AGILE SOFTWARE DEVELOPMENT PROCESS EXTENSION FOR SMALL TEAMS

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Abstract- Agile processes do not exploit working software for creative thinking about new requirements. Therefore, a big challenge is how to effectively integrate creative thinking, into the agile processes to improve clarity and realistic of the requirements and then improve decision making with the team thinking process and provide high quality software to meet the real needs of consumers. To explore alternatives, this paper reports the extension of Crystal Clear process with creativity techniques using Creative Problem Solving framework (CPS) in a small project team. This study compared the results produced by the "chartering processes" of Crystal Clear and Crystal Clear extended with CPS which were used by an experimental workshop to design a mobile application. The evidence suggests that Crystal Clear extended with CPS generated more novel ideas than the original process for the same project and produced an increased number of more useful ideas.

Keywords- Agile, Crystal Clear, CPS, Creative.

I. INTRODUCTION

When we talk about IT software project development, we should apply the right methodology to ensure the project success. We also need to set criteria to measure the progress and success. A particular methodology may suit one specific project better than the other. The selection of the right development methodology is critical to achieve success. Agile methodology is a widely used approach for developing non-critical software applications in the modern software industry. The advantages of Agile include but are not limited to adaptive planning, early delivery, evolutionary development, continuous improvement, and rapid and flexible response to change [1]. However, the short durations of sprints can discourage the incubation and reflection needed for creative thinking [Poincare 1928]. Therefore, a big challenge is how to effectively integrate creative thinking, into the Agile processes to improve clarity and realist city of the requirements.

This work proposes an improvement of the Crystal Clear family of Agile [2] by applying Creative Process Thinking (CPS) framework to improve Crystal Clear creative stage processes such as "chattering" and "recalibration".

The CPS application does not consider other stages of Agile development (e.g. coding). The evaluation of the proposed extension process was conducted by a small team of software engineers to design a travel guide application for mobile devices.

II. AGILE METHODOLOGY: CRYSTAL CLEAR

Agile practices, also referred to as lightweight methodologies, include several specific methods: (1) crystal method, (2) dynamic systems development, (3) extreme programming (XP), (4) feature-driven development (FDD), (5) lean software development, (6) kanban, (7) scrum etc. [3]. Agile's flexibility solves problems by encouraging integration of changes during the development process through the close customer interaction with the development team. Agile emphasizes the importance of the people's input into the process. Crystal Clear is often used by small development teams. A usual team consists of two to eight people located in the same room or co-located. Because the people interaction is critical, face to face communications are preferred. Such an approach can help to manage variety of IT innovations and implementations [4].

Crystal Clear has three main stages. The first stage is chartering: establishing a development team, making a preliminary feasibility analysis, shaping and fine-tuning the methodology of the development, and building the initial development plan. The second stage consists of cycle delivery which includes recalibrations, iterations, deliveries and reflections. This cycle is repeated until the product is delivered to a customer. The final stage is a wrap-up that involves the product deployment to the target system along with reviews and reflections about its performance in the user environment

III. EXTENSION PROCESS OF THE CRYSTAL CLEAR

3.1 Chartering Process Improvement

Software product development starts with design process that should produce useful, realistic and novel ideas. Lack of creativity is a well known problem and a challenge in software development. The Osborn-Parnes's (1967) process for the Creative Problem Solving (CPS) is a method with wide application for resolving several types of problem. It looks for opportunities to improve the efficiency of actions. CPS method is based on group meeting sessions of people with diverse outlooks. All team members act as creative resources. CPS is a mental process of searching for the new and novel creative solution. This tool focuses on divergent and

convergent thinking, the ability to develop multiple ideas and concepts to solve specific problems [5]. If we identify places in an Agile process where creative thinking can improve the end result, we can do it by adopting the method that is consistent with the Sternberg's definition of creativity [6] to generate useful novel ideas for the application requirements.

This paper proposes to enhance the software application design process by extending two stages of the Crystal Clear process, chattering and recalibration, with application of the CPS framework. The chartering stage is used for creating novel visions and generating realistic requirements specification. At the recalibrating stage the project requirements and plans are analyzed and updated according to the experience gained in the delivery cycles earlier.

3.2 Chartering Process

A new project usually starts with the chartering activity. The team examines all parts of the project, typically including business value, requirements, domain model, technology plans, project plan, team makeup, process or methodology. The team's core includes an executive sponsor, senior designer, users and designer programmer [7], the other roles such as systems analysts, test, coordinators etc. get involved as the need arises. The entire exploratory 360° activity for Crystal Clear project will take approximately from a few days up to two weeks. After the team discusses what they known, identify problems and needs the team members decide whether it makes sense to proceed with the project or cancel it. In essence the preliminary project feasibility study provides a high-level project-wide review of the key issues governing the development effort of the project. The last two parts shape and fine-tune the methodology conventions and build the initial project plan [8].Fig1.Presents the stages of the extended chartering and recalibration processes in Crystal Clear.

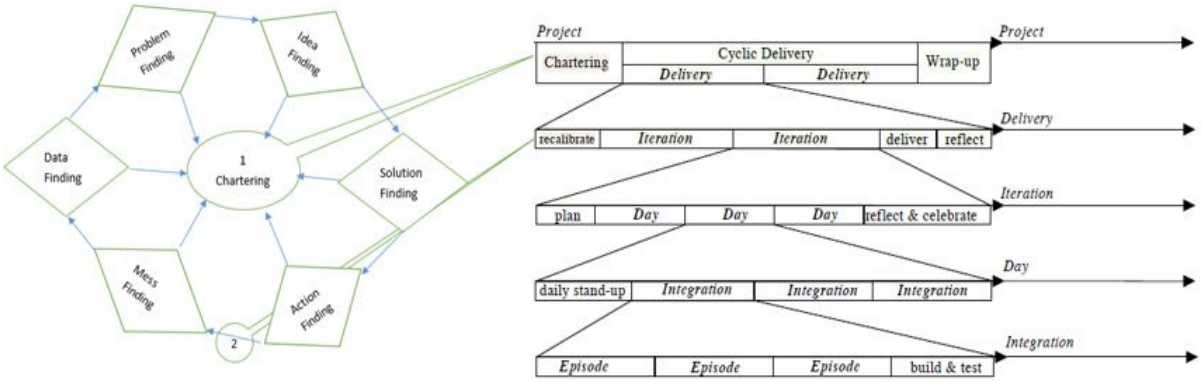


Fig.1. Extended chartering and recalibration processes

It shows the application of CPS (Treffing & Isaksen version 4.0) to extend the chartering process and re-calibration process [5]. The process encourages everyone in the team to join in and share information and experience.

The CPS process is divided in three components/ phases: (1) understanding the problem (2) generating ideas (3) finding out effective solutions and making some action planning. The components encompass six stages: mess finding, data finding, problem finding, idea finding, solution finding and acceptance finding [5].

Some stages in the creative problem solving and crystal clear process are equivalent. The Crystal Clear chartering stage involves four steps: a) building the core of the team, b) performing the exploratory 360°analysis, c) shape and fine-tune the methodology conventions and d) building the project plan. The four phases of CPS can be mapped to the corresponding stages of the chartering process as follows. The 360 stage employs the following CPS phases: mess finding, data finding, problem finding and idea finding (see Table 2 and Table 3). Next, the shape and fine-tune stage employs the solution finding phase and finally, building the project plan stage employs acceptance finding phase (see Table 4). These mappings will enhance the crystal clear osmotic communication process to achieve the most effective results.



Fig.2. Crystal Clear with CPS application workshop

The above discussion led to the following propositions. The first proposition states that the requirements generated from the application of the extended chartering process will produce more novel ideas than original chartering process in the same project. The second proposition states that the requirements generated from the application of the extended

chartering process will produce less useful ideas than original chartering process in the same project. These propositions were evaluated by a two-part experimental workshop. The evaluation was drawn by comparing the results of the both workshop parts. The next section gives a detailed description of the process.

IV. EVALUATING EXTENDED CHARTERING PROCESS

4.1 Workshop Description

The process of the evaluation was started by setting a vision for the software application by the project's sponsor (see Table1). To examine the extended chartering and original chartering processes for Crystal Clear a workshop consisting of two parts simulating the beginning stage of the development of a travel guide application for mobile devices was conducted. The first part conducted by a team of four software engineers used Crystal Clear only, the second - Crystal Clear with CPS (see Fig 2). The collected evidence was used to determine whether CPS application led to any real improvements in the quality and number of ideas generated during the designing stage. The time constraint of 60 minutes was applied to both workshops and the results were compared. The evaluative criteria were set to reflect generated ideas usefulness and innovativeness in relation to the project sponsor's vision of the application. The result comparison and evaluation was done by the team members based on of the ideas' quality and relatedness to the possible user needs. The mentioned workshops served the purpose of testing two hypotheses that were formulated based on the literature review conducted by this study.

4.2 Workshop Results

The team members generated twenty ideas that matched the project vision. Then the team selected the ideas that matched the application requirements Table1 shows the vision and the ideas in the chartering stage.

Table 1: Crystal Clear chartering stage components

Travel Guide App For Mobile Device				
Chartering Stage				
	Vison	Duration	No.	Ideas
crystal clear	make a useful travel guide, let tourist to love it	60mins	1	search
			2	extimation to visit particnlar place , budget extimation
			3	hotel listings
			4	restaurent listing
			5	attraction schedule, especial or events period ★
			6	weather forecast
			7	maps
			8	transportation
			9	compass
			10	itinerary calendar
			11	user comment/ recommendation
			12	rating hotel, place, restaurant
			13	chat ★
			14	3rd party apps sharing ★
			15	picture gallery sharing ★
			16	attractions in the local area
			17	major attractions★
			18	GPS attraction push description
			19	do and don't list ★
			20	useful foreigner in different languages
Ideas selected for development are marked by the star sign				

The chartering process was extended with CPS at each step, including divergent and convergent techniques with brainstorming and thevariations such as Round-robin brainstorming, and Gordon-little variation[9]. SomeCPS steps that map to the corresponding chartering steps (see Table 2) show the results of the chartering stage.

Table 2: Chartering stage with CPS for understanding the problem stage

Travel Guide App For Mobile Device							
Chartering Stage							
	Vision	CPS Stage	Duration	No.	Divergent Ideas	No.	Convergent Ideas
extend crystal clear chartering process with creative problem solving	the travel guide app aim will provide for the needs of truc and reliable, valid information. and help the use enjoy them travel and create unforgettable memories.	Messing Finding	60 mins	1	attractive	1	help the use enjoy them travel and create Unforgettable memories
				2	fun	2	For the needs Provide true and reliable, valid information
				3	real help to the user		
				4	reliable battery efficent		
		Data Finding		1	small size	1	no need to learn
				2	fun		
				3	usefulness		
				4	recommendation		
				5	complete: all in to is available	2	fast load simple opeation
				6	simple		
				7	fast to load		
				8	help		
				9	easy to using		
				10	popular element design	3	real help user and love to use
				11	Valid information updated Timely		
		Problem Finding		1	no need to learn		How can we produce mobile application popular design, personal traits and help customer to enjoy traveling?
				2	fast load simple opeation		
				3	real help user and love to use		

Table 2 shows the vision of the application made by the team. The team followed the CPS step by step "mess finding" to find out the goal modeling and mining of the requirements. Each member joined discussion about seeking the opportunities, and establishing broad, general goal for the project. The results generated by the team following the vision for the travel guide application are supposed to provide a solid base for the development of reliable and valid product that will help users to enjoy traveling and create unforgettable memories. Table 2 shows that the divergent technique resulted in eleven facts and the convergent one pointed out three important facts that can lead to the problem finding. Therefore we need to converge specific possible problems in to one global problem "How can we produce mobile application popular design, personal traits and help customer to enjoy traveling?" Next step will be producing ideas by each team member to solve the global problem.

Table3: Chartering stage with CPS generating idea stage

Travel Guide App For Mobile Device							
Chartering Stage							
	Vision	**CPS Stage**	**Duration**	**No.**	**Divergent Ideas**	**No.**	**Convergent Ideas**
extend crystal clear chartering process with creative problem solving	the travel guide app aim will provide for the needs of true and reliable, valid information. and help the use enjoy them travel and create unforgettable memories.	**Idea Finding**	60 mins	1	chat	1	chat, share picture,3rd part share,photo album creator
				2	shar picture		
				3	self travel map create		
				4	map landmarking	2	self travel map create，map landmarking，picture show guide，fun sticker，direction，traveler journal with picture，Constellation characteristics of different tourists
				5	picture show guide		
				6	translater		
				7	survival phrase		
				8	do and don't list		
				9	fun sticker		
				10	direction		
				11	3rd part share		
				12	budget estimation		
				13	scan picture or words and translate automatically	3	translater，scan picture or words and translate automatically，local language help
				14	hotel, place, restaurant, road, recommendation		
				15	random place recommendation		
				16	search directly	4	survival phrase，do and don't list，budget estimation，hotel, place, restaurant, road, recommendation，search directly，transport, hotel , food survival guide，local area special event or holiday calendar remind，list of major tourist attractions
				17	GPS automatic push local information		
				18	made short clip movies including sound		
				19	3d picture for attractions, food		
				20	virtual local pet		
				21	transport, hotel , food survival guide		
				22	traveller journal with picture		
				23	photo album creator	5	random place recommendation,Locals Specialties Recommendation, ex: about the weather what time is better for travel
				24	virtual tour guide like cartoon character, talking any information related with the place, auto push		
				25	list of major tourist attractions	6	GPS automatic push local information
				26	local language help	7	made short clip movies including sound
				27	earn money such as travel game	8	3d picture for attractions, food
				28	Locals Specialties Recommendation, ex: about the weather what time is better for travel	9	virtual tour guide like cartoon character, talking any information related with the place, auto push
				29	Constellation characteristics of different tourists	10	virtual local pet
				30	local area special event or holiday calendar remind	11	earn money such as travel game

Table 3 shows the total of thirty divergent ideas that after convergent were reduced to eleven. The idea included normal, funny, and crazy. The normal ideas include chat, sharing pictures, 3rd part sharing, photo album creation etc. The funny ideas have self-travel map creation, picture show guide, fun stickers, traveling journal with pictures, constellation characteristics of different tourists, virtual tour guide with cartoon characters using voice for giving information related to a specific place, auto push etc. And the crazy ideas like virtual local pet or earning money travel game.

The final step in the workshop was to plan for action including solution finding and acceptance finding. Table 4 shows the solution of the main feature list of the travel guide application.

Table 4: Chartering stage with CPS planning for action stage

Travel Guide App For Mobile Device							
Chartering Stage							
	Vision	CPS Stage	Duration	No.	Divergent Ideas	No.	Convergent Ideas
extend crystal clear chartering process with creative problem solving	the travel guide app aim will provide for the needs of true and reliable, valid information and help the use enjoy them travel and create unforgettable memories.	Solution finding	60mins	1	chat, share picture,3rd part share,photo album creator	1	chat, share picture,3rd part share,photo album creator; self travel map create,map landmarking,picture show guide ,fun sticker,direction,traveler journal with picture,Constellation characteristics of different tourists; survival phrase, do and don't list, budget estimation, hotel, place, restaurant, road, recommendation, search directly, transport, hotel, food survival guide, local area special event or holiday calendar remind, list of major tourist attractions, GPS automatic push local information;
				2	self travel map create, map landmarking, picture show guide , fun sticker, direction, traveler journal with picture, Constellation characteristics of different tourists		
				3	translater, scan picture or words and translate automatically, local language help		
				4	survival phrase, do and don't list, budget estimation, hotel, place, restaurant, road, recommendation, search directly, transport, hotel, food survival guide, local area special event or holiday calendar remind, list of major tourist attractions	2	random place recommendation,Locals Specialties Recommendation, ex: about the weather what time is better for travel; made short clip movies including sound; 3d picture for attractions, food;
				5	random place recommendation,Locals Specialties Recommendation, ex: about the weather what time is better for travel		
				6	GPS automatic push local information	3	virtual tour guide like cartoon character, talking any information related with the place, auto push; virtual local pet; earn money such as travel game
				7	made short clip movies including sound		
				8	3d picture for attractions, food		
				9	virtual tour guide like cartoon character, talking any information related with the place, auto push		
				10	virtual local pet		
				11	earn money such as travel game		
		Acceptace finding		1	chat, share picture,3rd part share,photo album creator; self travel map create,map landmarking,picture show guide ,fun sticker,direction,traveler journal with picture,Constellation characteristics of different tourists; survival phrase, do and don't list, budget estimation, hotel, place, restaurant, road, recommendation, search directly, transport, hotel, food survival guide, local area special event or holiday calendar remind, list of major tourist attractions, GPS automatic push local information;		**Final Ideas for Development** chat, share picture,3rd part share,photo album creator; self travel map create, picture show guide ,fun sticker,traveler journal with picture,Constellation characteristics of different tourists; do and don't list, local area special event or holiday calendar remind, list of major tourist attractions, random place recommendation, virtual tour guide like cartoon character, virtual local pet; travel game
				2	random place recommendation,Locals Specialties Recommendation, ex: about the weather what time is better for travel; made short clip movies including sound; 3d picture for attractions, food;		
				3	virtual tour guide like cartoon character, talking any information related with the place, auto push; virtual local pet; earn money such as travel game		

4.3 Post Workshop Analysis

The workshop implemented Crystal Clear "chartering process" with CPS to generate more novel ideas that reflect the vision of the project (see Table 1 and Table 3). The extend process discovered new requirements (see Table 5) that can be attributed to the CPS process creativity. Due to the CPS employment a richer and more robust Agile chartering process was conducted that enhanced the development of the software product - the travel guide application.

Table 5: Result comparison between CC and CC/CPS

Comparison Table		
Criteria	**Crystal Clear no CPS**	**Crystal Clear with CPS**
Number of idea	20	30
Ideas selected	6	17
Time spent	60	60
Vison	gengeral vision	more detail vision
Ideas structure	simple list (sigle level)	structured list (multi level)

Table5 shows result comparison between Crystal Clear and Crystal Clear with CPS approaches. Crystal Clear with CPS resulted in 17 ideas being selected out of generated 30 and Crystal Clear alone produced only 6 from 20 generated (see Table 1).

The results of the workshop gave support to the fist proposition and rejected the second. The advantage of Crystal Clear with CPS was manifested by (1) more ideas generated selected (see Table 5), (2) better visions(see Table 1 and Table 2) and (3) better idea structure(see Table 3).

CONCLUSION AND FUTURE WORK

In this study CPS is applied to Crystal Clear design stage to develop mobile application requirements. The study results clearly show that by using CPS a development team can create more novel and useful ideas as well as have clearer vision and produce more

realistic requirements for the project. Overall, the Agile methodology has different types of methods that despite relating to Agile all have their unique characteristics. If the Agile engineering processes are to be widely applied, they need to be tied to business objectives and require more agility, rapider response, and better innovation.

The results of the study can also serve as recommendations for Agile practitioners such as managers, developers, designers etc. The study shows that the application of CPS to a creative stage within Cristal Clear can greatly improve the quality of the application design, that will require little or no change in the future Agile iterations, by generating most of the requirements in the beginning stage of the project. This will eventually save time, finances and shorten product's delivery time.

The future research can further examine the application of CPS within the other Agile related methodologies that are used by larger development teams for larger projects. The same approach can be also tried for the traditional Waterfall methodology in the Requirements Specification phase, Design phase or both. In general CPS can be used anywhere in the software development process where the need for extended creativity thinking is required.

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