Commitment and Consistency in the Collaborative Software Development Process of Extreme Programming

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Abstract: In this work we (i) expose and analyse the social-psychological principle of commitment and consistency embedded in the Extreme Programming software development process, (ii) illustrate how this principle can be leveraged to impact upon project success, and (iii) provide practical evidence of the manifestation of this principle and its effects in the Extreme Programming domain, through nascent results from our qualitative case study. This work is in its initial stages; our intent is to persuade the reader that commitment and consistency are indeed relevant factors in Extreme Programming process, are potentially impactful on organizational success, and are worthy of further study.

1 INTRODUCTION

The work presented here forms part of a larger project, the goal of which is to produce an overall positive impact on organizational success, (i) by exposing and analysing the influences of extant social-psychological, interpersonal communications phenomena on collaborative software development practices, and (ii), by devising guidelines to aid organizations in leveraging associated positive influences, while mitigating their potentially detrimental effects. In this report, we relate initial work on one element of the project: the social-psychological commitment and consistency principle's role in the collaborative software development methodology of Extreme Programming (XP), and the principle's implications for project success.

The XP software development methodology embraces collaboratively-based processes and practices which are aimed at improving project success, and are motivated by two crucial elements: effective communication among the people involved in a project, and an even division of responsibility between business people and technical people (Beck, 1999). These processes and practices have their basis in a set of principles stressing collaboration, receptivity to feedback, respect, and honesty among

individuals. XP practices and processes are designed to support information sharing at both the social and technological levels.

In developing XP processes and practices, Beck drew upon work exploring a people-oriented approach to software engineering, such as Weinberg's seminal text *The Psychology of Computer Programming* (1998), which provides insights into issues such as ego, personality traits, motivation, interpersonal communication, and teamwork (Beck, 1999). However, no accounts exist, to our knowledge, suggesting that Beck explicitly incorporated the social-psychological commitment and consistency principle into XP processes and practices. We hypothesize that this principle indeed pervades XP practices, and furthermore, that it impacts on the success of the XP process. The purpose of this paper is to present an argument that our hypothesis is reasonable, and technically consistent with XP process. This work is an important precursor to any practical test of the hypothesis, such as our complete future study involving in-depth assay of our qualitative data. Our argument is based upon technical analysis of the nature of XP process, and upon inceptive analysis of our qualitative data. In the sequel, we support our argument as follows: first, we provide a brief outline of XP processes and practices, and of the commitment and consistency principle; next, we

analyze XP processes and practices to clearly reveal the presence of the commitment and consistency principle therein; next, we determine how this principle manifests in XP operational practices involving people interaction; and finally, we present nascent supportive evidence from our ongoing, and incomplete, industrial case study.

2   XP PROCESS

XP belongs to the agile family of software development methodologies, and thus, embodies a process which is iterative and incremental. The project is comprised of some number of releases, and each release is implemented by some number of iterations.   Releases occur frequently, normally every one to three months. Each release provides an increment in system functionality, and constitutes a complete, working system. A release is comprised of some set of iterations, each of which is typically one to three weeks in duration. New functionality is incorporated frequently, typically multiple times daily, and the current, working system is available to all stakeholders at all times.

The project's business people are represented by one individual, known as the customer. This individual is always available on-site, and her responsibilities include generating user stories (system requirements), participating in release and iteration planning, and responding to questions about user stories posed by developers (the technical people).

Each release is governed by a release plan, which is established by developers, the customer, and possibly managers, at a release planning meeting. In this meeting, the customer presents some set of user stories, and developers estimate timelines for each story. The customer, with the aid of developers, then selects some group of stories to include in the next release. The customer selects the set based either on scope (desired functionality) or time (stories that are accomplishable by a given date). During release planning, the customer may alter user stories based on developer input. For example, a story may be partitioned into a set of smaller stories so that the customer can retain important functionality in this release, and leave less important functionality for a future release. Developers, the customer, and possibly managers, negotiate until all agree to the release plan (Beck & Fowler, 2000).

A release is implemented over several iterations. User stories for an iteration are selected by the customer from among those in the current release,

typically in order of importance to the customer. The number of stories included is determined by the developer timelines provided during release planning. Next, developers collaborate to decompose the selected user stories into distinct programming tasks, each of which can be completed in one to three days. A list of these tasks is maintained in a highly visible, public area, such as a whiteboard in the development area. Developers sign up for tasks of their choice. The developer who signs up for a task must write her name alongside the task, as well as her own estimation of the time it will take to complete the task. If the iteration's total task estimation time differs from the customer's expectation, the customer may alter the iteration by adding or removing (parts of) stories (Beck & Fowler, 2000). The tasks are subsequently implemented by developers. During task implementation, a developer may consult the customer, at any time, for clarifications to user stories that impact the task.

Mandatory to XP process is the daily meeting, which is attended by all developers and business people. As part of the meeting, developers provide updates on the progress of their chosen tasks, and record these updates on the public task display.

We have presented a very brief account of XP process above. It is important to note that, for the sake of brevity, we have omitted details that are not principally relevant to our work of relating XP process to the social-psychological principle of commitment and consistency.

3   COMMITMENT AND CONSISTENCY PRINCIPLE

In this section, we provide a brief description of the commitment and consistency principle for the purpose of relating it to XP process. A comprehensive account of this principle and its various implications is beyond the scope of this initial report. The interested reader is referred to a pertinent summary in (Cialdini, 2008).

3.1   Outcome Consistency

The social-psychological principle of commitment and consistency is summarized as follows: "Once we make a choice or take a stand, we will encounter personal and interpersonal pressures to behave consistently with that commitment. Those pressures will cause us to respond in ways that justify our

earlier decision" (Cialdini, 2008, p. 53). The pressures are so powerful that a person's fulfilment of the commitment feels "automatic" (Cialdini, 2008, p. 55). The principle can thus shape future reality by causing individuals to behave consistently with expectations, which in turn can enhance performance (Kruglanshi & Higgins, 2007). Note that such commitment fulfilment is referred to in social psychology literature as outcome consistency, compliance, or behavioural confirmation.

Not all commitments, however, are equally effective in eliciting consistent future action. Commitments are most effective when they are active, public, and require some effort; moreover, the most important precondition for effectiveness is that the individual assumes responsibility for the commitment freely (Guéguen & Pascual, 2000). Evidence from numerous domains demonstrates that effective commitments elicit outcome consistency (Cialdini, 2008). The various underlying social-psychological factors driving outcome consistency are beyond the scope of this report, but are well-described in the realm of social psychology (Aronson, 2011).

3.2 Compliance Escalation

The effects of the commitment and consistency principle are not limited to a single commitment. It has been shown that outcome compliance for a commitment is strengthened if that commitment is the end result of a progressively escalating sequence of commitments (Aronson, 2011). Compliance escalation can produce positive results; however, it is often used unscrupulously in a compliance technique commonly referred to as foot-in-the-door (Burger, 1999). Evidence abounds from various domains, such as sales and marketing, detailing the deliberate exploitation of this aspect of the commitment and consistency principle to influence behaviour (Cialdini, 2008).

4 COMMITMENT AND CONSISTENCY IN XP PROCESS

The commitment and consistency principle manifests in XP process during planning activities and task implementation. Below, we outline both positive and negative outcomes of the this principle in XP process.

4.1 Positive Outcomes

The commitment and consistency principle manifests in XP iteration planning. The commitment is undertaken when the developer takes responsibility for a task. The commitment is active, since the developer selects her own task, and derives her own time estimate. The commitment is public, since the developer records her name and estimate on the task list, which is in a prominent public location, and recounts task progress in daily meetings. Most importantly, the commitment is made freely, since the developer, herself, chooses to assume responsibility for the task. Thus, XP process clearly sets the stage for effective commitments; if the commitment and consistency principle applies in this domain, then outcome consistency implies that developers will complete their tasks on time. This is an important consequence, since timely task completion is known to be critical to the success of software development projects (Verner, et al., 2008).

Compliance escalation can occur during task implementation, when a developer's task changes as a result of customer clarifications. If the commitment and consistency principle holds in this domain, it implies outcome consistency would be strengthened; the developer's urge to complete the task on time would be strengthened, along with associated positive implications for project success.

It is important to note that these positive results can be expected only if the commitment and consistency principle holds in the domain of XP software development. This is a reasonable assumption, since transference to various domains is well-established (Cialdini, 2008). Nonetheless, transference to this domain must be corroborated with evidence from the domain itself. Providing such evidence is part of our larger project; initial results are presented in Section 5.

4.2 Counter-Productive Outcomes

As noted above in Section 4.1, the commitment and consistency principle can manifest in the form of compliance escalation during task implementation. However, a positive outcome is not guaranteed in all such situations. The outcome is counter-productive when outcome consistency, i.e., completion of the altered task, requires more time than afforded by the recorded estimation. The developer can fall behind, which is known to negatively impact project success (Verner, et al., 2008). It is important to note that such a situation is not considered part of normal XP process. Customer clarifications are expected to be

of a minor enough nature that the recorded time estimate remains appropriate for the escalated task. If the recorded estimate is no longer appropriate, XP process requires iteration renegotiation. However, we note that due to the effects of compliance escalation, it is possible the developer may fail to recognize the need for renegotiation. Thus, she may find herself in an impossible position: Outcome consistency causes her to feel a strong urge to complete her task within an unrealistic time-frame.

Social psychology provides ample evidence from various domains detailing such counter-productive outcomes stemming from the principle of commitment and consistency (Cialdini, 2008). Although it is reasonable to assume transference to the domain of software development, this assumption must be corroborated with evidence from the domain itself. Providing such evidence is part of our larger project; initial results are presented in Section 5.

It is worth noting that the aforementioned manifestations of the commitment principle, both positive and counter-productive, are specific to XP process. These issues cannot arise in traditional software development methodologies, because developers' tasks and deadlines are largely determined by business agents, and the commitment and consistency principle therefore does not apply.

5 CASE STUDY

In this section, we describe the current standing of our ongoing, incomplete, study relating XP process to the social-psychological commitment and consistency principle. The study's setting, approach, and data acquisition methods are briefly outlined below, and a more comprehensive treatment is available in (Woit & Bell, 2014). Data analysis relating to the commitment and consistency principle is ongoing; however, some relevant preliminary results are presented in the sequel.

5.1 Study Setting and Approach

The study is set in a private organization that follows the XP development methodology to develop web-based communication software. The development team comprises twelve individuals; the customer works on-site, attends all meetings, and is always available to respond to developer questions.

The research approach is qualitative in order to explore how the participants attach meaning to their own experiences (Merriam, 2009). It is phenomenological in that it seeks to explore the issues from a shared perspective, and in context (Reid, et al., 2005). The phenomenological approach is apt in this context because the participants are not a random sampling of a larger population, and are relatively few in number (Onwuegbuzie & Leech, 2007).

5.2 Data Acquisition

Data is collected via participant observation and unstructured interviews in order to explore locally relevant issues without imposing pre-determined categories or themes (Guest, et al., 2013). Data integrity is reinforced via an aide memoire (Zhang & Wildemuth, 2009), containing broad topic categories which include interactions with developers, interactions with customer, and examples.

5.3 Results and Data Analysis

Data analysis is ongoing; below, we group preliminary results into categories, and within each category, present a provisional interpretation of the results with respect to the commitment and consistency principle in this XP domain. A limited amount of non-qualitative data is incorporated into the analysis for the purpose of corroborating some observational and interview data. This additional data is obtained from project documentation, such as records of planning and iteration meetings, and XP tracking documents.

5.3.1 Requirement Concession Escalation during Release Planning

Data from customer interviews and observation indicate that during release planning, the customer frequently agreed to a requirement concession that came about as an extension of a smaller, previously agreed-to, concession. The customer reported that he would not have agreed to many such concessions had they not been presented as extensions of previous concessions. Nonetheless, he reported feeling mostly more satisfied with his final requirements. This demonstrates accordance with the commitment and consistency principle: The customer is more likely to agree to an escalated concession given that he has already agreed to a smaller version of the concession. There is outcome consistency, in that the customer has no desire to subsequently alter his final agreement. This is a positive outcome of the commitment and consistency principle, since customer satisfaction,

which is the measure of success in an XP project, is increased (Beck & Andres, 2004).

5.3.2 Unplanned Task Escalation during Implementation

Observational data, and developer responses indicate that frequent task escalation occurred during the implementation phases. Some escalations resulted from customer clarifications which were solicited by the developer. Other escalations, however, resulted from customer-initiated interventions. These latter situations occurred when the customer accessed the current working product, and found a task implementation inconsistent with his understanding of the requirements.

Developers reported sometimes being unable to complete their tasks within the recorded time estimations, known as *over-commitment* in XP, because they accepted task scope escalations even though they were untenable within the recorded time estimations. Developers reported over-commitment negatively affected their motivation. When probed, they were perplexed as to why they had accepted such escalations, and as to why they had not realized the modified tasks were un-implementable within their recorded time estimations. They were especially confused by the fact that the more effort they had put into the definition of a task, the more willing they were to accept its escalation. This behaviour seemed counter-intuitive and unexplainable. However, some explanation is provided by considering the commitment and consistency principle: The individual is more likely to agree to the escalated task since she has already agreed to a smaller version of the task. Her commitment to the task is strong because she has put effort into defining the task, and her willingness to escalate the task grows from this strength. Furthermore, the effects of commitment escalation may render her unlikely to subject the recorded time estimate to subsequent scrutiny.

The interplay of XP process and the commitment and consistency principle result in developer over-commitment. This is counter-productive in two ways. First, it negatively impacts project success directly (Beck & Fowler, 2000). Second, it demotivates developers, which is also known to negatively impact project success (França, et al., 2011).

5.3.3 Deliberate Task Escalation during Implementation

Data from customer interviews indicates that occasionally, under the guise of a simple requirement clarification, the customer deliberately escalated a task's scope in order to recover some concession he had made during release or iteration planning. The developer's willingness to accept the escalation, the interplay of XP process and the commitment and consistency principle, and the associated counter-productive outcomes, are all similar to those outlined above in Section 5.3.2.

However, on two occasions, data from developer and customer reports, and from observation, indicate that the customer made no attempt to disguise his deliberate scope extension as a simple clarification, and in fact asked the developer to collude with him, in violation of normal XP process. The developer agreed for the reasons outlined in Section 5.3.2 above. Data from developer interviews indicates the emergence of additional counter-productive outcomes in these two situations. Other developers reported feeling betrayed by the collusive behaviour, and experienced an associated decrease in motivation. As noted in Section 5.3.2, decreased motivation negatively impacts project success (França, et al., 2011). Developers also reported feeling that XP's spirit of collaboration and trust had been undermined. Although more analysis is required in our particular situation, it has been reported that such feelings can also impact negatively upon the success of an XP project (Beck & Andres, 2004).

This situation also differs from the unplanned task escalation outlined in Section 5.3.2 in that the commitment and consistency principle does not appear to influence the customer. Normally, the customer reported satisfaction with the requirements concessions he agreed to during planning, in accordance with the commitment and consistency principle, as reported above in Section 5.3.1. Why, on some occasions, did he find himself dissatisfied with a concession? The customer reported that these were concessions he had felt pressured into making. Thus, the commitment and consistency principle did not apply in this situation, since its important precondition—free agreement—had been violated. Therefore, it is unsurprising that the customer felt no obligation to follow through with these concessions.

Note that we expect the customer's feelings of coercion were a result of the psychological phenomenon known as social proof (also called informational social influence). Further research is required regarding the interplay of the commitment and consistency principle and social proof; however, this is beyond the scope of our preliminary analysis.

5.3.4 Timely Task Completion

Our data confirms that the conditions necessary for effective commitments do hold in our domain, as follows. Observational data confirms commitments were active and public. Data from developer interviews indicate developers did not feel coerced into their commitments, and that they felt satisfied with the agreements they forged during release and iteration planning. Thus, if the commitment and consistency principle holds in our domain, we should expect consistency of outcome, in the form of timely task completion, and our data does indeed corroborate this. Our initial analysis of observational data, and of project documentation, indicates timely task completion occurred; that is, actual task completion time was acceptably close to the recorded estimated time. Our explanation of timely task completion is vague, and perhaps unsatisfying, because a comprehensive account of our actual measurements is beyond the scope of this preliminary report.

Data from observation and project documentation does show exceptions to timely task completion, however. Preliminary data analysis shows these exceptions coincided with periods of developer over-commitment, as outlined above, in Sections 5.3.2 and 5.3.3. They also coincided with uncontrollable external factors, such as illness, and infrastructure modifications.

5.4 Threats to Validity

It is possible developers were unwilling to disclose issues they considered disparaging to the customer, because he was a primary stakeholder in the organization. Data collector bias is also possible (unconscious distortion of collected data). These threats are common to empirical studies based on qualitative data. We endeavour to address these by the generally accepted methods of (i) following an aide memoire (ii) using unstructured interviews to put participants at ease, (iii) assuring participants of anonymity, (iv) including an organizationally-external researcher, and (v) data-triangulation (Shadish, et al., 2002).

6 CONCLUSIONS

This work relates our preliminary investigations into the role of the social-psychological commitment and consistency principle in the collaborative software development methodology of Extreme Programming

(XP). We hypothesize that the commitment and consistency principle is intrinsic to XP process, and impacts on its success. We argue that this hypothesis is reasonable, and technically consistent with XP process, supporting the argument through technical analysis of XP process, and nascent analysis of preliminary data from our qualitative case study.

Our data indicates that the commitment and consistency principle manifests in our domain to promote timely task completion and to increase customer satisfaction, both of which are critical to project success. Our data is also reveals that the commitment and consistency principle can contribute to developer over-commitment and demotivation, both of which are known to negatively impact project success. Finally, our data demonstrates that when its preconditions are not met, the commitment and consistency principle does not hold in our domain, and that, moreover, its absence contributes to demotivation, with negative implications for project success.

Our results imply that individuals must play an active role in properly managing the manifestation of the commitment and consistency principle in XP processes and practices. Ignorance of the principle, or its improper management, can contribute to preventable, negative outcomes. However, when properly leveraged, the principle can impact positively on project success.

This work is in its preliminary stages, and does not yet constitute comprehensive support of the notion that issues related to commitment and consistency are intrinsic to XP project success. However, we hope our preliminary analysis and nascent supportive evidence have provided an arguable case for the importance of continued data analysis, and continued investigation into this area.

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