# Empirically Derived recommendations for personalised text-based Technical Support

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**Abstract.**
Technical Support (TS) is a post sales service provided to users of Information Technology (IT) products where, ideally, TS advisors respond to users' needs in a timely and effective way when they have problems using a product. Users are not fully satisfied with company-based TS services; partially due to the lack of guidance and support on how they should use information to learn about their software systems and how to assist them when problems arise.

This paper presents empirically-derived practices for Technical Support (TS) services. Through an analysis of online forums we identified types of users (personas) and grouped them according to levels of expertise and what they value. Additionally we identified characteristics of the communication handling process that influence desirable and undesirable outcomes. Focussing solely on text based support, we present ways that TS advisors can identify user types and, having identified the user type, how to tailor their response accordingly. Finally, we also indicate how ignoring user-types or through inappropriate handling of a question, the TS advisor/user interaction can fail.

There are indications that adopting this persona-level of support will lead to an improved TS, with a higher likelihood of a successful outcome. Successful outcomes have implications for customer retention, company growth, improved reputation of the company, and improved quality of the software being developed.

**Keywords:** Information Technology; Technical Support; User Characteristics; Online Technical Support Forums; Individualisation; Human Factors, Grounded Theory.

## 1 INTRODUCTION

This paper presents empirically-derived recommendations for personalised text-based Technical Support (TS) as drawn from an analysis of TS online forums. There is some evidence to suggest that companies are failing in their efforts to provide effective TS, as users are ignoring what these companies offer in terms of user documentation, FAQs, chat, call centers, email and websites. They seek out alternative sources of help in the form of community forums where they appear to be better supported [1-3]. We collected threads (messages) from each forum and using a grounded theory approach identified successful and unsuccessful practices of TS services. The work we report here is based on data collected from one hundred and sixteen threads (3,064 messages) from eight online open source forums. We focused our findings on personalised TS practices that are shown satisfy user requirements. Our results aim to allow commercial organisations (and other interested parties) identify types of users and how successful tailored practices address their needs. Additionally we present lessons learned, and practices to avoid and are likely to lead to unsuccessful outcomes where the user / TS advisor interaction broke down before offering a solution to a given problem.

The literature indicates that, to achieve a much better user experience, TS should consider the individual characteristics of the user [4-8]. The current trend where user characteristics are poorly defined has proven to be unreliable, not repeatable, and inconsistent. A review of the literature suggests that a core problem is the neglect of user characterisation in TS, where, at best, a user's characteristics are captured in an ad hoc fashion [7, 9, 10]. This is somewhat surprising given that the user experience can be enhanced by channeling support to meet the user's individual needs [2, 3, 9]: Providing personalised response to each user is an effective user-satisfaction strategy [11]. The literature shows that personalised value-added services can meet users' requests at a deeper level than that of traditional TS services by providing accurate information and processing the information to satisfy user requirements [7]. Wang et al [12] suggests that successful communication with users can even reduce software failure rates and produce better versions of the application [12].

In our research we aim to empirically derive and evaluate characteristics of users in order to determine prevalent user attributes, which enhance the process of implementing personalised TS. Empirically derived personalised attributes could reinforce our current understanding of how to characterise users and, by taking a more inductive approach, may possibly provide novel perspectives and new attributes that may in turn improve TS. Furthermore, we aim to validate the empirically identified characterstics in a survey with a group of TS advisors and TS users. Without such empirically grounded characterisation efforts to personalise TS may be misguided.

In this paper, we present ten empirically-derived recommendation of personalised TS communication handling process that illustrate Persona*lisation* In Practice framework. A higher level description of Persona*lisation* In Practice framework is described in Gizaw et. al [13]. In this paper, we describe the detail successful and unsuccessful practice of personalised TS services that identifies TS users according to groups of characteristics. To empirically-derive the recommendations we investigate the successful and unsuccessful threads in a forum with the following research question:

*Research question one:* What are the scenarios in TS that satisfy user requirements?
*Research question two:* What can we learn from the unsuccessful scenarios in TS?
*Research question three:* How can the observed scenarios be used to more effectively construct TS systems for improved personalised TS services?

This study is organised as follows: Section 2 describes the grounded theory method that underpins this study. Section 3 presents the results where the user characteristics are categorised, and the recommendations. In Section 4 the limitations of the study are stated, and finally Section 5 concludes and summarises this study.

## 2    METHOD

The purpose of this study is to inductively generate theory to gain a deeper understanding of the interaction of individuals in the context of TS forums. Adopting an inductive, qualitative approach, we generate theory to inform a framework for how user characteristics and the associated communication handling process affect the outcome of TS advisor/user interaction. Threads from TS forums are analyzed to understand communication patterns, and what people understand about a given issue when using text-based communication. In this way we elicit information on how people can be grouped together in a comprehensible and manageable way.

The research method is shown in Figure 1. The methodology is iterative whereby we continue to investigate the phenomena until tending to saturation (i.e. where after several analyses of the data no new theme emerged). Theoretical sensitivity was gained by comparing the empirically-derived themes with output from literature reviews on Personalisation and Technical Support, which provided conceptual clarity of concepts that might be relevant to guide the research.

Theoretical sensitivity is the ability to see relevant data and to reflect upon the empirical data material with the help of theoretical terms [14]. To keep an open mind in the field of interest, the study uses existing related literature on personalisation to elicit information on how users can be modeled and grouped together [2, 3, 15]. The literature was applied *ex post facto* to place the derived user characteristics with the context of the wider literature on human factors[14].

| | Theoretical Sensitivity | Data Collection And Analysis | Characteristics Refinement | Framework Refinement |
|---|---|---|---|---|
| **Input/Data** | Literature on: Personalisation Technical Support | Forum Threads | Categories: Characteristics of emergent concepts | Validated Categories |
| **Method** | Straussian Grounded Theory: Conceptualisation | Grounded Theory: Theoretical Sampling Constant Comparison | Cohen's Kappa Inter-rater reliability testing | Grounded Theory: Theoretical Sorting |
| **Process** | Conduct LR on: Personalisation Technical Support | Axial Coding → Data Collection / Open Coding | Refine → Agreement Level / Disagreement | Theory practice Integration Selective Coding Diagramming |
| **Output** | Goal Defined: TS Attributes of Personalisation | Categories: characteristics of emerged concepts Theoretical Saturation | Validated Code | Substantive Theory Framework |
| **Rationale** | Identify the gap Define RQs | Identify Concepts (Codes) Address RQs | Reduce Subjectivity Check Agreement | Validate Findings Refine Theory |

**Fig. 1.** The Research Method

## 2.1 Grounded Theory Method

A qualitative grounded theory approach is adopted according to Strauss and Corbin [14] to developing a theory (or framework) that specifically informs company-based TS systems and actors. The main distinguishing features of the Grounded Theory Method (GTM) include the continuous undertaking of theoretical sensitivity, data collection, coding and analysis, memoing, sorting and constant comparison, theoretical sampling, and theoretical saturation [14].

## 2.2 Data Collection and sampling

TS forums are selected as a data source mainly due to:

- Forums provide opportunity by being a naturally occurring data set that reflects the perspectives of users, which means a higher the success rate. Thus there is a higher possibility of uncovering good practice [2, 3, 15].
- Ralph and Parsons [16], in their conclusion suggest that many information sources such as user message posts to online forums have not been well-exploited for personalisation and those forums might be rich resources of data to mine towards characterisation of personalisation attributes.

In accordance with Strauss and Corbin's [14] Theoretical Sampling (Purpose Sampling) method, we started data collection by initial sampling and the rest of the data collection iteration was guided by the emerging theory. The dataset for the research was collected in three rounds until it tended towards theoretical saturation. Table 2 shows the total dataset collected in three iterations. The first dataset was selected by an initial sampling of TS forums based on a Google search using the search string: "IT Technical Support Forums." Frequently used forums were selected (Table 1, forums 1-6). The sampling method was purposive, where the remaining two forums (7 and 8) were selected by looking for more diversified domains in terms of the users' broader level of expertise. In the first six forums novice users were under represented therefore

when back  to search for less technical domains where novice user evident or represented in order to create a more balanced dataset.

**Table 1.** The eight TS forums used in the study

|  | Tech Support [1] | Tech Guy [2] | Computing [3] | Cybertech help [4] | Daniweb [5] | 5star support [6] | PC Help [7] | Technical Assistance [8] |
|---|---|---|---|---|---|---|---|---|
| Number of Threads | 22 | 25 | 19 | 5 | 7 | 6 | 17 | 15 |
| Number of Messages | 638 | 729 | 516 | 190 | 231 | 109 | 445 | 206 |

**Table 2.** Dataset Sampling

| Dataset | Description | # Forums | # Threads | # Messages | # Messages per Thread |
|---|---|---|---|---|---|
| 1 | Exploratory sample | 6/8 | 40 | 747 | 1-54 (range) |
| 2 | Focussed set | 8/8 | 61 | 1217 | 1-87 (range) |
| 3 | Long interactive threads | 8/8 | 15 | 1100 | 51-127 (range) |
| **Total** | | **8** | **116** | **3064** | **1-127 (range)** |

The eight technical support forums as shown in Table 2 are selected due to their support for many diversified IT domains in terms of level of expertise, bearing in mind more interaction patterns can be found and different user characteristics can be identified.  In total 116 threads were collected within the three iterations; 3064 messages were found within these 116 threads.

### 2.3    Data analysis

According to the GTM of Strauss and Corbin [14] data interpretation involves three stages of coding: *open coding* to discover categories, *axial coding* to further develop and relate the categories and finally *selective coding* to integrate and refine the theory. The three coding techniques are not necessarily sequential analytic steps. For example, open and axial coding overlapped in this study and were iterative, as categories were developed and refined. In addition, axial and selective coding overlapped as categories were related and integrated into an explanatory theory.

In this research *open coding* began with the first thread and a message-by-message analysis. The purpose of open coding was to identify codes in the data and to begin to discover categories and their properties and dimensions [14].  Table 3 presents an example of open coding that began with a simple interpretation of each message that summarises the underlying concept (shown by the square bracketed text). For instance line 072 is coded as "**Problem of users not stating the question properly**". Consequently a memo about the concept is created as shown in line 073. We used the scientific software program called "Atlas.ti" version 6.2 to manage and analyse the textual data. The tool also helped to connect and visualize files as well as index the data.

**Table 3.**   Open Coding Examples

| Line | Text and [open code] |
|---|---|
| 072 | "Had you explained what your reason was we could have advised you sooner". **[Problem of users not stating the question properly]** |
| 073 | **Memo**: *The TS advisor reminded the user it would have been better to state the question and reason in the first place* |
| 078 | "I think this poster is not reading the answers"  **[Novice User]** |
|  | **Memo:** *Prior discussion shows the user has low level experience* |
| 080 | "It's hard to soar like an Eagle when you are flying with Turkeys" **[Insulting]** |

After identifying categories through the open coding process, the next step is an intermediary coding process known as *axial coding* [14]. In axial coding, concepts are sorted, synthesised

and reassembled. Each property of a given concept is grouped into a new set of categories that represent the ideas. Strauss and Corbin [14] define a *property* as a general or specific characteristic of a category and a *dimension* as a location of a property along a continuum or range. For example, 'credibility', is one of the categories identified as something that is important to a user in this study. It has a dimension ranging from trust to mistrust. A property of 'credibility' is the differentiator *cause*, where credibility can be 'caused' by the product, the vendor, TS advisor, the instruction, the consequences of executing the instruction, or the software that diagnoses the problem.

*Selective coding* is the final coding process in GTM, and involves the selection of core categories of the data. *Selective coding* systematically relates the categories identified in axial coding, and integrates and refines them to derive theoretical concepts. This is achieved according to a coding framework that captures the phenomenon in terms of context, causal conditions, intervening conditions, action/interaction and consequences. The *context* captures the environment within which decisions and actions take place; the *causal and intervening conditions* reflect the why, when, how come, and where the phenomenon occurs; these culminate in a portrayal of *actions/interactions* of the people in response to what is happening in the situations (answers the questions 'by whom' and 'how'); and finally we consider the *consequences* of the action taken or inaction (answers what happen as a result of the actions/interactions).

After theoretical saturation, we conducted an inter-rater reliability test evaluation using Cohen's *kappa* [17]. Cohen's *kappa* inter-rater reliability test was performed using IMB SPSS version 20.0. Initial results produced an inter-rater agreement of 0.673 k value, but subsequent discussions between the 'raters' led to the refinements of some category definitions. A further independent inter-rater test was performed which achieved a 75% agreement which according to Landis and Koch is a "substantial agreement".

# 3 RESULTS

## 3.1 Categories

Emergent concepts are categorised according to their properties and dimensions. These concepts are grouped into three main categories according to similar characteristics as outlined in Table 4:

- User characteristics: It is further decomposed to level of expertise and user values.

- Communication process: It is further decomposed to activity and emotions.

- Outcomes: it is further decomposed to successful and unsuccessful.

Table 4 shows the occurrence of each concept, category and the frequency counts of each attribute that occurred during the process of coding. This study focuses on the successful and unsuccessful outcomes according to the dataset.

There were different outcomes of the TS forum threads, with some ending up as '*successful*' 62%, others as '*unsuccessful*' 15% and the remaining were those that were labeled as 'unknown' 23%. A successful outcome is a practice where the user's question is answered to their satisfaction e.g. "*Yep, seems to have fixed it. Thanks*" or where a good communication handling process occurred e.g. "*Ok. Thank you for your help anyways, much appreciated*". An unsuccessful outcome is a practice where the user's question is not answered to their satisfaction e.g. "*It's starting to get on my nerves*", "*I think I need to take it to a tech because this is way over my head*".

However, from the interaction data it was observed that most of the threads that ended up with a status of "unknown" finished after the right information had been posted. So indirectly, it could be assumed that participants just did not acknowledge it, or had maybe left the forum before the response was posted. Users usually will not come back to the thread after they have

solved their problem to inform TS advisors. Hence we can assume that most of the threads of status "unknown" can be considered as successfully ending threads. Despite this assumption, we only use the threads with known outcomes to build our theory since the outcome of the interaction is important.

### 3.2    Successful and unsuccessful practices of TS forums

The empirically-derived personalised successful and unsuccessful practices provide a theoretical interpretation or explanation of user characteristics found in TS forums and communication handling process. Considering the research questions, Personal*isation* In Practice was identified as the central phenomenon [13]. The term Personal*isation* In Practice emerged from the data analysis to describe the many successful practices of the personalised communication handling process. This Personal*isation* In Practice must be viewed in the context of content predilection and communication patterns that satisfy user requirements in a more targeted manner, some of the unsuccessful practices that do not satisfy user requirements, and how these unsuccessful stories can be turned around to be successful.

**Table 4.** Ranked List of Categories

| Core Category | Category | Concept | Number of Occurrence |
|---|---|---|---|
| **1. User Characteristics** | **1.1 Level of expertise** | *Novice* | 47 |
| | | *Intermediate* | 11 |
| | | *Experienced* | 16 |
| | **1.2 User Values** | *Loyalty* | 24 |
| | | *Value for Money* | 27 |
| | | *Credibility* | 26 |
| | | *Security* | 10 |
| **2. Communication Process** | **2.1 Activity** | *Emphasis* | 50 |
| | | *Procedure* | 18 |
| | **2.2 Communication Issues** | *Misinformation* | 9 |
| | | *Misunderstanding* | 22 |
| | | *Confusion* | 12 |
| | **2.3 Technical issues** | *Multi-Component* | 22 |
| | **2.4 Emotions** | *Frustration* | 18 |
| | | *Anger* | 12 |
| **3. Outcomes** | **3.1 Successful** | *Satisfaction* | 141 |
| | **3.2 Unsuccessful** | *Insult* | 5 |
| | | *Frustration* | 10 |
| | | *Anger* | 9 |

Based on the successful and unsuccessful outcomes we now present ten recommendations with examples extracted from the empirical data, indicating how the empirically-derived practices might help improve the quality of TS through focusing on the communication flow observed within TS forums. These practices, while providing only a small set of examples, can provide important insights into how user profiling and communication handling in TS forums can impact on success.

**P1: Establish and handle user's *level of expertise*.**

**P1.1 Establish user level of expertise**: TS advisor can establish user *level of expertise* by noticing the explicitly stated user *level of expertise* or analysing the implicit performance of users' diagnosis process to determine users' *level of expertise*. As a result, based on the synthesis of forums in this research, users' *level of expertise* is described comprehensibly and in a manageable way in three ranges:

- *Experienced*: - A user who is skillful or knowledgeable as shown through extensive contact or participation or observation. Experience is exposed either implicitly, for example, through the painstaking steps the user has taken in order to diagnose the problem (E.g. "*Here is what I did so far to troubleshoot problem*") or explicitly through mentioning or categorising themselves as experienced, knowledgeable, expert (E.g. "*I work as support professional*").
- *Intermediate*: - A user who is not familiar with a given domain but displays skills in using different software applications. An intermediate is exposed explicitly through the practical steps the user has taken in order to diagnose the problem while pointing out their lack of experience on a specific domain.
- *Novice*: - A user who is new or inexperienced in a certain task or situation. Typically a novice user explicitly mentions or categorise themselves as a novice (E.g. "*IT HAS BEEN YEARS SINCE I HAVE TAKEN A COMPUTER CLASS AND I AM LEARNING*").

Establishing a user level *of expertise* is an important aspect of a TS service. For example, out of the 26 clarifications processes observed in threads, in 50% occurrences the TS advisor tried to establish the users' *levels of expertise*. In those 50% instances the ultimate success rate was 77%, whereas in the other 50% instances the success rate was 61%. In episodes where TS advisor did not capture user *level of expertise* the thread frequently ended in confusion, misinformation and misunderstanding. For example, of those threads where the users *level of expertise* was established 8 threads resulted in confusion, misinformation or misunderstanding. In contrast, where the user's *level of expertise* wasn't captured 20 threads resulted in confusion, misinformation or misunderstanding, showing that it is better to obtain the users' *level of expertise*. Establishing a user level of expertise has a big impact on the successfulness of the communication handling process and problem solving. As shown in Table 5, the success rate for *experienced*, *intermediate* and *novice* user *level of expertise* is 75%, 72.7% and 55% respectively. However obtaining the *level of expertise* is only one part of the personalisation pattern once established, the TS advisor needs to moderate the response accordingly as in the next practice P1.2.

**Table 5.** Successful and unsuccessful outcomes according to levels of expertise

| Level of expertise | Outcome (at end of communication) | | Total no. of threads |
|---|---|---|---|
| | Successful | Unsuccessful | |
| **Experienced** | 12 | 4 | 16 |
| **Intermediate** | 8 | 3 | 11 |
| **Novice** | 26 | 21 | 47 |

**P1.2 Handle user *level of expertise*:** The empirical data suggest that being able to gauge the level of the user's expertise greatly influences the personalised communication handling process and the success of the outcome. For example, of the 47 threads where the user declared themselves as novices, the TS advisor tended to provide *procedural instructions (a fixed step-by-step sequence of activities)* (74.5% of the time - 35 threads). Of these 35 threads that were answered procedurally, 31 had '*successful*' outcomes with, on average, 5 messages per thread. This is a high success rate, over a short message span, suggesting that *procedural instructions* suit *novice* users. In contrast, the 12 novice queries that were not answered procedurally had a success rate of 33.3% and took, on average, 10 messages to reach a conclusion. This, allied with the comments of some of the novice users when not provided with procedural instruction, re-enforces the impression that procedural instruction suits novice users: "*WHAT THE <Abu-*

*sive Word> IS GOING ON?[1]", "You seem to think that everyone thinks as you, well, <NAME> we don't GO AND PLAY WITH YOUR TOY!!!!!"*

On the other hand, when it becomes clear that the user has a high level of expertise (we categorise as *experienced*), different patterns are observed. The TS advisor enquire as to the diagnostics performed by the user and provide a greater proportion of *declarative answers (stating only facts)*, only providing procedural answers 50% of the time (in contrast to the 74.5% associated with *novice* users). Also when users declare themselves as experienced (16 threads) the problem is solved quickly and the number of messages in the thread is typically low: Of the 16 threads where the user declared themselves as experienced, 12 had *'successful'* outcomes, and only 31% of the threads were above 10 messages long. However, not considering the *level of expertise* of the user has a big influence on the flow of the communication handling process and the consequences of the results. For example, users might be insulted and as a result might become frustrated and angered (see *P10*: *Manage emotions practice*).

**P2: Provide different options with regard to the affordability of the service to the user**

In TS forums, users mention the *affordability* of the product in order to add additional services implicitly linked to a purchased service like after-sales services such as warranty or individual service. The *affordability* of the service which users' request are: **Free**: "*I want a free one*"; **Cheap**: "*I'll find one cheap enough*"; **Costly**: "*I'm looking for PAID PRODUCT -- not free*". The empirical data shows that TS advisors provide different options which can be afforded by the user: **Free**: "*You can try many commercial cleaners with no cost and there are totally free available too.*" and **Costly**: "*There are good and paid alternatives out there*". Usually users first ask about the *affordability* of the service frequently in the beginning of their query. For example, out of 27 occurrences of *affordability* 70.3% of the request occurs during the beginning of the query stage and 29.7% occur during the clarification stage of the forum workflow. This shows the importance of different options with regards of the *affordability* of the service to the user.

**P3: Manage third-party products**

TS advisors may not be an expert in *third-party* software and drivers that are involved in the problem. Not managing *third-party* software has a big impact for the successful communication handling process and problem solving. The empirical data show that TS advisor describe the involvement of the *third-party* software and the complexity of the problem as challenging e.g. "*Considering the details for this problem I can't exactly classify it as ordinary*". Usually TS advisor supports only specific products and might not have detailed knowledge of other software which works together with the product. In TS forums, different TS advisor participates with different levels of experience, and knowledge of different software, which can satisfy users' requirements. Out of 22 occurrences when the TS advisors recommend *third-party software* is involved over half. TS advisor sometimes asked for help with *third-party* software (software they are not directly familiar with) this will lead to variable outcomes. Although over half were **successful**, TS advisor needs to be careful in a system where they are not familiar with the *third-party* software.

**P4: Generate visually appealing material**

According to the findings of this study, effective personalised TS require spending sufficient time giving information and suggestions to users and increasing the clarity of information by generating visually appealing materials. TS advisors were found to use the practices *augment*

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[1]  The use of capitalisation is taken directly from the forums, in this context suggests anger, as a textural form of shouting.

*step-by-step instruction* and *signify the main point of the instruction* to make the material more visually appealing:

**P4.1 Augment Step-by-step procedural instruction**: The empirical study in a forum shows that TS advisors provide a bullet pointed or numbered *step-by-step* sequence of instruction that must be followed in the same order to correctly perform the task in order to solve the problem. TS advisors use *step-by-step* instruction for the following purposes: to explain the actions to take in solving the problem: "*Please follow these instructions*", "*follow these steps*"; to clarify each state-what else happened: "*Please post all of your hardware, giving as much detail as possible*". When providing instruction for the question asked, the TS advisor might, for example, explains the GUI of each step. The empirical study shows that TS advisor often includes a screenshot of each step of the instruction pointing out where the users take the next action. In these cases there was a 72.2% success rate in the threads.

**P4.2 Signify the main point of the instruction**: *Emphasis* is used to signify the main point of discussion. *Emphasis*, in this context, is defined as a stress laid on particular words, by means of position, repetition, or other indication; intensity or force of expression. Instructions that the user should follow were emphasised by bolding a word or phrase: "***Please read and follow all these instructions very carefully***" and changing the color: "*<--Very important Ensure you have....*" Or "***Note: It is important…***" TS advisor also emphasis the text to remind a user to be careful as a cautionary reminder by: Upper case: "*I would advise you not to use ANYTHING*". The evidence suggests that emphasising important parts of the instructions helps the user to follow the instruction accordingly. For example TS advisor *emphasis* as 'to-do' instruction, we found that 44.4%, as a warning 'not-to-do' instruction 30% and as a reminder 'not-to-forget' instruction 25.6% out of 88 occurrences of *emphasis*. Among 88 occurrences where *emphasis* is used by TS advisor in their instruction threads ended '*successful*' in 78.4%. Additionally users use *emphasis* to indicate their emotional situations such as *frustration*, *anger* or *satisfaction* (see *P10: Manage emotions practice*). Out of 50 occurrences of *emphasis* we found 24 % for *frustration*, 18 % for *anger* and 18% of happiness is used to express users' emotions.

**P5: Prompt user to provide individual context**

TS advisor should prompt the user to provide information regarding the steps they have tried and action taken to try to solve their problem; the tools used to diagnose the problem, and detailed information regarding what happened at each stage of the problem. In this study, a detailed clarification process preceded a successful outcome the majority of times. Unsuccessful outcomes were more frequently associated with queries where clarification was not sought. Out of all 116 threads, 53 had clarifications and 46 of these were '*successful*'. 63 threads did not have clarifications and only 26 threads were '*successful*'. TS advisor might think they understand the context of a question, but not. This assumption frequently led to anger and misunderstanding. This suggests that TS advisor should be aware of trying to obtain full context before committing to a diagnosis or solution. In fact, in situations where a premature response was given by the TS advisor in general, the success rate was only 2 out of 12.

**P6: Avoid premature response with respect to the problem context**

The empirical data suggests that by-passing clarification doesn't prove very successful; the subsequent responses being premature are leading to misinformation. This is well illustrated by the frustrated comments of users as the threads proceed: *"Just trying different fixes willy-nilly in hopes of resolving the problem is a waste of time and energy and more likely to make things worse than better*". For instance, 29.4% of '*unsuccessful*' threads occurred during the clarification process due to miscommunication. In some cases when the communication is unsuccessful, moderators may be involved in solving an argument between the user and TS advisor and helping resolve the actual problem leading to a successful conclusion.

**P7: Establish privacy and security requirements of the user**

The empirical data shows that users' *security* and *privacy* requirements is one of the important factors of personalised communication handling process, which user values and TS advisor need to establish users' *security* and *privacy* concerns. Usually users' show their concern about *security* by stating how much the problem or the software used to diagnose the issue is free from risk or danger e.g. "*I was worried in case it could be some kind of virus that key logs the password*". TS advisor establishes users' *security* concern and takes different kinds of measures to protect users from risk or danger (e.g. "*That suggests to me that <NAME> might have a dodgy <NAME> setup.*" and request the user to make sure whether the user has already taken the necessary measures to avoid the risks as a caution (e.g. "*Have you changed all your passwords for your online accounts to something more secure Strong Passwords*").

**P8: Establish users expected perceived value of the service.**

The empirical data shows that user' expectations and perceived quality are determined by their loyalty to a specific product/brand. Usually users provide what they prefer: "*More my thing, I like the strength of <NAME> Software.*" and what they do not: "*I swore I would not ever purchase another <NAME> product*". Establishing user perceived value practices has a direct relationship with building users' trust. For instance, TS advisor asks users name and return user name with a welcome message towards increasing user loyalty so that users feel more comfortable with services that recognise the user as individuals rather than regular user (E.g. "*Hello Slime, and Welcome to <NAME>*".

Additionally, TS advisor do not affiliate themselves with specific vendors and provide a balanced suggestion to the user. However, TS advisors who promote or relegate a product may change the discourse of communication negatively. Such negative practices may not be acceptable by the user. For instance a user responded to a promotion "*<Abusive Word> guys you are good marketers!*" Is a good example to show where TS advisor promotes a product can result in the user losing trust in the TS advisor and his/her loyalty to the product.

**P9: Monitor the communication flow**

**P9.1 Avoid being criticised and accuse of misinform users**: *Misinformation* is one of the concepts revealed in this study which may cause uncertainty about the information provided; create communication difficulties and loose of confidence of the user and delaying of the solution. In TS forums, users are misinformed due to the following reasons: leaving important steps out of the process: "*I assume you meant to put the /s after the },*"; not providing necessary information: "*I tried to follow your advice on the <NAME> Software, but it kept saying...*" and assuming the user is familiar with the topic and using technical words to novice users: "*Just what is SF???*". *Misinforming* users may lead to unsuccessful terminations of threads which in turn results in disappointing users. Out of 9 occurrences of *misinformation,* 22.3% had an '*unsuccessful*' outcome, whereas 77.7% occurrences ended as '*successful*' of which 55.5% occurrences were corrected by the TS advisor themselves and 22.2% occurrences needed the involvement of moderators.

**P9.2 Avoid misunderstand user requirements**: *Misunderstanding* in this context is the wrong perception of someone's idea. In a forum, users *misunderstood* TS advisor due to the following circumstances: when TS advisor implying one thing and mean another; when TS advisor uses technical words and when TS advisor assuming users knows what they are referring to. Usually TS advisor realise and explain the specific instruction. For example, "*I think you misinterpreted my post, but I'll try to help you out with that*" and "*I should have been more specific*" are the best practices of TS advisor. Sometimes moderators may involve when the misunderstanding continues "*You are being advised correctly*"; "*The above suggestion is best and user-friendly, provided you follow all instructions word-for-word*". The importance of understanding the

users' intention and requirement is most apparent when the user does not explain the problem properly. Out of 22 occurrences of users *misunderstanding*, 72.7% end up *'successful'* and among those, 22.7% needed moderators' involvement. 27.3% of users *misunderstanding* communication issues lead to the *'unsuccessful'* ending. Thus it is important to understand user requirement before TS advisor provide any information and to be presented clearly and concisely.

**P9.3 Do not confuse users with multiple solutions**: *Confusion*, in this context, is the uncertainty of accepting the advice or suggestion provided or the hesitation of performing instructions to solve the problem occurred. In a forum, *confusion* occurs when more than one TS advisors were involved "*As it's counterproductive to have more than one person working on the same issue, I've passed on the information to <NAME>*" and when users are provided with different options for the solution "*Given two options what will be the right one to follow*, "*Which method is best? I'm a little confused*". In a forum, out of 12 occurrences of user *confusion*, 58.3% of *confusion* occurred because of multiple response from TS advisor and 41.7% of *confusion* occurs because of the involvement of multiple TS advisors. In conclusion, *confusion* is the cause of *frustration*, anger and insult. Among the 12 occurrences of user *confusion* 8.3% of *confusion* ends with *frustration* and 33.3% of the *confusion* ended with anger. When *confusion* occurs, both user and TS advisor may be angry as they consider the cause is the other person, and they insult the other participants, thereby leading to the failure of the communication. In general, among the 12 occurrences of *confusion* 75% ended in *'successful'* by good communication practices of TS advisor. Thus, participants in communication, handling process should avoid *confusion*, or start to moderate when it occurs.

**P10: Manage Emotions**

TS advisors should be trained in the ability to understand the emotional situation of the user from the written submissions provided by the user. The data suggests that it is better for a TS advisor to address the emotions (for example calming the user down by emphasising) before providing further instructions to solve the problem.

**P10.1 Calm annoyed user**: *Anger* is one of the concepts of emotions revealed in this study as the consequences of communication issues. There are different circumstances observed in TS forums that trigger users' anger that affects the communication process such as: Incorrect instruction provided to the user "*Please reread your "instructions" before you say that weren't followed*" and advertising products "*<Abusive Word> tricked me*". TS advisor calms the annoyed user not to aggravate the situation e.g. "*Please tone down your language*" and guide to the proper communication and problem solving process i.e. "*If you could read you would SEE that all the information YOU asked for is in the replies*". Out of the 12 occurrences of user *anger*, 33.3% occur because of TS advisor *misunderstood* users, 41.6% of *anger* occurs because of the clarification process takes too long and 25% occur because users were angry with vendors before they posted their query in the forum. This study shows that failing to calm an annoyed user down led to *'unsuccessful'* outcome in 21 occurrences for instance among the 21 occurrences of *anger* during communication, 42.8% ended up *'unsuccessful'*.

**P10.2 Respond quickly and give a high priority attention to frustrated user**: *Frustration* is defined as unfulfilled expectations or dissatisfaction of users. Among the 18 occurrences of users' *frustration* in the communication handling process 38.9% occur because of the clarification process taking longer and 61.1% occurs because users were frustrated by the product performance before they came to the forum. When frustration occurs the user may lose confidence in the TS advisor, and may leave the thread prematurely and consequently to an *'unsuccessful'* ending. However, responding quickly, giving priority and calming down, the user may be able to build confidence. For example, indicators "*I understand you're frustrated*" and "*The task will be time consuming and frustrating but doable*" are good examples of this practices. However, not exercising this ends *'unsuccessful'*, for instance, among the 28 occurrences of user *frustra-*

*tion* during communication, 35.7% ends up *'unsuccessful'*. Among the 35.7% occurrences of user *frustration*, 70% of users gave up the TS service.

**P10.3 Remove inappropriate users**: When users expose negative emotions, TS advisors are expected to calm down the situation and guide and support the users. However, the empirical data shows that some users insult TS advisors, which create displeasure and the TS advisor In turn can become offensive. Among the 5 occurrences, we found that users were annoyed because 40% TS advisor did not established and handle a user's *level of expertise*, 40% of TS advisor *misunderstood* the users and 20% occurred because users' were *frustrated* in the clarification process. On the other hand, TS advisor was insulted the users 68.5% because the user *misunderstood* them. The empirical data in the forum shows that when TS advisors *insult* users, *moderators intervene* in the communication. For instance among the 19 occurrences of *insults* performed by the TS advisors 31.5% times *moderators intervened*. Moderators calm down the situation by warning the TS advisors and users not to insult each other and by warning inappropriate behavior is not acceptable in the TS forum.

## 4     Discussion

Research question one: What are the scenarios in TS forums that satisfy user requirements?

The empirically-derived practices highlights that users of TS systems can be identified according to groups of characteristics such as level of expertise. The way this is picked up is through either directly asking or telling (explicit), or by implicit means (e.g. through the painstaking steps the user has taken in order to diagnose the problem). Once grouped in terms of personas, the communication must be adjusted accordingly e.g. procedural instructions (a fixed step-by-step sequence of activities) for novices, a mix of step guidance and declarative for intermediate, and mainly declarative answers (stating only facts) for expert users. Observing how users are handled in scenarios provide good guidelines to better understand the user-TS advisor communication process.

Research question two: What can we learn from the unsuccessful scenarios in TS?

The study also observed reasons why unsuccessful practices occur and what can be learnt from these practices in future TS advisor/user interactions in a company-based context. Practice such as not establishing a user level of expertise , establish privacy and security user requirements, managing third-party software, prompting user to provide individual context and avoiding premature response has a big impact on the successfulness of the communication handling process and problem solving. Such practices can lead to miscommunication flow such as misinforming user, misunderstand user and confuse users which may cause uncertainty about the information provided; create communication difficulties and loose of confidence of the user and delaying of the solution thereby leading to the failure of the communication.

Research question three: How can the observed scenarios be used to more effectively construct TS systems for improved personalised TS services?

Our empirical study indicates that users can be characterised not only according to a level of expertise, but also according to how they value system security, credibility of the service, and whether the system represents value for money to them personally. These emerging user characteristics can be considered during company-based TS system development to enhance the service in a more targeted, personalised manner. The successful communication handling process, based on these emerging user characteristics, provides a degree of manageable individuality with economies of scale. Groups of people can be aggregated into persona clusters to customise systems or content for their intended users.

# 5 Limitations

This research is limited by the choice of forum datasets, which in turn were in some ways limited by our access to them. The characteristics of online users may differ from the user that will interact directly with a development organization. While, data collected from our 8 selected forums (comprising 116 conversation threads from 116 different users) allowed us to identify characteristics across a range of different user types, and may share the characteristics of the wider population of TS users; we do not suggest that these findings can be generalized outside of the context of 8 Open Source forums.

Some the practices identified as leading to success in an Open Source forum (such as multiple TS advisors engaging with the user at run time) may not be feasible in a company based TS scenario. Future work could include a validation of our findings through a comparison of company-based datasets to produce more externally valid results.

Data derived from the TS forums contained different types of expression such as texts, symbols, and gestures and abbreviated words. This research only concentrated on analysing text since the core purpose of this research is text-based communication in TS. The other expressions (such as emails, telephone calls, gestures and symbols in the text) have not been collected or analysed in this empirical study. These complementary expressions could be included in the future studies to find more concrete and rich set of personalised characteristics.

Since the success of a given interaction is determined by a clear sign-off from the user, there were many threads that were indeterminate (we class as outcome 'unknown'). While we were careful not to use these data in our analysis, it may contain patterns of communication that run counter to our findings.

# 6 CONCLUSION

In conclusion, based on the empirical study of 8 open source forums we addressed our research question, which was to investigate successful and unsuccessful practices of TS forums to improve technical support systems to satisfy user requirements in a more targeted and personalised manner. We have shown ten recommendations. All recommendations are highly interrelated and re-enforce each other in several ways. The recommendations are interconnected in several situations that enable to better understand the user-TS advisor communication handling process. The recommendations also include reasons why unsuccessful practices occur and what can be learnt from these practices in future TS advisor/user interactions in a company-based context. The idea is that by applying the recommendations of the successful threads, the user will have a better experience, and the number of unsuccessful outcomes will be reduced.

There are some cross cutting practices such as a moderator's involvement that is required in almost all practices. Moderators become involved when recommendations have not been followed by the user, or when the TS advisor is unsure of how best to help the user. Moderators are shown to be important in resolving any disagreements, or in adding clarity where needed. The involvement of moderators can turn an unsuccessful interaction between the user and TS advisor into a successful interaction. The involvement of the moderator can be implemented in the context of company based TS for example when TS advisors are in doubt of the communication handling process they can use a moderator or pass a query onto an expert to other area of knowledge. This is fairly transparent to the user in a text based scenario, where the interaction is asynchronous, and short delays between interactions are expected.

There are some scenarios that we were not able to model for successful outcomes, one such scenario is when the user is abusive. This is perhaps also an example of where dealing with users in an open source forum varies from company based scenario. In open source forums, we found that some abusive users were banned from participating. The context of the forums is

different to a company based service agreements and therefore it needs to be discussed in the company, where rather than banning a customer, the company may choose to escalate the thread to a manager. A company needs to have a policy about how to deal with abusive users; this is outside of the scope of this study.

These recommendations are closely related and support each other. These integrated set of recommendations specifically facilitates personalised communication handling process in TS. The recommendations enhance TS advisors to personalise their TS services and satisfy user requirements.

## 7 Future Work

Future work includes a triangulation of data sources to include interviews with the TS experts giving advice, as well as the users asking for advice to gain further confidence in our interpretations.

We are currently validating the practices with a representative group of TS advisors and TS users, through a survey to ask them which practices TS persona practices they currently use (to highlight any gaps), and which of the proposed practices they think would help them in their various roles (to add confidence to our framework of practices).

## 8 ACKNOWLEGMENTS

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