PREREQUISITE ELICITATION - CATEGORIZING THE COMMUNICATION CHALLENGES BETWEEN SOFTWARE DEVELOPER AND CONSUMERS

Soobia Saeed, Syed Mehmood Raza Naqvi, Syed Hassan Ali

Abstract *—**In Requirement Engineering, gathering specifications for any software is undoubtedly a critical task. The process occurs during the initial phases of software development involving communications among designers and clients. Scientists actually discovered the fact that poor communications are among the many typical issues when determining and shaping clientele's demands. The dilemma might worsen the outcomes, for example, operational software failure. These communications are hard and complicated because this particular procedure always contains features like intellectual characters, strategies as well as resources. An investigation was taken off for exploring the communication difficulties which tend to be experienced by clientele and developers throughout the software specification gathering in Pakistan. Outcomes have revealed that we are facing some communication problems in the process of gathering the software specifications in Pakistan. Furthermore, it has been seen that majority of the professionals is following the methods which are typically utilized among the companies. Subsequently, we have got a great motivation to widen our analysis in this particular domain of Software Requirement gathering after conducting this research.***

I. INTRODUCTION

Specifications Gathering can be described as a procedure of looking, exposing, obtaining and description of needs for computer dependent software [1]. Application Specifications may be categorized into functional and Non Functional Specification. Those specifications which are comprised of the main business of the required software are called functional requirements. Functional specifications are also called System Behavior [2]. Such Specifications rely upon the application which is being developed as described by the client.Non functional specifications are those which are not the main specific business of the proposed system infact, they are used to evaluate the performance of the developed software so these are also called system constraint [3].

a. Overview

The computer software specification document ended up being the building blocks of the developed system.

That's why these documentations are extremely crucial in the process of designing the computer application. Bad software specification gathering results in the inferior software, overruns budgets, task failing, extra work, clients' disappointment as well as extra time and resources. A lot of research and readings have been conceded out to catch the best possible counters, processes and techniques for this problem. The major problem faced in this regard is the communication gap between the Technical staff and the clientele. The issue of this communication gap among the technical staff and the clients is a constant issue for more than two decades that is faced in most of the organizations [4]. In this research, we will determine the communication issues faced at the time of requirements gathering and would try to present some possible solutions that might be carried away so that we can minimize these issues.

b. Problem Statement

A Scholar Institute thinks about established that about "56% of blunders in introduced frameworks stood because of poor correspondence amongst client and investigator in characterizing prerequisites and that these types of errors were the most costly to fix using something like 82% of available runtime" [5]. Problems of understanding in requirement gathering can swift prerequisites that are unclear, fragmented, contradictory, and even inaccurate on the grounds that they don't address the necessities gathering companions' definite desires. Absence of client information emerges when clients are not completely mindful of their needs or can't import them. It additionally emerges when investigators and engineers neglect to ask the vital inquiries.

At the point when a framework should be

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Soobia saeed is with Ilma University, Karachi, Pakistan (Email: soobia_saeed123@hotmail.com)

Syed Mehmood Naqvi is with Ilma University, Karachi, Pakistan (Email: dr.naqvi@gmail.com)

Syed Hassan ali is with with Ilma University, karachi, Pakistan

(Email:syedhassanali.pakistani@gmail.com)

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characterized, a progression of addressing should be held comprising of partners. These partners incorporate customers, clients, programming engineers, framework examiners, domain specialists, and directors and so on. Its remained expected that ensuring the additional amount of individuals in a conference supports purifying the framework necessities and conceptualizing turns out to be much viable and less demanding. Be that as it may, there is one latent issue having more partners in a gathering.

The dialect obstruction is thought to be a noteworthy issue. At the point when there is no appropriate regular convention to impart the entire reason for getting together is vanquished. Distinctive partners may talk actually extraordinary dialects, e.g. Chinese and English. In any case, even inside similar dialect, it is famous that partners from various spaces, (for example, administration, assembling, advertising, and specialized) utilize similar words with various implications. At the point when actually unique dialects are utilized, there is the extra undertaking of interpreting the significant reports. At the point when allegorically extraordinary "dialects" are utilized, the issue might not be perceived.

c. Background, Objectives and Significance of the Study

Necessities gathering are the toughest and utmost basic piece of programming improvement, meanwhile blunders at this starting phase proliferate over the advancement procedure and are the toughest to overhaul far ahead. Necessities gathering are a troublesome procedure in which one needs to manage equivocalness, familiarity, inadequacy and irregularity, in which the learning of the prerequisites is not clear.

d. Issues in requirements gathering

Blunders in necessities gathering are, by and large, most genuine in programming improvement, and the toughest to fix. 75% of the frameworks mistakes are because of lacking framework detail [6].

e. Organization of elicitation issues

1. *Issues of scope*

The limits of the system are imprecise, so that pointless project material may be specified or essential strategy facts left out.

2. *Issues of understanding*

Clients have inadequate comprehension of their requirements experts have poor learning of the issue space client and examiner talk distinctive dialects (truly or metaphorically), self-evident data might be precluded, diverse clients may have clashed necessities or impression of their needs, prerequisites are regularly ambiguously communicated e.g. easy to understand or vigorous.

3. *Issues of instability*

Prerequisites advance after some time either in view of varying requirements or in light of altering observations of the partners [6].

4. *Proposed Model/ Framework*

Numerous frameworks improvement approaches have been proposed to address the issue of recognizing client prerequisites. Nonetheless, these philosophies for the most part concentrate on the investigation of client prerequisites as opposed to the elicitation of those necessities from the clients. They additionally make a certain presumption that clients know and can express their prerequisites – potentially with the assistance of an expert. Look into has demonstrated that numerous clients experience issues, articulating their necessities until they see them. It is truly inconceivable for a customer, notwithstanding working with a product designer, to indicate totally, definitely, and effectively the correct prerequisites of a product item before attempting some variant of the item [7]. The paper suggests another tactic for necessities collecting, utilizing paper prototyping. Be that as it may, most model assessments basically give clients access to the model and request their input. Almost no structure is given. Designers may likewise experience issues accommodating the regularly clashing input from numerous clients.

II. LITERATURE REVIEW

a. Requirement Gathering

Identifying with [8], concerns on requirement gathering is vital and developing to be urgent in programming applications. The reason being having less particular social occasion may bring about disappointment for the entire undertaking [9]. The matter that was faced off regarding is sourced components of necessities, techniques, issue that confronted and bolsters devices amid details gathering. This strategy likewise requires the movement of data to the critical actualities that will be applications determinations printed material This strategy is looking at arrangement procedures among partner to achieve a comprehension on a

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framework that need to be composed [10], [11]. [12] Express that all in all, the system is made by four principle exercises connection, building up concerns, settlement and collaboration with partners. As per [10] the settlement arranges those are:

1. Association must be bolstered being inspected.
2. Critical choice in plan seek kept up to exhibit in venture that is further.
3. Settlement arranges must be diverted naturally with a specific end goal to stay away from bias.

All the more as often as possible, this procedure is performed over and again. Different techniques have now been utilized for determinations elicitation such as meetings, information examination, prototyping, collaboration, ethnography, studies, situations, and standpoint. These procedures may be partitioned into two gatherings that are close to home association and non-individual discussion. Identifying with [1], these sorts of procedures are adjusted from different fortes such as sociology and designing.

As per [13], the most strategy used is meeting schedule. This strategy calls for direct examination amongst the questioner while the defendant. Extraordinary and rapid certainties will prone to be reachable from persons and precise gathering utilizing this schedule. The potentials with respect to the realities attained firmly connect to questioner's expertise. Information examination routine is led by checking on printed material and utilization of a presentation framework. This procedure is numerous reasonable for the renovating of older frameworks or by an inventive new expert. The printed material included incorporates outline printed material, manual frameworks, notwithstanding sorts and records found in the business forms. Nonetheless, more every now and again the printed material included contain obsolete or inadequate, as they are conflicting a result of the present business prerequisites [13]. Elicitation procedures that comprise of the work group are gatherings center gatherings, and workshop. [14] And [15] have ordered satisfying procedures that incorporate some time costly since it needs the interest of a few occasions immediately.

Emphasis collection is one of the methods executed in a pack meeting. This framework includes investment in regards to the shopper agents while the engineer to change data through discussions [16]. Prototyping is an alternative particular collecting routine which authorizes singular disapproval and reflects point by point figures that is observed as the best choice method for constructing the buyer UI determinations which must not remain perceived in entire. Top of Form a model could be outlined with any coding languages or improvement gadget to rearrange arranges [13]. The model responds more clear to unverifiable or altering of necessities [17].

Polls are usual to accumulate data when the errand includes numerous respondents and it is to be done inside a brief time length. Actualities obtained are ordinarily needed inside and out, less real, and less intuitive. As a rule, this strategy is best used to get about demeanors, theory, and basic elements for a technique. Situation based elicitation routine is really an outlined portrayal of this framework as depicted toward the begin of the arrangement, over the arrangement, furthermore toward the completion of the plan. The circumstance serves as a story and has data on the arrangement, activities and connections of clients as a result of the framework.

Ethnography is a report this is positively dedicated against an individual in a rearing ground that is evident [16]. This method utilizes different frame and appropriate to acquire data, such as ease of use and communication in the midst of clients framework with. This framework is accessible proper to be cast off to become applications requires on a new framework since it might perceive issues that are confronted connecting by plan besides framework technique which was used.

Standpoint is reliant on perspective tactic [18]. This procedure demonstrates a space from different viewpoints similar experiencing method, execution and programming. This system is valuable to create a technique on the off chance that it includes element and relationship which can be muddled between each other. After that it would likely serve as one approach to organization for building up worries on applications necessities. Multi viewpoint need's designing methodology (See) which used to make framework necessity from sources that is distinctive [19]. Choosing the procedures use is subject to the longing for ironic or careful, the full time, spending plan accessible, wants classification furthermore the need to get individuals included and concentrated on an assignment [13]. This decision additionally affected by types of test, arrangement and framework range. Despite the fact that [20] may consider the after purposes behind an examiner picking one or a blend of strategies: (i) system that they comprehend; (ii) methodology that

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transformed into their lovable; (iii) fit to a specific strategy (iv) as indicated by a sense that the routine are viable. Regularly a few methodologies used together on the grounds that a technique can't ever be able to speak to all circumstances.

b. Communication Model

A correspondence outline is presented in this part as a rule which were proposed by researchers from a few controls. The collaboration segments frequently called attention to are source-beneficiary, encoder-decoder, remarks, data, sound, setting and effect [21] the main plan debated is directed by Shannon-Weaver. The mentioned model depicts the association methodology as needing data assets, a note, a source, a sign, a beneficiary, a goal and sound. Value-based model is yet cooperation demonstrates depicted by [22]. This outline includes at least two people who capacity and react to the next individual. An email could be effectively traded just once both the transmitter and in addition the beneficiary sees it in a similar way. This strategy relies on remarks through the beneficiary to your transmitter, and it is affected by both the setting for which the separation technique happens, and also the channel decided on with regards to broadcast of that communication. Boone moreover perceived that the discernment connected with the recipient is vital in fruitful collaboration [22]. Another plan expressed that the significance of a message won't live altogether into the message, however, is built up by the collector focused on their own one of a kind history [23]. As an aftereffect of varieties in the background, this importance may fluctuate significantly through the proposed idea of the transmitter. The correspondence is a great deal more than basically an appearance; it takes members to decently share qualities such as dialect, experience, social qualities and information [21]. It was concurred that collaboration occurs in a particular setting, furthermore, this setting has no less than four estimations: physical, social, enthusiastic and worldly. The genuine measurement implies the genuine environment in which the connection occurs that can apply some effect of this substance in addition to the sort of the data. The social estimation mirrors the connections between the people furthermore the standards and nations of this general public by which they've been cooperating. The mental setting is produced using such perspectives once the cordiality or hostility notwithstanding custom or familiarity. The transient estimation incorporates the full time of which the cooperation happens. Berlioz plan underlines that correspondence is an intelligent procedure, without beginning, end, or a settled request of events [23]. He determines that four imperative segment of the
connection. That are supplied, substance, course and beneficiary. The channel for conveying and getting interchanges is made out of five person detects: seeing, tasting, noticing, hearing and touching. An idea and character show for each member inside the communication procedure is showcased by [24]. The level headed discussion by [24] is the way that an email will be prearranged through the aspects of this present source's identity and observations in regards to the earth, the unique situation, the message in addition to the beneficiary, and their self-impressions. Other than that, the beneficiary connected with messages was influenced by their specific observations and identity. Barnlund outline depicts that prompts are signs that an individual procedure through nature [25]. Another plan showed by Weinberg speaks to the corresponding strategy as a vastness sign. This outline proves that announcement is a not ever shutting procedure. This model can absolutely be extended by practically identical circles to point a couple of people into the collaboration bargain [25].

In accordance with the diverse sorts of association which is being portrayed overhead, we could streamline that a kind of correspondence comprises of six components. This outline incorporates foundations that encrypt the communication, the network or way on which the correspondence is sent, a sound that meddle using the connection strategy, a beneficiary who disentangles it, and remarks this is positively accommodated the starting point.

c. Communication Methods and Activities in Requirement Gathering

In view of [26][27] imparting practices in necessity social occasion might be formed into three phases: learning buy, settlement and combination.

1. Data securing: Because of the reality whole process, certainties share a learning e.g. locate, belief system, learning, background and innovation.
2. Learning transaction: Once the whole procedure certainties consult for programming needs data.

3. Data coordination: Once the entire strategy subtle elements acknowledge e.g. approach and pc programming particulars.

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The author can practice the model as a style of association in a necessity gathering procedure. The basis could be the client, the data might be the necessities, the course could be the procedure, the commotion might be the collaboration contests, the beneficiary might be the architect also the criticism could be the product needs determination. This implies, the contacts between conveying hypothesis and requests elicitation go past the shortsighted in regards to the corresponding false notion.[28] in the Present a corresponding structure you can use for necessity gathering. This system is settled on the decision and contribution of partners, partner's relationship, and correspondence assignments and makes utilization of imparting strategies. This structure moreover sees different elements such as social and legislative components, communication plan, system and capacity of an association.

A couple of conceivable snags that may emerge amid collaboration errands are additionally distinguished (as recommended in eating table 1). All through the learning buy an adequate level of knowledge ought to become from the area of planner and customer, however information securing could be hindered when they confront hindrances to comprehension. These obstructions are normally known as holes knowledge, which hinder the buy Data and therefore uncorrected an understanding. Progressive thinking represents the drawbacks in spanning holes in comprehension as far as permitting current assumptions to remain unchallenged, smothering creative ability furthermore the era of fresh out of the plastic new a few thoughts. Duty will be diverse clearly amongst architect and customer, offered the various distinctive elements that will affect inclusion.

Settlement is a sort of correspondence action that includes the distribution of evidence, in specific gave sees. A mutual perspective of exchange viewpoints should have been ready to arrange viably into the fortunate thing about all occasions. Data change might be acquainted with out of the necessities; this is absolute data that will be made firmly related them.

Data acknowledgment focuses round the measure of acknowledgment and fulfillment clients feel for an interesting framework. Criticism is eluded to interchanges procured from clients on records. Topic fear component can repress inclusion, connection and extreme acknowledgment connected with the framework. Inadequacies in clear methodology or a different change chief working with adjustment is uncovered by alteration organization. These difficulties must be low in buy to make certain viable communication. The capacity should be acquired with respect to Data of requests and commitment to the changes. Learning when gained ought to be consulted all together that perspective could be given and a wide Data of the issue territory came to. At that point, information required for acknowledgment by all gatherings.

Table.1: Challenges in Correspondences Exercises

Activities	Problems
Knowledge , Acquisition	Gap in understanding, Innovative thinking ,and Redundant aspect
Knowledge, Negotiation	Commitment, shared perspective, and information exchange
Knowledge, acceptance	Feedback, fear factor ,and change management

Source: Coughlan et.al [28]

d. Communications throughout Specification Gathering in Pakistan

It will be the general goal with this examination to break down the procedures and issues of cooperation amid necessities gathering undertakings amongst clients and designers particularly in Pakistan. The overview includes addresses on connection systems together with challenges amid social affair undertakings. The exact destinations with this exploration are to (1) to decide the collaborative techniques amid requests, gathering methodology and (2) to decide the specific troubles included amid requests gathering. To eventually accomplish the above objectives, recorded beneath are a touch of research inquiries that need to be tended to: Precisely what are the sorts of exchanging specifications amid specification gathering in Pakistan?

1. Precisely what is the strategy used in doing collaboration for requests gathering?
2. Precisely what are the troubles while doing necessities gathering?

 ISSN 1816-613X

III. METHODOLOGY

a. Methods of Data Collection

This investigation ended up being carried down by utilizing a questionnaire and investigation of case studies. The survey incorporates addresses on association notwithstanding difficulties to the assignment. The result with respect to the study have as of now been examined utilizing SPSS. This procedure would work to collect expansive certainties connected with the study.

b. Sampling Technique/ Dataset Description

Table. 1 demonstrates respondent course subject to part. These are for the most part of various organizations which are named government organizations, semi national government, and privately owned businesses MSC standing and non-MSC standing. Assessment of information recommends that 42.9% members originate after the individual organizations Sight and sound Super Passageway (MSC) status, 33.3% from individual organizations, non-MSC status, 21.4% from public offices and 2.4% are from partial public.

Table .2: Responder Distribution in accordance to division

Sources	Number	Percentage (%)
Government Agencies	9	21.4
Semi-Government	1	2.4
Private Agencies (MSC Status)	18	42.9
Private Agencies (MSC non- Status)	14	33.3
Total	42	100

Table.3, uncovers responder course in understanding to specific parts. These are normally people tangled up in this assignment nearby prerequisite gathering process. Assessment of information uncovers that numerous members are assignment leader 52.4%, expert 21.4percent, programming engineer 2.4%, creating 4.8% and additionally others 19.0%.

Table .3: Responder Distribution in accordance position

Sources	Number	Percentage (%)
Project Leader	22	52.4
Software engineer	1	2.4
System analyst	9	21.4
Programmer	2	4.8
Others	8	19.0
Total	42	100

The Requests assets are realities that wound up being accumulated from the customers. These identify with client determinations for the fresh out of the box new or overhauling framework execution. Through the investigation, it truly is demonstrated that heaps of sources had been utilized as a part of methodology acknowledgment needs. These sources result from customers. Responder chose work system as his or her principle source to spot PC programming needs. Distinctive assets used are needy from existing frameworks (half), organization rules (half), mastery learning (half), record (42.9%) yet others supply (4.8%) (relate feasting table 4).

Numerous companies pick and adjust their bases in agreement to innovation modifications. Aside from it, sorts of ventures are additionally influences by changes of different components, for example, for example money related, financial, social, laws, politics, treatment, geology and history. For instance, companies those techniques an administrative framework could bring about the inconvenience in gathering necessities contrasting with others. Moreover, the adjustments of organization and political structure in organization likewise impact in providing certain necessities sources.

These shiny new adjustments made a few customers feel unsatisfied and not able to perceive the arrangement. Occasionally, variations in particulars and the degree will influence on alterations of figures conveyed. Also actualities that have been organized gets to be conflicting. Truths wound up being conveyed through email, telephone and meeting. Data which wound up being gotten by email is a considerable measure less demanding to fathom when contrasted and additional standard.

ISSN 1816-613X

Table.4: Sources of Software Specifications

Sources	Number	Percentage (%)
Work Process	29	69
Expert Knowledge	21	50
Organization Rules	21	50
Existing System	21	50
Document	18	42.9
Others	2	4.8

To see needs requirement preparing which has been actualized, two or three difficulties connected with choice strategy and component which impacted that range and method have as of now been expressed by members. The members had been asked for to state in the review more than one technique which was valuable for requests elicitation methodology. As appeared in Table 5 the enterprise makes utilization of various assortments of requests strategies.

Table.5: Requirement Elicitation Techniques

Eliciting Techniques	Frequency	Percentage (%)
Interview	34	81
Survey	15	35.7
Scenario	12	28.6
Document Analysis	25	59.5
Questionnaire	13	31
Focus Group	9	21.4
Workshop	8	19
Use Case	8	19
Requirement Reuse	2	4.8

c. Sample size /Dataset size

The Assessment uncovers 34 from 42 members (81%) cos meeting while the strategy that numerous perfect for programming prerequisite social occasion. Whereas 15 out of 42 members (59.5%) picked report examination procedure, 35.7% picked review system, 31% picked overview, 28.6% picked circumstance, 21.4% picked a center cluster, 19% settled on workspace, 19% picked using cases and 4.8% picked detail recycle method that a considerable measure of perhaps not picked by respondents. That recuperation is a compatible previous investigation, which establishes meeting method is an approach which is best famously utilized for PC programming requests gathering process. System for archiving programming particulars incorporates a few exercises, for example, delivering of programming requests specs (SRS), looking at SRS content and checking SRS. These exercises had been carted away to guarantee report, which was delivered taken over the item quality rule and match the client. Programming needs report is an announcement which ought to be assembled by engineers ([17]). The arranging as a result of this report includes exercises, for example, for example, making PC programming requests specs (SRS), looking into SRS content and checking SRS. The realities of the PC programming requests report are needy upon the sort of framework this is positively ended up created and PC programming advancement handles ([17]). There are distinctive necessities that are suggested in detail report, for example, for example, IEEE, ISO 9000 and in addition others.

d. Research Model developed

The study results demonstrate that members followed some standard in getting ready SRS documents, between that remain through the Establishment of electric and Hardware Engineers (IEEE), Worldwide Benchmarks Association (ISO) 9000-3, Domestic Measures or inside institute. Examination of statistics presented that 53% responder takes after their private particular organization degree at any rate make reference to tantamount organization recorded the SRS report. While 28% of members more often than not don't follow slightly official basis, 13% of members stuck to model established through IEEE, 3% held fast to ISO standard 9000-3, whereas whatever remains of the 3% took after towards the National rules.

e. Difficulties

In this sub-segment, we give on association troubles in Pakistan. With an end goal to examine the trouble of interchanges amongst clients and creators with an expansion of detail, an occurrence inquiry about happens to be finished. The investigation included nine tasks. From the investigation, (allude Table 6) the consequences for the research indicated that correspondences issues could be separated hooked on five themes,

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particularly kind of info, identities included, collaboration capacities, channel of connection and methodology. The issues occurred the dissemination of information no doubt considering that the data is uncertain; needs and in addition extensions are for the most part changed. Aside from that, a lot of realities displayed is not in the client' field of mastery. And additionally the clients disregard focusing on giving the information.

On account of this, the designer appears that the information conveyed as a result of the customers is vague as opposed to reliable. It is on the grounds that the customers don't comprehend their capacities in framework improvement. The correspondences abilities are important to finish successful connection. This capacity may be appeared as particular, dental capacity and composing. The results have really recognized a few interchanges feeble focuses on conveying and introducing the information in light of the fact that insufficient cooperation capacity, presentation capacity and additionally thinking made. Some originator guaranteed the issue to understand certainties that composed on the grounds that insufficient shaping an impression through client.

Aside from it, there are numerous channels which cast-off to convey amongst client and architect. The final product demonstrates the station which was much of the time utilized is email, phone, face to handle and satisfying. There are issues through these medium, for example, for example clarification botches, actualities maybe not consistent and late of responses. Generally the actualities wound up being conveyed making utilization of various techniques, along these lines issues happen since individual may have distinctive perspectives and information of affirmed subject.

This circumstance needs to enhance to make certain great transmitting methodology for data. The character of customer and in addition creator additionally affected the acknowledgment and data conveyance. Character trait made out of staff responsibility and also quality, environment support, and individual capacity. The result uncover the conceivable absence of purchaser collaboration, devotion and capacity give to struggle in character. Among this case result in the client have really step by step routine turn-over, work trouble and adequate measure of staff. What's more, techniques additionally contributed into the troubles in interchanges.

Table.6: Challenges in Communications

Criteria	Challenges
Type of input	1. ambiguity and not clear of information 2. redundancy of information 3. frequent requirement changes 4. different information 5. changes of scope
Personalities involved	1. changes of staff 2. lack of cooperation 3. lack of commitment and participation 4. less tolerance 5. lack control of work burden 6. lack of ability to handle conflicts
Communication skills	1. lack of ability in solving the ambiguity 2. lack of ability in proactive and instructive information delivery 3. lack of communication skills (verbal) 4. lack of presentation skill 5. lack of logic written 6. lack of organizing an idea 7. lack of sorting information
Medium of communication	1. late of responses 2. interpersonal communication 3. cannot access file 4. information not consistent 5. informal information 6. unrecorded information
Procedures	1. changes of report frequently 2. changes of report types 3. changes of document 4. changes of management and political rules 5. changes of criteria acceptance

Regularly, requests and degrees remain repeatedly different and in addition it pretentious the data and in addition learning this is unquestionably conveyed.

IV.QUESTIONNAIRE RESPONSES

The author received completed questionnaires from 143 respondents, reporting on 164 distinct projects. As noted earlier, the majority of our respondents were developers involved with software for use within their own organizations (financial institutions, Banks, pharmaceutical companies, insurance companies, etc.). The responses to the first set of 42 questionnaires described 42 projects, 21 regarded as successful and 21 unsuccessful. The second set of responses included descriptions of 80 unique projects reported from various companies in the northeastern U.S. The third set of responses, completed by developers working in Sydney, Australia, included descriptions of 42 unique projects A sample of 164 projects is a reasonable size for empirical software engineering research. Sixty-six percent of projects were regarded as successful and 34% unsuccessful, 88%

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were development projects (63% successful), and 12% were large (in terms of effort) maintenance/enhancement projects (75% successful). The percentage of projects by number of full-time IT employees is 1-4 = 39%; 5-9 = 24%; 10-19 = 19%; 20-29 = 5%; 30-39 = 4%; 40-99 = 6%; and 100-180 = 8% (range 1-180, median 6).

V.RESULTS AND ANALYSIS

The percentage of "yes" responses to the survey questions is shown in Table 1. Table 2 shows significant correlations with project success (<0.05) as well as some associations between responses to selected questions. The author has classified our questions in these tables as follows: "C" refers to questions that deal with the project sponsor, customers and users; "R" to questions directly related to requirements; and "M" to questions related to the management of the development process.

a. Requirements Questions

Although good project management necessitates that the requirements are complete and consistent [28], gathering requirements with a specific methodology (R1) was not significantly correlated with project success (Table 2). However, in 49% of our projects, respondents did not know what requirements methodology was used. For the ones that did know, four projects used prototyping and eleven used JAD sessions with prototyping; for the remainder of projects, interviews and focus groups were the main requirements gathering method as it is mention in the appendix.

VI. RESULTS AND DISCUSSION

a. Findings and Interpretation of the results

Some interference has to be carried call at purchase to mitigate the consequence because of interaction challenges which occur among clients and designers. The listings of interference suggested are offered in dining table 7. Among the difficulties experienced by designers are always to realize the customer's real requirement. It is an arduous task for a lot of the customers usually does not recognize computer and system terminologies. Hence the author is able that after they mention specific terms, these are generally actually talking regarding various things. To mitigate this issue, it's important that clients must have A few fundamental insights about computers and systems.

Since the majority of the interaction among customers and designers have been in written form (emails, letters, papers, etc.), it's important that customers' needs to be able to show the requirements with no ambiguities. The next challenge may be the medium. Currently, almost all of the interaction between clients and designers are prepared either through personal oral communication (interview, meeting etc), letters or memos, and email messages. There was a necessity to boost the medium of communication in order to reduce the chance of misinterpretation. The fourth and 5th challenges are pertaining to developers' knowledge and power to express what needed properly.

Table 9. Interference Steps for Controlling Communication Difficulties

Challenges	Intervention Steps
Customer Knowledge	Provide knowledge to customer so that they can describe the problems better.

Our results, shown in Tables 1 and 2, indicate that requirements continue to be a big problem for software development (Moynihan, 1997, Schenk et al 1998) and one of the most common causes of runaway projects (Glass 2001). Given that control over requirements is necessary to move from the lowest CMMI level, it is clear that many of the organizations in our sample are still at the lowest level (CMMI 2004). These results agree with (Neill & Laplante 2003), whose respondents thought that their companies did not do enough requirements engineering. While sixty percent of projects began with poor requirements, less than 10% of projects used a development methodology designed to deal with unclear requirements. Not surprisingly, and consistent with observations made by Glass (1998), the author found that good requirements (R4), that were complete and accurate at the start of the project (R2), with a well-defined project scope (R5), resulting in well-defined software deliverables (R9), were all positively correlated with project success. The importance of user involvement in requirements gathering (R7) supports the observations of both Clavadetscher (1998) and Glass (1998). The author found that if requirements were initially incomplete, completing the requirements during the project (R3) was

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positively correlated with project success. Although Boehm (1991) includes a "continuing stream of requirements changes" in his top ten risk items, we did not find that changing the scope during the project (R6) was correlated with project failure. Also, being able to effectively manage requirements and any changes to them (M1) through a central repository (R8) was positively correlated with project success. The fact that only 66% of our projects used a central repository supports the suggestion that "we fail to use requirements management to surface (early) errors or problems" (Clavadetscher 1998). When the size of a project impacted on requirements gathering (R10), project failure was more likely. This result agrees with (Glass 1998), suggesting that project size hampers requirements gathering, and leads to unclear, incomplete, and potentially unstable requirements. Large numbers of customers and users had no significant impact on project failure.

Using logistic regression with the responses to the requirements questions, the best predictor of project success was R4 (the requirements were good) which predicted 89% successes, 58% failures, and 78% of projects correctly overall.

b. Sponsor, Customer and User Questions

A project that has customers/users who have a low turnover rate (C3), who have confidence in the development team (C2), and who have a high level of involvement in the project (C1), is likely to be a success. However, having a large number of customers and users (C5) were not correlated with project failure. Evidence shows that a high level of customer/user involvement right through the project from requirements elicitation to acceptance testing is necessary for project success (Standish 1999). The correlation between customer/user involvements (C1) with a level of confidence they have in the development team (C2) is interesting and leads us to ask about causal effects. "Our customers/users involved because they are confident in the development team or if they are involved do they become more confident in the development team?" We suspect that the answer is the former. This leads us to suggest that development teams who do not present themselves well to users and manage customer/user expectations properly may be sowing the seeds of failure.

The author were not surprised that a high degree of senior level sponsorship that lasted right through the project (C4) was significantly related to (C0) committed and involved stakeholders and (C1) a high level of customer/user involvement. Using logistic regression with responses to the sponsor, customer and user questions, the best predictor of project success was C1 (there was a high level of customer/user involvement), with C2 (there was a high level of customer/user confidence in the development team) which predicted 90% successes, 51% failures and 78% correctly overall. On its own C2 (there was a high level of customer/user confidence in the development team) predicted 70% projects correctly overall.

c. Project Management Questions

A PM experienced in the application area (M2) was not correlated with project success. "Successful project managers are generalists, not technical specialists"; while a certain level of technical competence is helpful, management and interpersonal skills are more important (garrison 1999). A project that has a PM who manages requirements effectively (M1), and uses a well defined software development methodology (M3) that is appropriate for the project (M4) and that has estimates of effort and schedule made with appropriate requirements information (M5) is likely to be successful. Good estimates of effort and schedule (C4) have a huge effect on project success (DeMarco & Lister 2003). As early as 1975 Brooks stated that more projects have gone awry for lack of calendar time than from all other causes combined (Brossler 1999). Optimistic estimation is still one of the two most common causes for runaway projects (Glass 2001) with cost and schedule failures exceeding any other kinds of software failures in practice (Glass 2003). Boehm (1991) includes unrealistic schedules and budgets in his top 10 risk items. Top of Form

Using logistic regression with the responses to the project management set of questions, M5 (making delivery decisions with appropriate requirements information), with M4 (the development methodology was appropriate for the project) and M1 (the requirements were managed effectively) was the best predictor of project outcomes, predicting 86% successes, 77% failures, and 83% correctly overall. On its own M1 (the requirements were managed effectively) predicted the project outcome correctly for 77% of projects. This result supports Davis, who claims that requirements triage is critical: determining which requirements a product must have given a time constraint and resources available within that time frame.

d. Important Correlations

The most important project success prediction

 ISSN 1816-613X

factors are that the requirements were good (R4) and that the requirements were managed effectively (M1). These two factors alone correctly predicted 93% of successful projects. Having good requirements is highly correlated with a high level of customer/user involvement. It is difficult to get good requirements without customer/user involvement.

The author investigates two factors more thoroughly since they are discussed little in the requirements research literature. These are (R5) did the project have a well-defined scope, and (M4) was the development methodology appropriate for the project? As shown in Table 2, both have significant correlations with many other factors. Note that there are also many other significant correlations that we have not discussed in this paper nor are shown in Table 2.

e. Scope

A well-defined scope is critical to project success. We found that scope was, significantly, positively correlated with a number of factors:

C1: a high level of customer/user involvement. Without this level of customer/user involvement, it is not easy to identify the problem to be solved. Without this identification it is impossible to define a project's scope. Asking, "what functions do you want?" and not asking, "what is this system for, who's involved?" is not likely to help define scope accurately. You can only ask these questions throughout the project when you have a high level of customer/user involvement.

C2: there is a high level of customer/user confidence in the development team. C2 is significantly correlated with C1. It is interesting that this is an important factor though not particularly well addressed in the research literature. Without a high level of confidence, one is less likely to elicit the right scope and from this weak starting place one is less likely to elicit the right requirements.

C4: senior project sponsorship lasted right through the project. This is a critical success factor. High level support induces greater cooperation that could be missing without such sponsorship. A high level sponsor may also be more aware of the wider scope of the project's impact.

R2: the requirements were complete and accurately defined at the start of the project. There is a natural correlation to the scope. With inaccurate scope or unmanaged scope creep, it will be difficult to identify a complete requirement set.

R3: the requirements were completed at some stage in the project. Similar to R2, a well-defined scope even if it creeps, can still allow a complete requirement set at some point during development. So long as the project chunk being worked on at one time has well-defined scope and the requirements are complete, then project success is more likely.

R4: overall the requirements were good. Given a well-defined scope, it should be easier to identify all the necessary requirements, i.e. requirements were good.

R6: did the scope increase during the project? This is negatively correlated; that is, the more scope increased, the less likely it was to be well-defined

R7: customers/users made adequate time available for requirements gathering. Exploration of the problem space with customers and users who have time to discuss this allows for better scoping of the project and of manageable chunks for development.

R8: there was a central requirements repository. This is a critical success factor. It is entirely necessary to have one, and only one, repository to store the requirements. This, of course, aids in scoping the project. It is easy for the development team to see the scope of their project and know that it is the agreed scope project-wide.

R9: the requirements resulted in well-defined deliverables. This is often difficult to do without a well-defined scope simply because the goal posts may keep shifting.

R10: the size of the project had an impact on requirements. This is negatively correlated; that is, the larger the project, the more important it is to define scope. It is also much more difficult to achieve.

M1: the requirements were managed effectively. A well-defined scope and decomposition of the project into related, manageable requirements chunks is difficult. Good project management and in particular, requirements management, is essential for a successful project outcome.

M3: a defined development methodology was used. A development methodology appropriate to the problem enables a better scoping of the requirements in that there is more likelihood that the project is scoped according to the relevant aspects of the defined methodology. As an example, all requirements relating to an information system will be scraped together to fit an information systems method within the wider methodology.

M4: the methodology was appropriate for

 ISSN 1816-613X

the project. This is very similar to M3 above. A project's parts are significantly better scoped if the development methodology of choice is appropriate to the project's parts.

M5: the delivery decision was made with appropriate requirements information. A well-defined scope will significantly improve the success of delivery decisions because without this knowledge it will be difficult to know what can be delivered as a complete piece of work within the project.

f. Appropriate Methodology

An appropriate lifecycle development methodology is shown to be significantly correlated with project success. There is some literature to support this notion, for instance (Jackson 2001), though it appears vendors are happy to assume they're one-size-fits-all does indeed fit. An appropriate methodology, M4, is significantly correlated with:

C4: senior level sponsorship lasted right through the project. A senior sponsor can enforce the right methodology and can equally defend a project manager or the developer's choice of methodology. This support is important for successful uptake of the approach.

R2: the requirements were complete and accurate at the start. Naturally, complete requirements allow for an identification of sub-problem types within the project, and then a choice of the appropriate methodology becomes more apparent.

R3: requirements were completed at some point in the development. As for R2, understanding aspects of the problem allows the right choice of method for that problem part. So, though requirements might not be completed at the start, awareness of the types of problems being addressed allows for the choice of the right methods.

R4: overall the requirements were good. Requirements are often best achieved when they are developed using the appropriate method.

R5: see M4 in section 3.4.1.

R7: customers/users made adequate time for requirements gathering. When this occurs, it is easier to get the right requirements, to understand the problem and then to select the appropriate methodology.

R8: there was a central repository for requirements. This helps the appropriate selection of methodology simply because there is one location to look for requirements and therefore one place to organize the requirements appropriately. It is easier to select the methodology based on this structure and single point of information.

R9: did the requirements result in well-defined deliverables? An appropriate methodology and an appropriate, well-defined scope, allow for well-defined deliverables that are actually delivered according to their scope as defined.

M1: the requirements were managed effectively. Requirements management is part of project management. Methodological selection is simplified through good requirements management as it is easier to understand the problem to be solved, and from there select ways to do that appropriately.

M5: delivery decisions were made with the appropriate requirements information. This is correlated with an appropriate methodology. It is much easier to make these kinds of decisions when you can trust the approach you are using for development. There are many factors other than those we have discussed above. You can't make accurate delivery schedules without scoping your project. You can't get this information except for a combination of factors, including budget, which we have not considered at all. Although this discussion appears simple, it is more complex than we portray. Politics, for instance, is something almost entirely ignored in the requirements research literature. In the workplace, it is a highly significant factor to what the requirements are actually delivered and what methodology is selected.

VII. RESULT AND DISCUSSION

This paper discusses the identifying and managing communication challenges among customer and developer during the requirements elicitation process. The knowledge in the intervention steps can be used by the customer to express their requirements. Hence it can reduce from getting incorrect input such as the ambiguous information and frequently changed requirements and scopes. Intervention steps also provide the communication facilities for the customer to discuss any information regarding the requirements. These intervention steps will be used in the process model to develop system in assisting communication between customer and developer during requirements elicitation. The author also believes that it is not easy to achieve effective communication, but this intervention step can be used to assist in managing communication challenges. Furthermore, complete and adequate management of the communication challenges can successfully create a good

 ISSN 1816-613X

requirement. Requirements document is always taken as the basis for software development. The developers we surveyed have mainly developed in-house software for their organization's user. Their organizations have a heavy reliance on software for many business functions. While the author would not assume that our results are typical of all organizations, we believe that they are reasonably typical of organizations that develop in-house software. Surveys are of course based on self-reported data which reflects what people say happened, not what they actually did or experienced. Because we surveyed software developers our results are limited to their knowledge, attitudes, and beliefs regarding the projects and PMs with which they were involved. Top of Form However, as the majority of projects are fairly small (63% employed fewer than 10 people and 84% fewer than 20), we believe that our respondents have a reasonable knowledge of most project events. The overall preponderance of small projects may, however, bias our results.

Overall, the best logistic regression prediction equation using data from each of the three groups of questions, was R4 (over all the requirements were good) with M1 (the requirements were managed effectively) which predicted 93% successes, 59% failures and 83% correctly overall. The author were surprised that so many projects started (and continued), with unclear requirements. Why are PMs prepared to go ahead with projects without either appropriate requirements or a development methodology able to deal with unclear requirements? It is common knowledge that good requirements lead to software development success so why are PMs apparently so unaware that they are prepared to jeopardize project success in this fashion? Poor requirements have a negative effect on the estimation process; this then leads to schedule and cost underestimates, inadequate staffing and then staffing itself becomes a major risk factor. Many project management problems are in fact requirements problems in disguise, particularly those related to scheduling and effort estimation. The results suggest that senior management needs better education regarding the importance of adequate requirements, and that good requirements are necessary to produce the appropriate schedule and effort estimates. While some consider that using UML for requirements modeling and management is helpful, in this research we find no supporting evidence. To the contrary, in at least one project the use of UML was forced upon the development team with no accompanying training; project failure was the outcome.

It might be important to distinguish between scope creep and requirements creep more clearly. Evolving requirements throughout a project tends to have no significant impact on success as long as requirements were considered complete at some point during the project. In contrast, scope increase was not correlated with project success. Perhaps the scope ought to be defined as the boundaries of the problem domain within which to seek requirements. It is important that these boundaries be defined clearly early in the project, whereas the requirements within those boundaries may evolve continuously.

Finally, having a central repository for requirements clearly correlates with project success. This is good news, because it is relatively easy to do. In fact, it is difficult to understand why a project would not have a central repository for requirements given the technology available today.

VIII.CONCLUSIONS AND FURTHER RESEARCH

The author discovered that:

- ✓ It is not the number of users involved that is important, but rather managing the size of the project in terms of functionality;
- ✓ It is not the requirements methodology per se, but rather use of an appropriate software development methodology into which the requirements methodology fits;
- ✓ It is not scope creep, but rather that the scope is well defined when it creeps;
- ✓ It is not a project manager experienced in the application area, but rather a project manager who manages requirements effectively;
- ✓ It is not necessarily having complete requirements at the start of the project, but rather completing the requirements at some stage during the project; and Projects that had a central repository for requirements were more likely to succeed.

The most important correlations for project success are to get good requirements and to manage those requirements effectively. Getting good requirements means a number of things. Some that are important are a high level of customer/user involvement, high-level sponsorship throughout, to scope the project effectively and it is critical to have a good project manager who can manage, rather than one who just happens to know the application domain.

 ISSN 1816-613X

Table 1 show that current practices are fair at best. There is much opportunity for improvement at the start of a project in the requirements is. This is very important if we wish to increase the quality and success of our software projects. Analysis of our survey suggests further research is required in order to investigate:

What kinds of pressures lead project managers not only to start projects with poor requirements, but also to actually complete them without really knowing what the requirements are? How might the requirements analysis activity be better integrated with scheduling and cost estimation?

It may be more important to distinguish clearly between project requirements versus project scope. Is it possible that a good definition of scope at the outset of a project enables project teams to better deal with loosely defined requirements that later evolve?

Customer involvement and customer confidence in the project team indicate better likelihood of success. How are these interrelated? Do customers become more involved because they are confident in the team, or are they confident because they are involved? What motivates customer involvement and confidence?

This research serves as a starting point in motivating continuing research in requirements practice in industry and project success factors. We intend to continue with this research in the future.

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CORRESPONDING AUTHOR

Ms. Soobia Saeed
Department of Software Engineering
Main Campus, ILMA University, Karachi, Pakistan
E-mail: soobia_saeed123@hotmail.com,
s.saeed@ilmauniversity.edu.pk

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Table 7: Percentage "Yes" Responses to Questions

ID	Question	Success[18]	Failure[19]	Total[20]
		% Yes	% Yes	% Yes
C0	Were the stakeholders committed and Involved?	66	57	63
C1	There was a high level of customer/user involvement	80	47	69
C2	There was a high level of customer/user confidence in the development team	70	29	56
C3	There was a low level of customer/user Turnover	73	55	65
C4	Senior level project sponsorship lasted right through the project	80	50	70
C5	You were affected by large numbers of customers/users	29	33	30
R1	Were requirements gathered using a specific Method?	53	50	52
R2	Were requirements complete and accurate at Project start?	47	25	40
R3	If not complete at start were requirements Completed later?	80	23	56
R4	Overall, were the requirements good?	81	28	66
R5	Did the project have a well-defined scope?	81	46	69
R6	Did the scope increase during the project?	61	74	66
R7	Customers/users made adequate time available For requirements gathering?	80	42	66
R8	Was there a central repository for Requirements?	77	44	66
R9	Did requirements result in well defined Deliverables?	79	37	64
R10	Did the size of the project have a negative Impact on requirements?	31	52	38
M1	The requirements were managed effectively	86	35	64
M2	Was the project manager experienced in the application area	69	69	69
M3	Was a defined development methodology Used?	73	50	66
M4	Was the methodology appropriate for the Project?	81	46	65
M5	Was delivery decision made with appropriate Requirements information?	67	20	51
M6	The Project Manager was able to choose the development methodology	41	25	34

- ✓ This column represents the percentage of "yes" answers to questions for successful projects.
- ✓ This column represents the percentage of "yes" answers to questions for projects that were failures.
- ✓ Column represents the percentage of "yes" answers to the questions for all projects.

What appears to be more important than a defined requirement gathering methodology (R1) is that the project has a defined software development methodology (M3) that is appropriate for the project (M4), as both of these variables were significantly correlated with project success. Surprisingly, one-third of projects did not have a defined development methodology. Nearly half the projects began with incomplete requirements (R2). It is therefore not surprising that the scope was changed for many projects (R6); a 2 test of R2 with R6 was significant. The scope was also more likely to change for larger projects.

 ISSN 1816-613X

Table.8: Correlations of Questions to Project Success and to Other Questions				
ID	**Question**	**Direction of Success Relationship**	**Significant Correlation with Project Success**	**2 Correlation with Other Questions**
C0	Were the stakeholders committed and involved?			C4
C1	There was a high level of customer/user involvement	+	0	C2, C4, R5
C2	There was a high level of customer/user confidence in the development team	+	0	C1, R5
C3	There was a low level of customer/user turnover	+	0.019	
C4	Senior level project sponsorship lasted right through the project	+	0	C0, C1, R5
C5	You were affected by large numbers of customers/users			
R1	Were requirements gathered using a specific method?			M4
R2	Were requirements complete and accurate at project start?	+	0.006	R6 (-), M4, R5
R3	If not complete at start were requirements completed later?	+	0	M4, R5
R4	Overall, were the requirements good?	+	0	M3
R5	Did the project have a well defined scope?	+	0	M1, M3, M4,M5, C1, C2, C4,R2, R3, R4, R5(-), R7, R8, R9,R10 (-)
R6	Did the scope increase during the project?			R2(-), R5 (-)
R7	Customers/users made adequate time available for requirements gathering?	+	0	M4, R4
R8	Was there a central repository for requirements?	+	0	M1, M4, R4
R9	Did requirements result in well defined deliverables?	+	0	M4, R4
R10	Did the size of the project have an impact on requirements?	-	0	R5 (-)
M1	The requirements were managed effectively	+	0	R8, M4, R4
M2	Was the project manager experienced in the application area			
M3	Was a defined development methodology used?	+	0.007	M4, R4
M4	Was the methodology appropriate for the project?	+	0	R1,R2,R3,R4,R5,R7,R8,R9,C4,M1,M4
M5	Was delivery decision made with appropriate requirements information?	+	0	M4, R4
M6	The project manager was able to choose the development methodology			

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