

Systematic Process of Conceptualization For Enterprise Information System Renewal and Integration

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Abstract: We have had not yet practical method to define development concepts in spite of its importance for cost effectiveness of system development. In this paper, we propose a systematic process to define development concepts focused on renewal and integration of enterprise information systems. This process practices development concept definition as problem solving based on trouble shooting manner. So software engineers utilize their experiences and technologies of system development for the process effectively.

1 INTRODUCTION

Enterprise information systems (EIS) like Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Product Data Management (PDM), and project management are indispensable for business works today. Each enterprise uses EIS for business profit like productivity, cost reduction, quality assurance, and contribution of the amount sold every day. So owners can't help evolving their EIS continuously for change of their business environment and renovation of ICT in order to keep or enhance their business position profitably.

But it is not always easy to develop the EIS which satisfies owner's business expectation. Because EIS developers like SI (System Integration) vendors are not usually business experts. So it is not easy for them to understand correct business situation of EIS owners like their customers. And the customers are not always ICT experts. So it is not easy for them to understand real capacity of EIS based on the ICT which is changing and evolving continuously. Then mismatch between developers' business knowledge and customers' expectation might occur easily.

One of the roles of development concepts is to prevent from such mismatches. A development concept is a direction of expected system effects on starting development stage. It is based on developers' correct understanding of customers' business expectation and available ICT, and its suitable consensus between customers and developers will bring a cost effective EIS as

customers have expected, and reasonable amount sold for the EIS development effort of developers.

But in spite of such importance of development concepts, currently few experts define them in heuristic manners. And it is difficult to get not only manuals or tools but also reliable techniques or advices for development concept definition. This situation means there has been no development concept definition methods which can be used practically in real development field, yet.

In this paper we propose a systematic method to define development concepts for EIS renewal and integration. We call this method Systematic Process of Conceptualization (SPC) in this paper. Where, "systematic process" means project independent and well structured activity series to define development concept with understandable output forms, support tools, and some standards for efficient practice.

Trough remained section 2 to 6 we describe background and basic idea of SPC, detailed process of SPC, practical results of SPC project and evaluate SPC, a related research, and conclusion.

2 DEVELOPMENT CONCEPT DEFINITION METHOD

2.1 Background of SPC

There are two types of technical problem for development concept definition.

One is process problem to define development concept systematically, and another is transition

problem to transfer the defined concept to analysis and design phase of system development.

The Conceptualization method (Lockheed Martin ACC, 1996) described in section 5 has solved the transition problem, using context diagram as a part of a development concept. But this method depends on idea generation like brainstorming and breakthrough, so there are following subjects as process problem which SPC should resolve.

Subject 1: The definition process of development concept is not so concrete, so we should consider how to practice brainstorming and breakthrough depending on each project situation.

Subject 2: There are few support tools and manners to define development concept, so it is difficult for developers to get outputs which are logical and understandable for customers.

Subject 3: So it takes long time to define a development concept consented with customers.

2.2 Basic idea of SPC

Customers usually start EIS renewal and integration to resolve not technological problems like system usability but business problems like cost efficiency. So definition of development concept can be regarded as problem solving to get customers' business problems solutions based on EIS renewal and integration. On this standpoint we adopted troubleshooting (TS) approach which is familiar with experienced software engineers, as a problem solving manner of SPC.

Generally TS consists of 4 subtasks (Alma, 2000). The first formulate problem description subtask is to grasp trouble contents objectively based on related phenomena, the second generate causes is to generate causal hypotheses based on the trouble contents, and the third test is check the hypotheses based on experimentation. The last subtask, repair and evaluate is system repair based on resolution of the causes and check of the system to work correctly.

SPC consists of 3 phases to define development concepts as Fig.1 (IDEF0 form), and first 3 subtasks of TS are applied to these 3 phases.

The first grasping business domain phase corresponds to formulate problem description subtask of TS. In this phase developers grasp customers' business domain and understand customers' business problems and expectations. The second planning solution for current problems phase corresponds to generate causes subtask of TS. In this phase we extract a bottleneck which is the most important cause among current problems, and plan to solve it. The third verification and materialization phase corresponds to test subtask of TS. In this phase developers check whether the solution is a correct answer to resolve the bottleneck and its related main problems which prevent customers expect directly. And based on this check result, developers define a development concept for EIS renewal and integration.

These 3 phases are divided 7 processes (Fig.1), and they will be repeated at least twice to accelerate definition of suitable development concept.

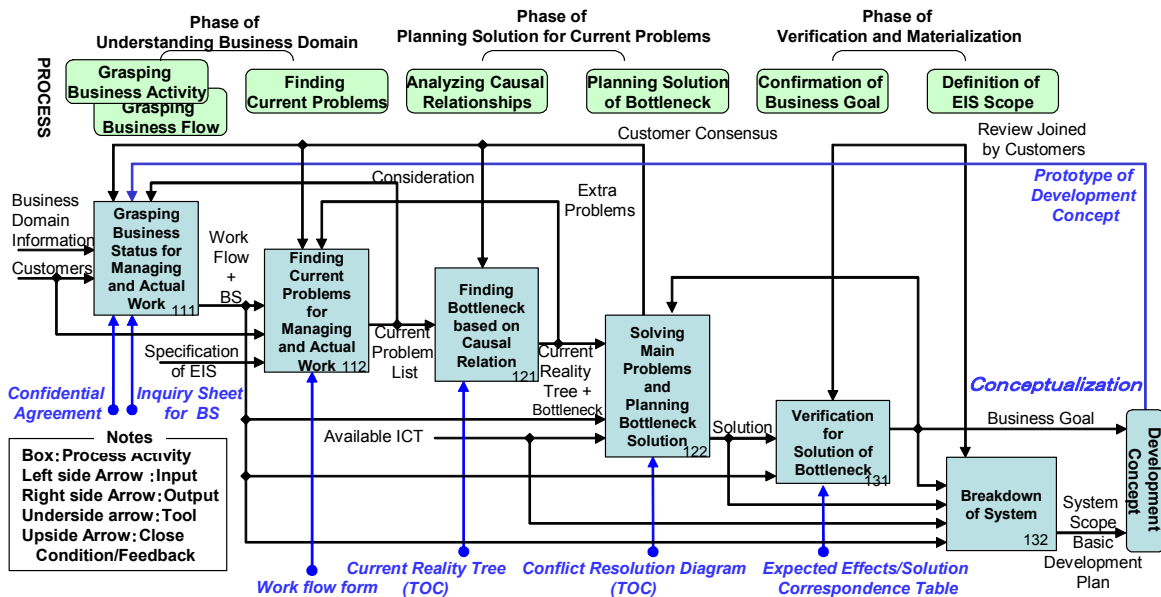


Figure 1: Construction of SPC process.

3 Definition of SPC process

The SPC is a kind of step wise refinement process as Fig.1, which outputs additional value (right side arrow) based on input information (left side arrow). Previous processes get feedback (upside arrow) from following processes, and the close condition of each process is consensus of customers or review joining customers (upside arrow). There are some tools (underside arrow) to support activities efficiently.

In this section we will describe detailed SPC processes, using partially a concrete case study, renewal of inventory system for sales and development of security devices.

3.1 Definition of Development Concept Prototype

In the initial start of SPC, developers define a prototype of development concept rapidly after first inquiry from customers. The prototype is based on early restricted information through SPC processes roughly. Purpose of this activity is to get a chance to hold a meeting with customers as soon as possible, discussing concrete items based on the prototype. This meeting is start line of next SPC repetition, which represents as a feedback arrow on Fig. 1.

3.2 Grasping Business Domain Phase

Customer's business expectation and current problems should be understood correctly for additional value of EIS renewal and integration. To understand them developers should grasp current

status of customers' business domain in both managing and actual work aspects.

This phase consists of 3 processes. The first process is for grasping customers' business activities generally, and the second process is for grasping customers' business work flow related current EIS. These 2 processes work concurrently. And the third process is for collecting customers' current problems.

1) Grasping Business Activity Process. In this process developers grasp information like customers' business domain, business role of EIS and customers business expectations for EIS renewal and integration. But customers' business information and related information is huge to grasp generally. So SPC provides Business Status (BS) which is a description form and an experimental guideline to collect minimum background information to understand customers' business situation. BS items include customers' business category, its trend, customers' business status or position, their business characteristics, EIS information, and customers' expectation. BS also prevents too much overhead to collect information. Moreover BS items are useful as a template of concrete questions to customers.

2) Grasping Business Flow Process. To grasp background of EIS renewal and integration necessity, developers need to understand current EIS as a system with business roles. So SPC provides tools for a business work flow to make clear business roles of EIS.

The tool is similar to sequence chart of UML, but it represents EIS and its actors as participants instead of objects, so users can grasp typical business

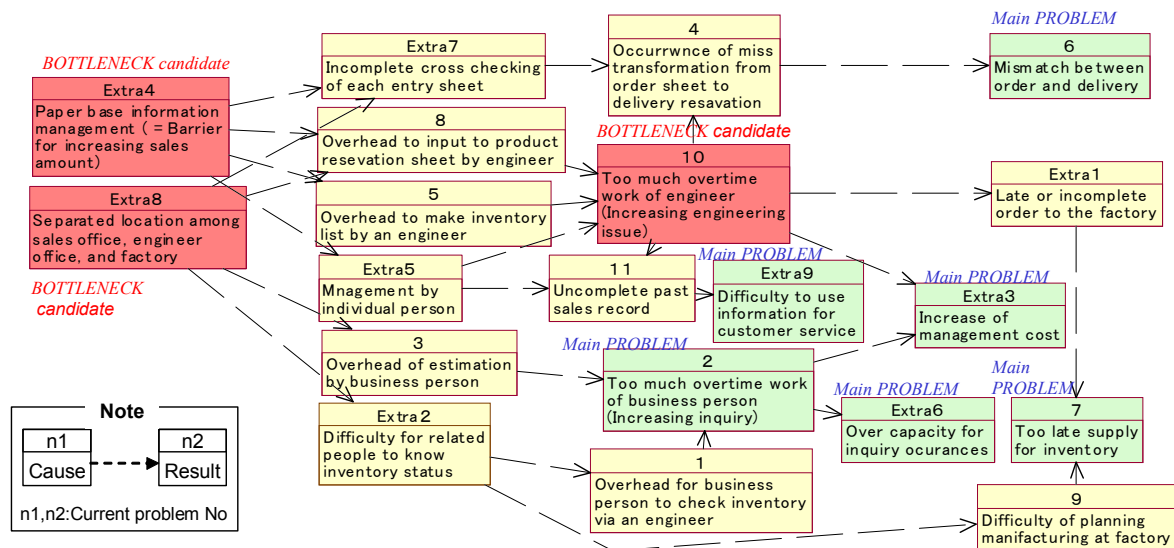


Figure 2: Current reality tree of security device inventory management.

information exchange among EIS and actors sequentially. Where, actors are both system users and outer systems.

3) Finding Current Problems Process. Collecting current problems are start points of consideration of development concept on SPC. Their main information sources are previous process activities, so the purpose of this process is to keep quality of collected problems, through considering them based on collected information, and providing feedback to previous processes if needed. Such consideration provides chances to find extra problems and brush up developers' understanding.

To make smooth progress of this consideration, a form named current problem list with consideration column is provided by SPC.

3.3 Planning Solution for Current Problems Phase

The first target of this section is to extract a bottleneck among current problems prepared on the previous phase. The bottleneck is a basic problem which causes various problems. The next target is to get a solution of the bottleneck. It is a concrete target to realize customer's business expectation.

SPC uses causal analysis for these targets, so SPC adopts TOC as support tools, because TOC includes various techniques based on causal relationships.

1) Analyzing Causal Relationships Process. SPC uses current reality tree of TOC as a support tool to extract bottlenecks candidates systematically based on causal relationships among current problems. Especially it analyses whole current problems impartially without prejudice, so it is useful to get totally optimised development concept.

SPC selects a bottleneck among the candidates as the most important target to resolve. The manner of its selection is to find a bottleneck which causes the most main problems on the current reality tree.

On our case study, renewal of inventory system, "Paper base information management" (Extra 4) is the bottleneck. This problem had been paid attention since the inquiry stage, so this analysis provides a backing to it. But it should be attended that related main problems have been made clear, and they will be resolved by solution of the bottleneck.

2) Planning Solution of Bottleneck Process. There may be many potential solutions for the bottleneck itself, effective solutions not only for the bottleneck but also for related main problems are not so many. And limited budget and development deadline are

severe constraints for the solution.

But conflicting solutions often appear, so SPC prepares conflict resolution diagram of TOC as a support tool to resolve such conflict. Through this tool, such conflict can be utilized to sophisticate the bottleneck solution.

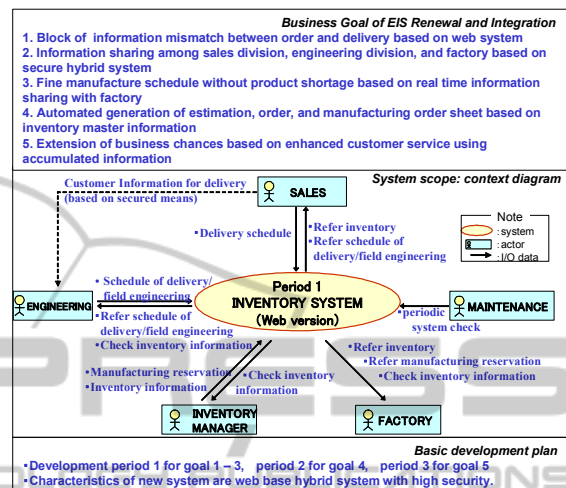


Figure 3: Image of development concept.

3.4 Verification and Materialization Phase

The first target of this section is to verify the bottleneck solution using a SPC tool. The next target is definition of development concept.

1) Confirmation of Business Goal Process. The first purpose of this process is confirmation not to occur communication gap between customers and developers during previous activities. The second purpose is definition of a business goal. SPC provides expected effects/solution correspondence table as a support tool for these purposes.

This table consists of 3 columns. The left column is for customers' business expectation described on BS, and center column is for resolved main problems by the bottleneck solution. If these 2 columns contents are not consistent, feedback to previous processes is needed. If consistent, business effects brought by resolution of the bottleneck and related main problems will be input on the right column. These effects are the business goal of EIS renewal and integration.

2) Definition of EIS Scope Process. Purpose of this process is to complete a development concept, making the scope of new system and basic development plan. Fig.3 is a development concept image of our case study.

SPC uses context diagram for the scope of EIS as the Conceptualization method uses. Representation of context diagram is based on information exchanging between actors and system, so it is easy for customers and developers to grasp outline of new EIS generally. Moreover it is easy for analyst and designer to understand system scope concretely as upstream information.

Based on this system scope and the bottleneck solution the basic development plan will be made for limited budget and development deadline, too.

Then the development concept has been completed. It consists of the business goal, system scope of new EIS, and basic development plan to realize the goal and the scope.

4 SPC RESULTS AND EVALUATION

We will introduce following 2 practical results of development concept definition based on SPC (Table 1 S1, S2), and evaluate SPC based on them.

4.1 SPC Results

1) CRM, Project Management integration. This case is CRM integration with project management functions (S1) in SI division (Nishioka, 2003). One of business expectations of this project is cost reduction of SI business by communication gap resolution between sales persons and engineers.

We collected about 60 problems on phase of grasping business domain. For example, sales persons had used CRM, and engineers had used project management tools, but there had been no ways to access the systems each other.

Through current reality tree analysis we extracted the bottleneck, lack of collaboration between sales persons and engineers. It caused main problems like difference of documentation systems between sales and engineering, and un-sharing information like customer status on CRM and development project status on project management tools.

So we proposed development of new EIS integrated CRM and project management as a bottleneck solution. This solution also included new product concept, so it would satisfy another business expectation about a new sales product of SI division.

This proposal was reviewed by division managers and directors individually, and agreed.

2) Inventory Management System Renewal. This

case is system replacement of inventory management (S2) as SI business.

Customers usually hesitate to explain business detail to outsiders, so it was useful to provide image of needed information for development concept definition through the concrete prototype, and discussion about the prototype with customers was useful to understand business situation of them.

Detailed information can't be open here because of confidential agreement with the customer, but in this discussion we had gotten concrete information like work flow, new original functions expected by customers, and recent business troubles.

Especially business troubles caused by current system are important, because trouble information, its frequency, and damage cost are important points to be cared for new system development. And one of the most effective factors to get the order was a part of the development concept not to repeat the troubles. This part can be evaluated quantitatively as cost effectiveness, and its effect was more practical than abstract effect like information sharing.

Table 1: Development concept definition cases.

Project	Developer	Product type	Development concept definition method	r C a o s t e t	Meeting frequency rate	
						ID
C1	CRM	Maker A ICT vendor	C/S SI	Conceptualization method	1	1
S1	Internal SI management	Maker A	C/S Internal dev.	SPC	0.6	-
S2	Inventory management	SI venture Maker B	Web SI	SPC	0.6	0.24 (0.4)

Note) Rectangle means regularized cost rate

4.2 Evaluation of SPC

Before SPC we had used the Conceptualization method. So C1 on Table 1 is a project applied the Conceptualization method, and S1, S2 are projects applied SPC. Cost rate means ratio of total development man month based on C1, for example, S1 rate is S1/C1, and C1 rate is C1/C1=1. Meeting frequency rate is ratio of meeting times to define development concept with customers comparing based on C1. Where, number in bracket is regularized by total development man month, so regularized rate of S2 is 40% (0.24/0.6).

The followings are evaluation of SPC based on Table 1 mainly.

- i. Project independency: In C1 project we should consider how to practice brainstorming and breakthrough, but in S1 or S2 project we could use SPC systematic process without worry how to practice the development concept definition.
- ii. Wide applicability: We could applied SPC to

various type of development concept definition like internal development of company (S1), SI for customers (S2), EIS integration (S1), EIS renewal (S2), client/server system development (S1), and web system development (S2) as Table 3 shows. These facts depend on benefit of systematic and usable definition process of SPC, which manner is based on problem solving like TS including cause analysis, and which activities are supported by various tools like TOC. So outputs of this process are logical and understandable for customers. Moreover experienced development engineers are familiar with TS manner, so they can apply the process without so much stress.

iii. High productivity: Regularized frequency of meeting for development concept definition of S2 is 40% of C1, so productivity or load of developers and customers is improved clearly. This fact depends on SPC benefit of quick start of information gathering based on prototype discussion with customers, guideline of minimum information to be gathered based on BS, causal relationships analysis and its support tools, and problem solving manner with concrete target like a bottleneck of current problems and customers expectations.

And SPC clears the transfer problem to use context diagram as the Conceptualization method.

But SPC is not a general method like it. SPC focuses on EIS renewal and integration, so SPC can't be applied to new EIS development based on new business concept. However, almost all SI projects are system renewal and integration or new system development for usual business, which SPC can be applied.

5 RELATED RESEARCH

We will describe the Conceptualization method as a research relating development concept definition.

The Conceptualization method is general method to discuss "Is this the right system to make?" based on business needs and available technology.

The Conceptualization method is means of idea generation to get development concepts through collecting target domain information, brainstorming based on it, and breakthrough based on them. Its characteristic is to define development concept as business goal and system scope written in a context diagram. Especially the context diagram is understandable intuitively, so it is useful for team communication and presentation to stakeholders.

ACC regards the Conceptualization method as

the top level technology of object oriented system development. Especially they regard this method to realize seamless transfer from development concept definition to analysis and design phase based on business goal and context diagram.

SPC succeeds context diagram representation from the Conceptualization method, but SPC focuses on EIS renewal and integration, and SPC regards development concept definition as problem solving based on systematic process and support tools instead of brainstorming and breakthrough.

6 CONCLUSIONS

In this paper, we proposed SPC as a systematic method to define development concept focused on EIS renewal and integration.

SPC practices development concept definition as problem solving for customers based on TS manner. Through SPC developers grasp customers' business domain, activities and situation, so they can understand customers' business problems and expectations correctly. And they extract a bottleneck among the problems based on causal relationship, get and sophisticate a bottleneck solution, and verify the solution. Then each output is summarized as a development concept consented by customers, which realize seamless transfer to analysis and design phase. SPC supports such whole activities by the 3 phases and 7 processes systematically with support tools like TOC.

Characteristic of SPC is to adopt TS as concrete problem solving manner to define development concept consistently. So each process output is logical and understandable. Especially experienced developers are familiar to TS, so it is easy for them to use their practical experiences for development concept definition based on TS manner.

Through practical results of projects applied SPC we confirmed merit of SPC, project independency of each process activity, wide applicability, and high productivity of development concept definition.

On the other hand current SPC tools are useful, but automatic supports like transformation process output to following processes are not enough, so current subject of SPC is to enhance tools for higher productivity.

We intend this subject to link the theme of software development integration which includes integrated design and programming environment (Nishioka, 1993).

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