, enabling to filter the feedback by categories, monitor usability, tweak designs, and track the success of new iterations.

By adopting current digitalized methods and techniques, we speed-up and increase a scale of feedback collection process, but we do not solve related to this problems (e.g. automated analysis of customer feedback). There are challenges that stay unsolved yet. Therefore, paper touches such challenging issue as: fruitful customer engagement into feedback provisioning process, and automation of feedback analysis process. The next section provides analysis of digitalized customer feedback strategies and highlights corresponding challenges. Section 3 presents an approach towards Semantically-enhanced Customer Feedback System facilitated by Semantic Feedback Framework.

2 CUSTOMER FEEDBACK CHALLENGES

Despite the fact that there are a lot of various tools and platforms to support customer feedback (suggestions, ideas, etc.) gathering exist nowadays, there are still a lot of challenges and bottlenecks with respect to this process. The most significant of them are: customer engagement into a process of feedback provisioning; simplification of this process for him/her (feedback provider) via making it more personalized, more intuitive and unobtrusive; minimization of human/expert involvement into a process of feedback analysis by feedback consumer via automation of feedback computation.

To attract customers and make them willing to provide a feedback, companies try to apply different approaches. Some companies maximize amount of possible feedback provisioning channels to keep a close contact with a customer, no matter what kind of communication device, location or further actions customer has. But, all this multi-channel strategies and obtrusive behavior do not guaranty willingness of customers to provide a feedback. Another strategy to attract customers to provide a feedback is to offer customers monetized compensation and discount coupons, or participation in a lottery. Taking into account psychology of people and possibility to get something valuable for little time spent, this strategy seems to be more successful. But, again, nobody can guaranty that people honestly answer all the questions of surveys and do not chose answer randomly. “One click feedback” strategy does not require more than few seconds to share own opinion by clicking “like” or “dislike” button or clicking a “star” to rank an associated content. But this strategy brings a benefit only in some specific cases, because, generally, simple “like/dislike” or “rank” based strategies are not sufficient for companies who require more comprehensive and specific feedback.

To get comprehensive feedback from customers, to get some suggestions or shared ideas, we have to deal with customers who are interested in product/service improvement and willing to spend time for that. One way to achieve this is to recognize any inconvenience, trouble or difficulties that customer experiences at particular moment and help him/her by asking associated questions. In case you succeed with problem detection and customer starts “conversation”, you immediately have valuable feedback and have a customer who will provide you more useful information while you or your automated support system provides him/her necessary suggestions. Therefore, we have to supply customer with appropriate communication channel to help him/her to specify occurred problem. Customer’s activity, aimed at searching of problem solutions, might be considered as a certain form of a customer feedback on inconvenient functionality or design of a product/service. Since we are talking about automated solutions, system should deal with a product/service description (product functionality and features), as well as problems definitions (provided by customer), in machine readable form to automate appropriate matching. Thus, customer feedback supportive system should supply customer with a tool for problem definition and provider with a tool for product/service description, and further transform them into machine readable form. Nowadays, Semantic Web technology (Berners-Lee et. al., 2001)(Semantic Web, 2001) might be considered as one of the most promising approaches for this purpose, enabling automated integration and computation of data on semantic level using corresponding domain ontologies and semantic matching/alignment techniques (Shvaiko and Euzenat, 2012)(Jain et.al., 2010).

What might be a good purpose (additionally to already mentioned) that inspires customer to provide a feedback and share own opinion about product/service? It is a “believe”, believe of a customer in a fact that his/her feedback (suggestion, preferences, etc.) will be taken into account and, someday, will be paid back. People are not willing to spend time providing feedbacks to the products/services that they have bought or have used already. Because companies do not apply business models where customer gets new improved version

of a product (he/she has bought) for free or with valuable discount. But, customers might be interested in co-creation of a new product/service that meet their expectations and preferences, as well as be interested in improvement of existing services they are using. Thus, we need a mechanism that collects customer's preferences/suggestions with a purpose of further influence on: improvement of existing and/or already used services; elaboration of a new product/service that meets expectations and needs of customers; improvement of advertisement process towards more intelligent and personalized one. From one hand, this mechanism should be centralizer in a sense of focusing at particular customer. From the other hand, it should be distributed among various systems and services used by him/her. Thus, such mechanism could be considered as a distributed system that creates or updates a personalized customer profile of a person; provides aggregated customer profile for product developers and service providers (based on context-dependent target group request); behaves as a personal assistant providing personalized advertisements for customer.

While collecting feedbacks after product purchase (service use), not much customers are really willing to spend extra time after (especially if really interesting for the customer aspects might constitute only a little part from the scope of whole feedback form). Therefore, assuming that customer is interested in further extension/update of his/her personal customer profile, feedback collection mechanism must support proactiveness of a customer in the feedback provision process and provide a possibility to initiate provisioning of a feedback at the moment considered by customer as a right and suitable one. It means ability of a customer through pointing at any part of visual representation of a product, highlighting certain concept (meaningful word) or piece of a text to access feedback provisioning tool with respect to associated feature/functionality of the product/service.

Let us consider some examples. Many websites, internet shops and aggregators use automatic localization of a customer and change not only the language of product/service description, but also change a currency, associated price conversion, transportation options, etc. Sure, such intelligent personalization avoids extra location definition by user. But, in context of globalization and international mobility, such automated localization adds inconvenience for non-local users. Therefore, instead of having corresponding issue among many others in a separate customer feedback form, it would be more logical to allow user to provide a corresponding feedback exactly at the moment he/she manually change localization. Another example might be beneficial for product developers. Let us imagine a person who is looking for a kettle of particular color and with unheated surface feature. In case, the person cannot find appropriate product, he/she should be able to specify concrete needs and preferences directly from the current product page via appropriate access points: by pointing to the colored part of the product image, be able to find and specify a color property among a list of the properties/features associated with selected part of the product; by selecting corresponding piece of a text that describes some features of the product surface, be able to specify "unheatedness" as a desired feature of the kettle's surface. One more example might be taking from on-line e-Learning domain. It is a normal practice to ask students to provide a feedback at the end of the online-course by filling certain form. This form might not always concern exact issues that are important for students. Student might not remember all the problems related to the content or the study process of the course at its end. It would be reasonable to allow student to stress the problem immediately when it appears, does not matter whether it is unclear explanation of certain topic or task definition, a gap of the student's knowledge in certain topic/subject, or a schedule for the tasks performance, etc. So, by getting contextual access to appropriate/associated part of the feedback directly from the course materials, student can dynamically provide valuable input for the course instructor. As we can see, such approach does not only engage customers into feedback provision process, allowing them proactively behave to specify personal needs, preferences and desires via more intuitive and context-aware interface, but also uses human intelligence for natural extension of a feedback model in dynamic and co-creative way.

To survive in highly competitive environment companies should understand that there are no any other bosses than customers. It brings new challenges because customers want to talk to organizations in their own words at a time and place convenient to them. One of the best ways to collect data from the customers is to give them the opportunity to recall/retell and share their experiences in their own words. "Don't box them in by predefined questions that might not always be appropriate," said Shayne Paddock, Chief Information Officer of ZDirect Company that provides hotel management solutions and Hotel Marketing Automation tools in particular. To

provide better services and make more accurate decisions, company should understand the thoughts and feelings of a targeted group of people. With respect to automation of review analytics, opinion Observer system, presented in (Liu B. et. al., 2005), helps potential buyer to compare different customer opinions with respect to the target product(s). Other relevant researches have been done with respect to the sentiment classification (Dave K. et.al, 2003).

Current tools automate customer feedback analytics in a scope of structured data. The problem is that we collect only information that we managed to structure before and miss the rest information that might be crucial. Current automation of existing customer feedback supporting systems restricts customer with a defined set of answers or possible options to be chosen. Allowing some restrictions and putting some boundaries to the systems, we are able automation of a process, but we also get restricted scope, restricted outcome, restricted achievements… This problem concerns not only customer feedback domain. According to (Mcdonald J. et. al., 2012), most computer-assisted assessment involves students being able to recognize a correct response rather than recall and independently generate an answer. We automate a process, but with restrictions caused by this automation, we do not approach the final goal. In case of customer feedback systems, predefined set of options means that feedback consumer knows possible opinions of the customers in advance and uses their feedbacks only to get a statistics. But, many companies nowadays are looking for more. They would like to hear actual opinion, new suggestion and idea, new knowledge from the customer that could not be provided via fixed predefined questioner forms. Thus, we should more consider meaning of free-text customer feedbacks, assuming that other forms of feedbacks are more or less structured already.

Automation or semi-automation of customer feedback analysis and its further computation is possible only if content can be understood not only by human (expert), but by machines as well. Semantic annotation of customer feedback becomes very crucial for automation of its analysis. Nowadays, innovative customer feedback systems should adopt semantic technologies and support semantic annotation of a content. It is very hard, if not impossible, for any automatic technique to achieve perfect accuracy due to the difficulty of natural language understanding. Systems that need near-perfect solutions require convenient user-friendly mechanism for human involvement to correct errors made by automatic techniques. It is much more reasonable to ask user what (s)he meant, rather than to ask some external expert about the same later.

3 SEMANTICALLY-ENHANCED CUSTOMER FEEDBACK FRAMEWORK

Semantic Web technologies will work in a full extend and bring benefit to the society welfare only if information will be presented in machine readable semantic form. To reach the Web with semantically annotated data, we should follow Semantic Web paradigm and not only transform existing old data into machine readable form, but produce new data and knowledge in a form already suitable for automated processing, reuse and shearing by machines (semantically oriented software). Both cases require sophisticated semantic annotation tools to adapt existing and create new content. Taking into account huge amount of existing human oriented content, a process of its further semantic annotation could not be associated with duties of content owners/creator only. In contrast, creation of new semantically ready (annotated) content will be considered mainly as a duty of content creator. Taking into account that content creators are not domain experts or knowledge engineers, we need simple, effective and very handy tools to support users to produce semantically ready content. In the future, when people will study methods of semantic annotation (most probably even at the school level), we will be able to use more sophisticated and professional methods and techniques imbedded into all the content creation tools. For the moment, the main tool people utilize to express their feelings, attitudes, thoughts providing a feedback is natural language. Thus, we have to apply natural language processing (NLP) techniques simultaneously follow a process of initial content (feedback) creation, making it semantically ready in (semi)automated way via suggestion of appropriate semantic transformations.

Automation of unstructured free-text feedback analysis requires advanced and intelligent mechanisms for its semantic annotation, however, even structured elements of customer feedbacks lack for semantic annotation to be further integrated with other semantically related data and services. Semantic Text Analysis enables to "understand" the natural language statements provided in a free-text feedback format (Jurafsky D. and Martin J.H., 2000)

(Allen J.F. et.al., 2008). Among the various NLP techniques, opinion mining and sentiment analysis (Gamon M., 2004) might be especially valuable for customer feedback analysis. One of the solutions is to design and develop methods that enable the automated annotation of plain text with ontology concepts (Cherfi H. et. al., 2008). One of such methods (Zavitsanos E. et. al., 2010) is based on the pre-processing of the input text with techniques that extract semantic information from text (e.g., word senses) using knowledge bases, like the WordNet thesaurus, and the Wikipedia electronic encyclopedia. There are also some unsupervised pattern based techniques that automatically annotate text with existing ontology concepts without using any type of learning: (C-)PANKOW (Cimiano P. et. al., 2005) and ONTEA platform (Laclav´ık M. et. al., 2009). NiosTo - a software application that implements an opinion word extraction algorithm as well as a dictionary-based sentiment classification (Agathangelou et. al., 2014). Initial extraction and further annotation of instances in customer feedbacks allow basic classification and clustering of the feedbacks to simplify further analysis for expert. But, the extracted data goes beyond the entities; it includes their properties and their relationship graph as well. It can be further analyzed for a more precise interpretation and reasoning based on semantic description of application domain and particular product or service. It might build new knowledge with respect of product functionality or possible additional use case. Free-text form feedback typically lacks strict structure, but in many cases it carries structured or semi-structured information. The state-of-the-art information extraction (IE) techniques are usually meant for web documents or news. Customer feedbacks are different in the sense that they often contain references to product- or service-specific functionality, goals, features, usability, etc.

To minimize level of human involvement and allow automation of customer feedbacks or suggestions analysis, we should minimize their free-text part and transform it into semantically enriched machine readable form. Feedback should contain explicitly defined semantic meaning to allow further automated computation. In the previous section we already discussed challenges of feedback analysis automation and highlighted importance of text mining/analysis to make content more structured and meaningful. Existing text analysis software could be considered as a good separate tool for domain experts, but they are too far to be imbedded to any other application/service as a part of its functionality and be easily used by ordinary user.

Since organizations do not have the capacity to employ professional annotators to make customer feedbacks machine readable and ready for automated analysis, we have to involve customer to this process. It would be reasonable to utilize users' capabilities (knowledge and experience) and involve them into the process of semantic annotation of a feedback (in other words, allow them to provide semantically-enriched feedbacks). At the same time, it is a non-trivial exercise for an ordinary feedback provider as well as an average web content provider (who is not an expert in knowledge modeling and representation) to provide semantically annotated content. Therefore, it is crucial to provide feedback providers with easy to use interfaces that simplify the annotation process, placing annotation in the context of their feedback provisioning process. However, not only content of customer a feedback needs to be semantically annotated, but whole feedback should be present in machine readable form to be further used by other applications/services and integrated with other data. Thus, we have to elaborate a framework (see Figure 1) around semantically-enhanced customer feedbacks, including: ontology as a basis for semantic enhancement of customer feedback, tools for feedback consumers (product/service providers) to make digital content semantic feedback enabled and prepare corresponding semantic feedback template, tool for feedback provider (customer) to provide semantically enriched feedback by populating corresponding template with actual inputs, and tool for further processing and management of semantic feedbacks.

Digital Content Enhancement Tool (DCE tool) allows digital content creator to annotate/associate various elements (or parts of them) of the content (image, video/audio, buttons, links, etc.) with corresponding concepts from domain ontology. Extended with appropriate JavaScript package and corresponding bindings of ontology concepts and elements of a digital content, this digital content becomes ready to support intuitive and proactive feedback provisioning. Whenever user clicks at mapped part of an image, or choses certain time frame of a video/audio file, or focuses at button or link, and activates "feedback provisioning" function via contextual menu, he/she will be redirected to appropriate semantic feedback provisioning form (SF Form). Due to the binding of selected element to particular semantic concept of domain ontology, system naturally presents associated concepts to the user and allows further annotation of corresponding

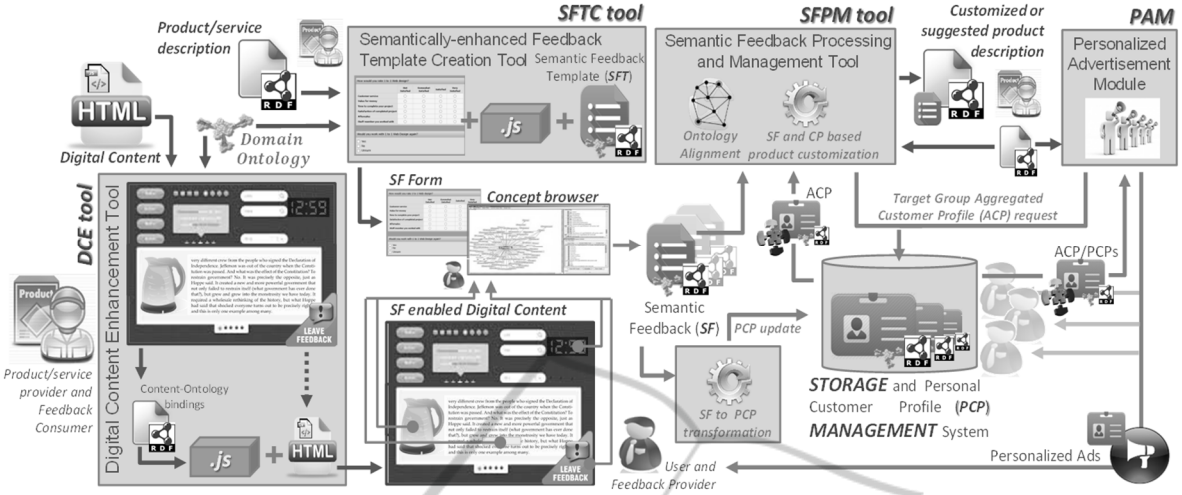

Figure 1: Semantic enhancement of Customer Feedback Framework.

properties (Concept browser). To be even more intuitive, system filters and sorts out elements of ontology and presents the most relevant of them. Thus, referring to our examples from the previous section, user will be able to specify properties of thekettle (color, surface heating ability, etc.), to block automated localization function of websites, etc. In case of highlighting a free-text content or free-text based answers of a user, system applies NLP and automated semantic annotation techniques (e.g. OnTeA, RDFaCE, DBpedia Spotlight, Semantator, etc.) to find relation between the text and concepts of domain ontology. Thus, system builds corresponding bindings (associations) of the text with ontological concepts on the fly, and redirect user to the same semantic feedback provisioning form. Additionally to semantic enhancement of digital content, feedback consumer is supplied with SFTC tool to create semantic enable customer feedback form - Semantic Feedback Template (SFT). SFT is a RDF file that contains semantically enriched feedback template, ontology-driven structure with possibly defined annotation options.

Gathering all necessary tools and formats under Semantic Feedback Framework, the framework requires corresponding ontology for semantic enrichment of a customer feedback. Semantic Feedback (SF) and Semantic Feedback Template (SFT) consist of a set of functional and non-functional properties. Non-functional attributes describe a purpose and target group of a feedback, feedback requestor, time, place, etc. Functional part is a set of feedback elements that presents a structure of corresponding survey, poll, quiz, rating, etc. In contrast to SFT, SF instance contains actual inputs (values) from a feedback provider as well as an extra non-functional properties related to feedback provider. Structured elements of feedback are presented by corresponding subclasses that present multiple-choice questions with a set of predefined options, ranking lists, votes, matrix forms, etc. In turn, unstructured elements are text-, visual-, sound-, video-, and emotion-based elements of customer feedbacks. Taking into account, that any text is a set of small meaningful pieces, text-based element is presented as a set of such pieces - knowledge statements (RDF triples). We did not research other types of unstructured elements in detail, because it was not in a scope of the presented research. Further elaboration of this issue is left for future work.

Being created, SF is further processed by Semantic Feedback Processing and Management Tool (SFPM tool). Applying SF and corresponding ontology alignment on top of semantic description of the initial product/service, SFPM tool provides customized, improved or suggested product description update for product/service provider. At the same time, SF becomes a source for personal customer profile (PCP) update in the PCP Storage. Storage and PCP Management System allows management of own PCP for users and provides aggregated customer profile (ACP) based on target group request from product/service providers. ACP could be used by SFPM tool to generate new product/service that meets customer needs and expectations. Similarly, Personalized Advertisement Module (PAM) can push personalized advertisements to potential customers by matching PCPs with product/service descriptions.

4 CONCLUSIONS

The paper tackled some of the challenges of customer feedback gathering and its automated processing. Nowadays, companies are looking for new strategies and techniques to engage customer in collaboration process making the process attractive and friendly for them. They require automation of customer feedback analysis and approach that allows retrieving of new knowledge out of collected feedback and suggestions. Therefore, paper discussed possible steps to meet highlighted challenges and proposed an approach of semantic enhancement of customer feedback framework. Involvement of customers into collaborative product review and feedback provisioning process will provide a deeper understanding of their needs and increase the likelihood that the new products will meet customer's needs. Earlier customer involvement into the process of customer feedback semantic enrichment might dramatically facilitate automation of feedback processing.

The vision of a Semantic Web has been proposed to annotate web resources with semantic mark-up, using knowledge representation languages, such as RDF(S) or OWL. Analogically to WWW, we adopt Semantic Web technologies to facilitate automated analysis and computation of customer feedbacks. Representation of a customer feedback in machine readable form with appropriate semantic annotation (especially human oriented free text part of feedback) will not only allow machines automatically manipulate with the content, but also retrieve new knowledge out of it and make it available to other systems for collaborative analysis and unexpected results. Referring to Dr. Kenji Takeda's statement "What's interesting if you publish data and make it freely available to everybody, so truly open, the people who use this data are not necessarily the ones you think of", we make customer feedback an interoperable and sharable piece of information.

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