# Understanding the Pre-Contract Process of Small Software Projects

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*Abstract*— **The phase of pre-contract of software projects is highly relevant for providers and acquirers. This time consuming phase should be done in a cost-effective way, since the possibility of finishing in a software contract is uncertain. The literature reports some macro-activities to guide this process. However, they are coarse grained, and therefore, difficult to follow in practice by practitioners. Moreover, it is not clear how the industry deals with the pre-contract process; particularly, when addressing the pre-selling of small software projects. This article presents an exploratory study that involves 14 Chilean software companies, in which we performed qualitative research to understand how they conduct the pre-contract process of small projects. The results were arranged in a model, named the Pre-Contract Process (PCP) model, which identifies the most prevalent actors, activities, outcomes, and a workflow according to the best practices used by these companies. These results extend those reported in the literature; particularly, the PCP model contributes with more in depth information about how to conduct the macro-activities in practices. Although this process is still preliminary, it can be used to inform the design of pre-contract activities in software companies and educational institutions. Future software engineers and practitioners can take advantage of it to address their own project pre-contract processes.**

*Keywords- pre-contract process model; qualitative research; pre-selling activities; small software projects; Chilean software industry.*

## I. INTRODUCTION

As in the rest of the world, most software projects performed in Chile are small. Many of them are conducted by micro and small software companies that do not have an explicit project pre-contract process (also known as per-selling); i.e., they use implicit procedures with a structure that depends on the person in charge of conducting them.

This lack of an explicit process jeopardizes the capability of the provider to measure, improve and repeat the process, and also to train the newcomers. The literature reports some general proposals as guidelines for such a process, however, there is no evidence on the use or usefulness of these proposals in small project prospects.

In order to understand the way in which the companies deal with the pre-selling process of small software projects, we conducted an exploratory study on 14 Chilean software companies, involving 20 practitioners experienced in this area.

The study identifies the most prevalent components in the processes according to the involved organizations; e.g., the major activities, the eventual workflow, the participating roles, and the key information to gather.

We used the guidelines of Grounded Theory [1, 2, 3, 4] to collect, analyze the individual data, and finally generate the Pre-Contract Process (PCP) model. Before starting the data collection, we defined the following working hypothesis to guide the study: *Providers use an ad hoc and implicit process to perform the pre-contract stage*.

The study results indicate that, at high level, the PCP model has several similarities to the one proposed by Savolainen et al. [5]. However, PCP study gains on understanding of the fine-grain activities, the conditions to make the transitions between activities, and the dynamic of the process that make it reusable, evolvable, and transferable to particular work contexts in academia and industry. Therefore, the PCP model represents an advance on the state-of-the-art. It can also help improve the state-of-the-practice in the academia, but mainly, in the micro and small software companies.

Next section analyzes the main models reported in the literature to address the pre-contract process of software projects. Section III describes the exploratory study conducted to understand the process in the observed companies. Section IV presents the results of the study, which were arranged in the proposed PCP model. Section V analyzes the variability level of PCP, considering its nature of unstructured process. Section VI discusses the threats to the results validity, and Section VII presents the conclusions and future work

## II. RELATED WORK

From the provider perspective, the pre-contract stage starts with the reception of the customer request, and finishes when the customer indicates whether or not it accepts the supplier's proposal [5, 6]. The activities performed during this stage play an important role in the sustainability of software companies; particularly, in micro and medium-sized organizations [7]. The pre-contract represents an opportunity for providers to obtain new contracts, but also a risk because the acceptance of the project bids is not ensured. Proposal accuracy is highly important in this stage, since delivering underestimated bids will negatively affect the sustainability of the company [8].

Fig. 1 shows a summary of the main pre-contract processes reported in the literature. The process labeled as "A", proposed by Happio and Ahonen [9], indicates the effort estimation and activity planning as the most relevant ones to carry out during the pre-contract stage.
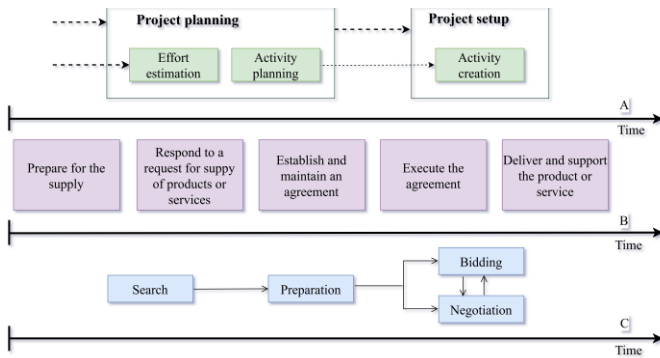
Figure 1. Pre-contract processes according to A [9], B [10], C [5].

Another process was proposed by the norm "ISO/IEC/IEEE 12207:2017(E): Systems and Software Engineering – Software Life Cycle Processes" [10] (labeled as "B"). It defines a set of activities to conduct part of a supply chain process; the first two activities correspond to the pre-contract stage, and their goal is to identify the product or service that better meets the requirements of the acquirer.

In these two first activities we can find fine-grained tasks like the problem and solution discovery, the proposal preparation and bidding, and the proposal negotiation and adjustment. However, there is not detailed information that allows practitioners to carry out those activities.

Savolainen et al. [5] identify, as other researchers [8, 9], major activities in the pre-contract stage: *search, preparation, bidding and negotiation*. In the first phase (*search*), the problem or opportunity to address and the context in which it occurs are identified. Then, the provider analyzes the technical feasibility of the project, and its potential profitability. Based on that, it decides whether or not to prepare a project proposal for the customer.

If it does, during the *preparation* phase the provider interacts with the customer to define the goals and scope of the product to be developed. It includes the main functionality of the product and also its limits. Considering such a definition, the provider generates a project proposal that includes the project schedule, deliverables, costs and the product scope (*bidding*).

Finally, some aspects of the proposal could be adjusted through a *negotiation* process between the stakeholders and the provider. As we can see, these four phases involve several collaborative activities between the participants.

There are also some proposals to address this pre-contract process that come from the business domain. For instance, Cooper and Budd [11] present an adaptation to the sales funnel, which lets a company monitor and control its pre-contract process from a business perspective. Similarly, Söhnchen and Albers [12] define six stages of quality for project proposals that help these proposals evolve through the sales funnel.

Although these pre-contract processes give a general guideline for providers, they are difficult to apply in practice without previous training or detailed documentation. Moreover, it is not clear their level of adoption or effectiveness in the industry, since this aspect has not been reported in recent literature. Next section introduces the study performed to explore the pre-contract processes in the observed Chilean software companies.

### III. DESCRIPTION OF THE EXPLORATORY STUDY

We used Grounded Theory (GT) to perform this qualitative study, following the guidelines given in [1, 2, 3, 4]. Fig. 2 shows the main steps performed to gather and analyze the information from the participating companies, and then generate a theory (i.e., the PCP model) for the pre-contract process.

The *data collection* was conducted using *theoretical sampling* [4]. This approach seeks and collects pertinent data to elaborate and refine the categories that then will be used in the emerging theory [1, p. 96].

In parallel to the data collection we started the *data analysis* that included the *initial* and *focused coding* [4]. As shown in Fig. 2, the data collection and data analysis are complementary, and they should be performed jointly until achieving *theoretical saturation*.

During the data analysis, the coders wrote memos (i.e., notes, diagrams, and sketches) to obtain the emerging categories and concepts from the interviewees comments; this activity is known as *memoing*. In parallel, the coders performed *constant comparison* among the collected data to verify similarities and differences. Thus, it is possible to create new codes that help in the data analysis process.

The data collection and analysis are performed until they do not produce new codes or concepts; i.e., until achieving *theoretical saturation*. Then, we can synthesize the coded information and generate the emerging theory, as recommended by GT. Next subsections explain the main aspects of this study.

#### A. Participants

Twenty engineers from 14 Chilean software companies participated in the study. Four of them belonged to micro-companies, five belonged to small companies, six were part of medium-sized enterprises, and the last five were workers from large companies. All of them were knowledgeable of the pre-contract process of small project prospects in their current companies, and had at least 3 years of experience doing this activity. These were part of the inclusion criteria for the participants in this study.

These companies were focused on performing bespoke projects, and develop mainly ad hoc applications for particular business niches. Most of these applications were web and mobile information systems.

#### B. Data gathering instruments

The data gathering was performed through semi-structured interviews, one per participant according to the guidelines of Wohlin et al. [13, p. 62]. The interviews were conducted using videoconference and the same session structure.

At the beginning of the session, we informed the participants on the goals of the interview and the dynamic to follow. Then, we asked them about the main items of the questionnaire, which included open and closed questions. The sessions were recorded with the participants consent, and lasted 60 minutes on average.
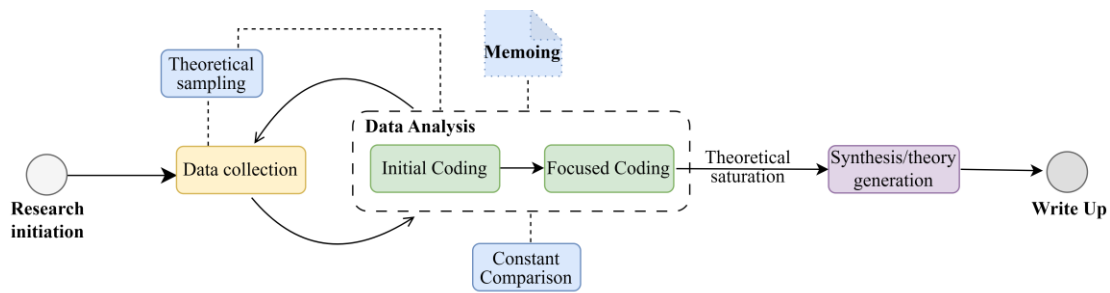
Figure 2. Structure of the research process followed in this study.

## C. Data processing and coding

The records of the sessions were transcribed, obtaining over 125,000 words (272 pages). The data coding was started as soon as the transcribed information was available, as recommended in [1, p. 45]. This activity was performed manually. After processing the coded information, we created the process model that is introduced in the next section.

## IV. PRE-PROJECT PROCESS MODEL

Fig. 3 presents the major activities (indicating if those are mandatory or optional), and workflow of the PCP model. Particularly, the green rectangles indicate activities where the provider interacts with the customer (or stakeholders). The solid borders indicate mandatoriness, and the dashed ones, optionality. The hexagons in purple represent activities that are performed only by the providers team. The arrows between activities indicate the workflow; particularly, solid lines show mandatory transitions and dashed lines indicate optional transitions. The numbers into the activities symbols indicate how many interviewees perform them as part of their pre-contract process. The results show a high agreement on it.

### A. Prospecting stage

As shown in Fig. 3, the structure of the PCP model involves two major stages, *prospection* and *pre-sale*, and both include particular activities. The *prospection stage* usually starts with a customer request that comes through an email or phone call to the person (usually a secretary) that formally receives this information and delivers it to the pre-selling personnel. Then, the pre-selling people filter the requests and decide whether or not to upgrade them to leads. If the information is not enough to decide, the provider asks the customer to fill a questionnaire or a checklist to get extra data. The answer is considered by the provider as an indicator of the level of interest, realism and urgency of the customer.

The interviewees indicate that the most frequent sources of new requests are references from other customers, and the repurchase intention of current clients.

After a request becomes a lead, the provider performs a first approach to the client and the lead (shown as *"customer initial contact"* in Fig. 3), in order to analyze if the lead deserves to be upgraded to the category of project prospect.

According to the interviewees, the key information that providers need to gather on project prospects includes: the actual need to be addressed, the available budget and time, the current situation (as-is), the future situation (to-be), the involved technologies, the number of potential users, and references to similar systems. Depending on it, and also other context information, the provider decides if the lead becomes a project prospect.

### B. Pre-selling stage

These prospects usually follow a workflow that includes from the problem and solution discovery, until the decision of the customer on the acceptance of the provider's proposal. Eventually, any counterpart can abandon the process for any reason; e.g., the prospect became not interesting or unfeasible.

The pre-selling stage starts differently depending on if the customer is new or known. Medium-sized or large suppliers usually count on a pre-sale and a Key Account Management (KAM) area for addressing each of these paths. However, smaller companies fusion these areas for affordability reasons.

In the case of *new customers*, the providers perform a first meeting to know each other (i.e., the *discovery meeting*), but mainly to present their business services and context, and also to ask for information about the lead. That information allows both parts to take a look at the customer's problem and opportunities. The next step in the workflow is to discover the solution.

In case of already *known customers*, the provider skips the *discovery meeting* and goes directly to *solution discovery* activity. According to the interviewees, the *discovery meeting* and the *solution discovery* have similar goals; i.e., to explore the problem, context and solution, but at different levels and focusing the work on different aspects. The first one explores the problem and context more in detail, while the second one is more focused on the solution exploration. However, the providers consider the three components a pack that is reviewed in every meeting to gain certainty and detail. Keeping these components together allows the providers to better envision when to continue or quit the efforts on a particular project prospect.

The number of *solution discovery* sessions depends on several aspects, but mainly on the level of uncertainty of the prospect being addressed. Typically, in small prospects the provider performs one or two sessions.

Once finished the *solution discovery*, the provider estimates the *effort required* to develop the solution, and establishes the major deliverables and milestones. Usually, the pre-sale and technical personnel perform this activity, although in micro and small software companies these roles are played by the same person. The estimation process usually follows an expert judgment approach.
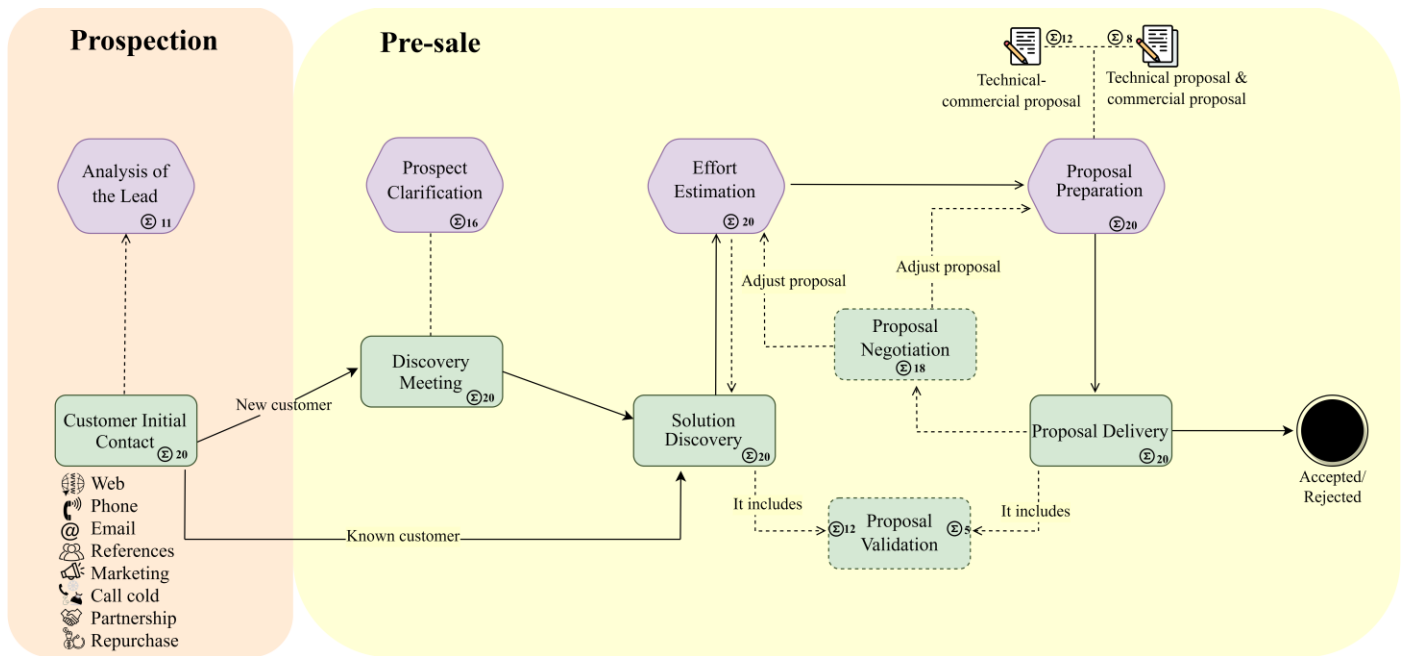
Figure 3. Software project pre-contrast process.

Then, the same people *prepare the proposal*. Twelve participants indicated to deliver separated documents; i.e., a technical and a commercial proposal respectively. The rest of the people deliver a single document that includes both aspects.

The *proposal delivery* usually includes a presentation to the customer. In such a session there is room to clarify business and technical aspects, and also negotiate the budget or scope of the proposal. After the adjustments, the provider repeats the proposal delivery; the process finishes when the proposal is approved, rejected or canceled. Next we explain the roles participating in the activities of the PCP model.

### C. Involved roles

Fig. 4 shows the roles that emerged from analyzing the coded information. The role names are convention among those mentioned by the participants. The numbers indicate many participants of this study use such a role as an actor of the process, and also to support what activity of the PCP model. Next, we briefly explain each of them.
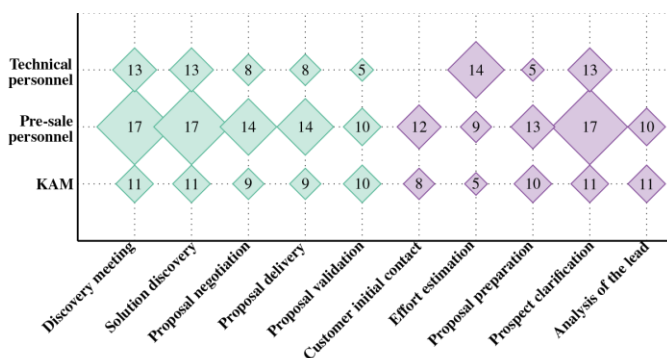


Figure 4. Roles participating in the Pre-contract process.

*Key Account Manager* (KAM) is the person in charge of managing opportunities and needs of the current clients of the company. This role is usually present in providers that keep separated the pre-selling and commercial areas.

*Pre-sale personnel* usually include people in charge of project sales, who also have technical knowledge of the products and services that the company provides. Frequently, these people are knowledgeable of the business domain they must address. In micro and small companies, this responsibility is assumed by the general manager or an owner.

*Technical personnel* involve engineers that participate in the development of the solutions. Some roles mentioned by the interviewees as part of this umbrella were: technical area manager, solutions architect, project leader, operations team, and development team. The technical personnel participate more actively in the effort estimation (cost, time and resources).

From the customer side, there are no formal roles defined. However, the information coding process allowed us to identify the following informal roles:

*Technical personnel* includes people working in technical areas in the customer organization; e.g., technical experts, IT managers, and operations engineers.

*Product agents* are those who have the actual need; they are the problem domain experts or the product owner.

*Decision makers* are people able to decide whether or not to continue with the project; e.g., the finance manager, commercial manager or company head.

The role that has more prevalence in the discovery meeting from the provider's side is the pre-sale specialist (who is part of the pre-sale personnel). Then, in the solution discovery sessions

the technical personnel become protagonists jointly with the pre-sale people.

The number of people per role participating in the meetings depends on the project prospect size, complexity and uncertainty level. In small project prospects usually participate one person per role.

### D. Supporting tools

The participants reported several tools to support data gathering during the prospection and pre-selling stages; Fig. 5 shows a summary of them considering each participant. All interviewees indicated to perform synchronous and asynchronous activities with the customer. Typically, they perform interviews supported by instruments like questionnaires or canvases.

They also reported asynchronous work of the provider, e.g., the development of mockups or informal diagrams, that are then used to validate or refine proposals. The customer also conducts asynchronous activities, e.g., filling questionnaires or completing checklists that helps the provider to better understand the leads or project prospects.

The variety of instruments (and combinations of them), used by the providers suggest that the pre-selling process is informal and ad hoc; i.e., it is conducted in a different way depending on who performs it, or the project context that is being addressed.

### V. ANALYZING THE STRUCTURE OF THE PRE-CONTRACT PROCESS

It is well-known that making a process repeatable and improvable requires a process specification and controlled structure. Such specification should leave room enough to make the processes flexible and adaptable to different project contexts. This trade-off is also present in the PCP model.

Although it is not formally specified, at a higher level the pre-contract process adheres to the structure reported by Savolainen et al. [5] (Fig. 1.c). However, analyzing each stage we can see that the process becomes ad hoc framed at low level. Particularly, it is a people-driven collaborative process [14], where the decision on how or when to perform a particular activity is made by the participants, depending on several context variables; e.g., the level of uncertainty of the project prospect.
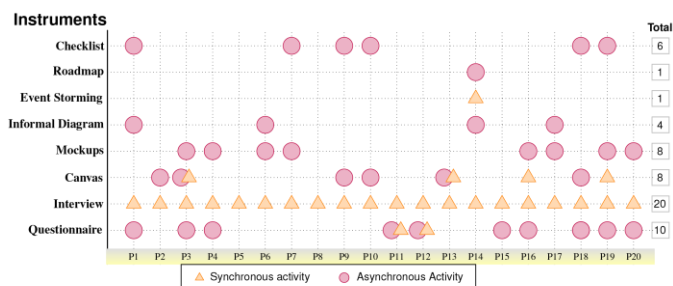


Figure 5. Instruments used during pre-contract process.

According to the classification proposed by Di Ciccio et al. [15], the PCP model corresponds to a *structured process with ad hoc exceptions*, since it has a general structure, but the fine-grained activities should consider external events and exceptions. In support of it, one of the participants indicated *"the activities that we perform during the pre-selling depend on the customer availability"* [P5]. This makes the provider leave the regular practices to deal with the required adaptation.

This demands high flexibility, therefore, the low-level workflow of this process cannot be prescribed or formalized. In support of it a participant indicated *"... the pre-selling process is quite informal, since our personnel use different strategies to identify an opportunity... Once we start to explore the solution, we become more formal by documenting the meetings and recording the information gathered from the customer…"* [P12].

Summarizing, after analyzing the information of the interviews using GT the results support the working hypothesis; i.e., *the providers use an ad hoc and implicit process to perform the pre-contract stage.*

### VI. THREATS TO VALIDITY

During this research we used several mechanisms to mitigate the threats to the validity of results. First of all, we used GT because this midrange substantive theory allows to focus the analysis to the studied contexts [2, 3]. This context also lets us determine inclusion and exclusion criteria for the participants [16]. Moreover, ensuring the anonymity of the participants and the companies helped us find professionals willing to participate in this study and get honest answers to the questions.

The use of GT is also supported by the soundness of this approach, since the evidence of the generated theory is verifiable using the source data [4]. For that reason, we have explained in detail the processes used in the study (Sect. III), presented the model that emerged from the data processed using GT (Sect. IV), and analyzed the results considering the stated working hypothesis (Sect. V). Thus, we show that the proposed theory accomplishes with the regular validation criteria established for GT. For instance, the PCP model is aligned to the underlying data and it has shown to be relevant for the domain that it shapes; i.e., the pre-contract process of small projects in Chilean software companies.

In order to deal with the threats to the construction validity, we used the interviews as instrument for gathering data from software companies with different sizes. We conducted this data gathering until getting data saturation.

Provided that we used open coding to classify the information given by the interviewees, a potential threat to validity could come from wrong interpretation of the transcriptions. In order to address this threat, three researchers participated in the open coding of the interviews. One of them performed the open coding, and the others validated and adjusted them in various discussion sessions.

### VII. CONCLUSIONS AND FUTURE WORK

This article presents an exploratory study to better understand the pre-contract process conducted by software companies when they have to deal with small project prospects.

The working hypothesis of this study indicates that *"the providers use an ad hoc and implicit process to perform the pre-contract stage"*.

Twenty engineers from fourteen Chilean companies participate in the study. We used Grounded Theory to code and process the collected data. The outcome was the Pre-Contract Process (PCP) model that shows the macro-structure of the process followed by these companies, and also its variability. These results are aligned to the working hypothesis.

This study, and particularly the proposed model, contributes to advancing our knowledge in a project stage that is critical for many software companies, but mainly for the micro and small ones. In this sense, the PCP model can be used to inform the design of pre-contract activities in these software companies, but also in computer science and engineering programs. Undergraduate and graduate students, and also practitioners can take advantage of it.

The future work considers extending this study in order to verify the validity of the PCP model in a larger context, including other Latin American countries.

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