Session23: **Modelling Methods for PSS Engineering**

A Guideline for the Product-Service-Systems Design Process

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> ### *A progress management tool which is not depend on particular development process are required*

Complexity in PSS design process

▶ A wide range of product lifecycle

　▸ Find appropriate combination of products and services by searching for opportunities throughout product life cycle

▶ Multiple Stakeholders in the design process

　▸ Cause stakeholders to flexibly change their development roles

▶ A Repeated Design Cycle

　▸ Evaluate the designed system and improve it to follow environment or customer requirement changes

　　– It is difficult to strictly divide development phase

Objective

Proposing a Guideline for PSS deign task management

Approach

- a. *Identify* the PSS design perspective and its design tasks
  - Literature reviewing
- b. *Organize* PSS design perspective and design tasks as useful format
 - Refer a software development guideline :SEMAT

SEMAT

SEMAT(Software Engineering Method And Theory) [Jacobson 12]

▶ A task management framework of software development

▶ They provide a card set that summarize software development tasks

Composition of each card

A) **Major factors**

▸ Perspectives of Software development

B) **States**

▸ Progress and health of development tasks

C) **Checklists**

▸ Standards of the state

D) **Phase of the states**

▸ Order of the tasks
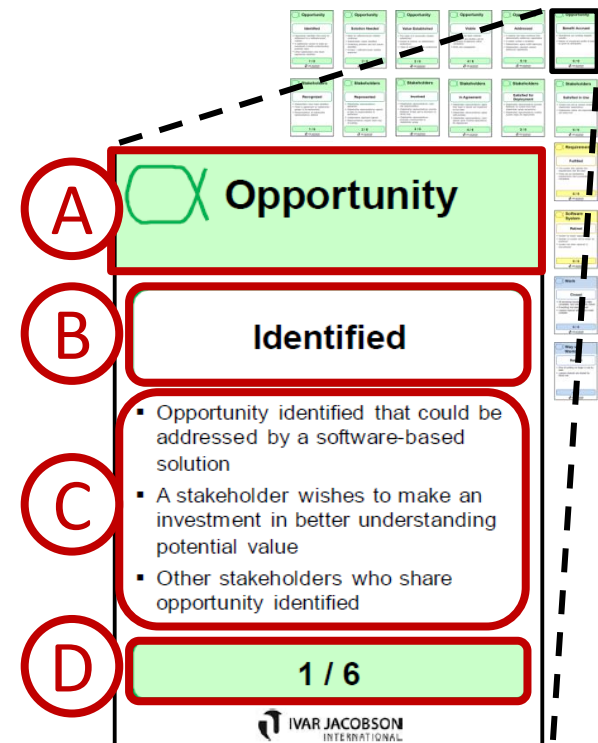
Research Methodology

▸ Develop PSS deign guideline following the SEMAT development process

  ▹ Contents (major factors, states and checklists) are original (Follow only the card format and how to use)
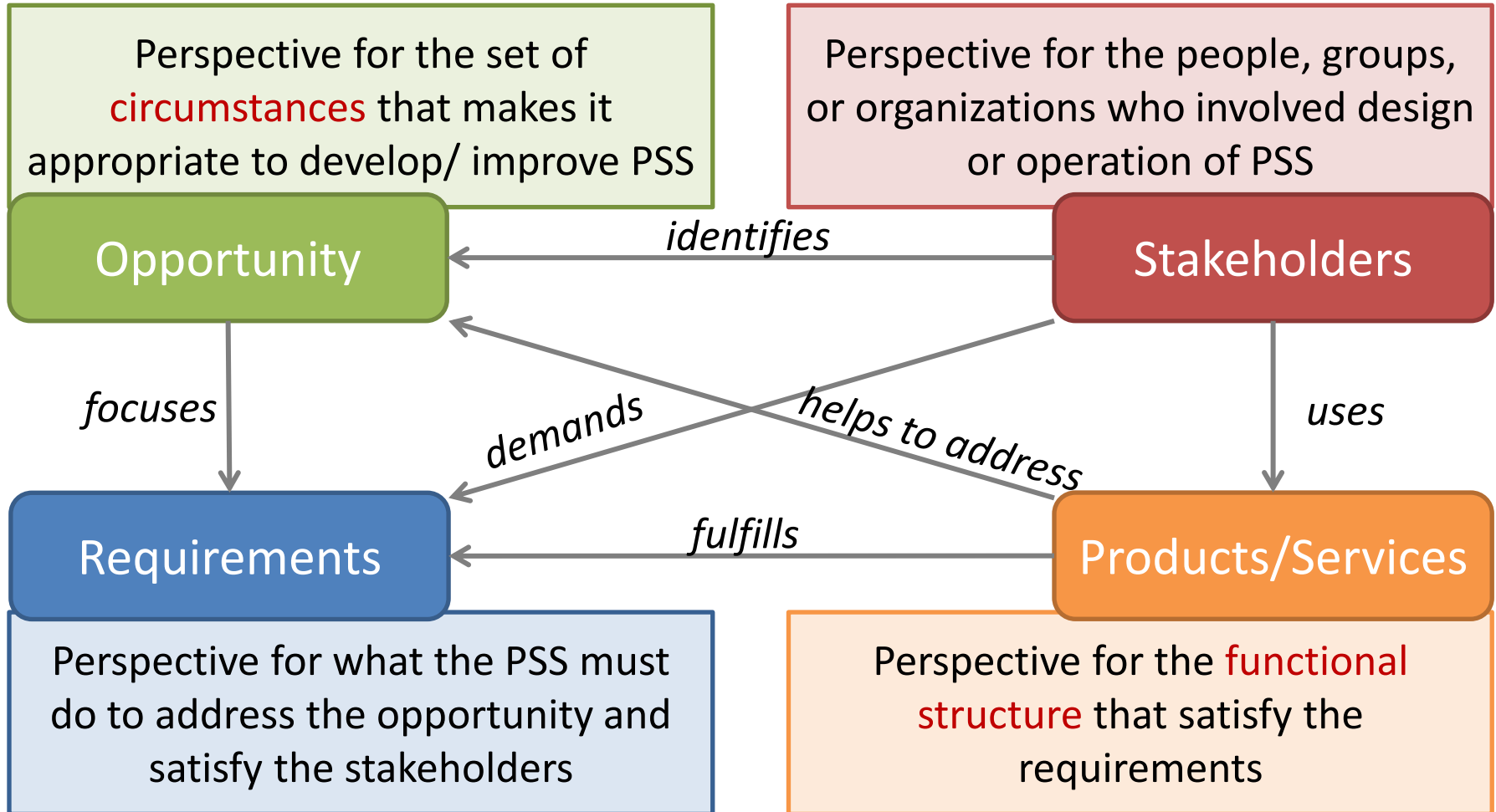
Development Process

① Reviewing PSS literatures

▸ Corrected 78 PSS literatures and extract keywords for PSS design

  ▹ Assemble PSS design practice and patterns

② Clarify the differences between software design and PSS design

▸ Compare the practice and patterns of SEMAT and PSS

  ▹ Identify Essential characteristics in PSS design

    – Expand major factors, states and checklist from original SEMAT

Overview of major factors

Perspective for the set of circumstances that makes it appropriate to develop/ improve PSS

Perspective for the people, groups, or organizations who involved design or operation of PSS

Opportunity

Stakeholders

identifies

focuses

demands

helps to address

uses

fulfills

Requirements

Products/Services

Perspective for what the PSS must do to address the opportunity and satisfy the stakeholders

Perspective for the functional structure that satisfy the requirements

Major factors   States   Checklists

Opportunity

①	Identified	④	Viable
②	Solution Needed	⑤	Addressed
③	Value Established	⑥	Benefit Accrued

Stakeholders

①	Recognized	④	In Agreement
②	Represented	⑤	Satisfied for Deployment
③	Involved	⑥	Satisfied in Use

Requirements

①	Conceived	④	Acceptable
②	Bounded	⑤	Addressed

Actor network Selected

- Criteria for selecting actors are agreed.
- Actors are identified.
- A plan for contracts are defined.

Design team leader **manages design progress by evaluating checklists of each states**

Products/Services

②	Demonstrable	⑤	Operational
③	Useable	⑥	Continuous Improvement

Proposal: A guideline for PSS Design Process (3/3)

Opportunity

Identified (1/6)
- Receiver's activities that can be supported by solutions of products and services have been identified
- Receivers have grasp the potential value and have wishes to invest
- Agents that share the supportable receiver's activities have been identified

Solution Needed (2/6)
- Needs for solutions of products and services have been promised
- Receiver's demand have been identified
- Potential problems and root causes have been found
- At least one solution of products and services have proposed

Value Established (3/6)
- Value-in-use have been defined when a solution succeeded
- Receivers have understand the secondary effects of solutions
- Receivers have understand the value in exchange of products and services

Viable (4/6)
- Main resource and process of products and services have been described
- Constraints when a solution was launched and deployed have been cleared
- Risks have been under control

Addressed (5/6)
- A demonstrated solution have been provided
- Effective systems have been available
- Receivers have agreed to the provide function
- Receivers have been satisfied the solution

Benefit Accrued (6/6)
- Obvious benefits in the operation has been created
- Predictable investment effects have been obtained.

Stakeholders

Recognized (1/6)
- Agents on Flow model (potential provider, receiver, relay agent) have been identified
- Representatives of all agent have been agreed
- Functions or scopes that each agent have been defined

Represented (2/6)
- A planner (mediator between agents) have been assigned
- A planner have agreed own functions or scopes
- How to collaborate between agents (how to realize the function) has been agreed
- Agents respect each effort

Involved (3/6)
- Agents have played their role
- Agents have respective feedback and involve decision-making
- Communications between agents have been well

In Agreement (4/6)
- Value for each agents have been defined and other agents have agreed it
- All agent have been agreed functions that will be realized with the priority
- All agent have been agreed minimum expected value

Satisfied for Deployment (5/6)
- Feedbacks have been provided to the entire system from each agent's point of view
- A ready to operate the system have been confirmed

Satisfied in Use (6/6)
- A system has been exceeded minimum expected value of agents
- Needs and expectations of the agents are satisfied

Requirements

Conceived (1/6)
- Requirements and functions of the system have been clear
- Users have been identified
- First capital investor have been identified

Bounded (2/6)
- The range of requirements and functions that should be implemented have been agreed
- The Criteria for succession (KPIs) have been clear
- The change management of requirements and functions have been agreed
- The non-functional requirements have been identified

Coherent (3/6)
- The overall picture of the PSS have been shared to the agents
- The critical usage scenario have been shared
- The priority of requirements and functions have been clear
- Collision of requirements and functions have been eliminated
- The effect of requirements and functions have been understand

Acceptable (4/6)
- Acceptable solutions for agents have been provided
- The agreed requirements and functions have had low probability to change
- Value have been clear

Addressed (5/6)
- A necessary and sufficient requirements and functions have been implemented
- Agents have agreed the system can be operated

Fulfilled (6/6)
- The system have satisfied the requirements and needs
- There have been no unsolved requirement to interfere with the completion

Products/Services

Actor network Selected (1/6)
- Criteria for selecting actors agreed.
- Actors identified.
- Plan for contracts defined.

Demonstrable (2/6)
- Features of actor network are verified by using simulations or reefing prior case.
- Stakeholders agree the adequacy of actor network.
- Important service encounter and process are verified.

Useable (3/6)
- been available and the required quality attributes have been achieved
- The user have been able to operate the products and services
- Functions and performance have been tested and demonstrated
- The defect level have been acceptable to receivers
- The contents of the products and services are well-known in each version

Ready (4/6)
- The products and services manual have been available
- Receivers have accepted the products and services
- Receivers have prepared the use of products and services

Operational (5/6)
- Products and services have been used in the receiver environment
- Products and services have been used by supposed operator
- There have been a use case that all functions of products and services have been operated
- The maintenance level of products and services has been agreed

Continuous Improvement (6/6)
- System for observing information about customers established.
- Team for continuous improvement organized
- Process for continuous improvement defined

How to use the proposed guideline

① Arrangement

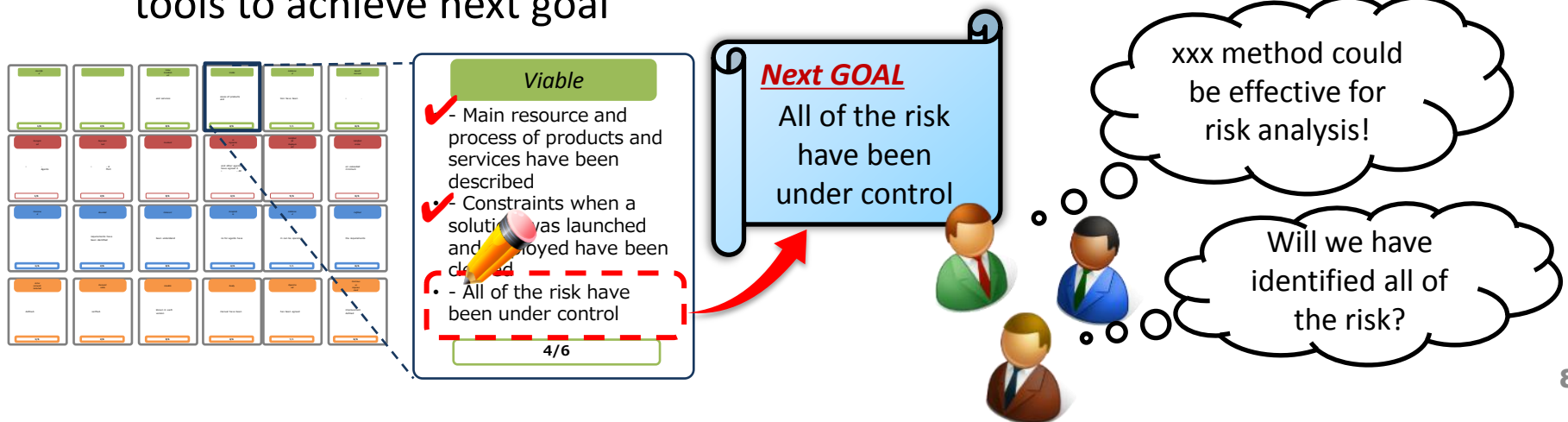▶ Arrange all the cards in order of state phase

② As-is Analysis

▶ Overview all the cards and evaluate checklist of each cards

③ Setting next goals

▶ Identify cards including unachieved checklist as next goal of the development team

④ Discussion

▶ Discuss about priority of the future tasks and selection of the supporting tools to achieve next goal

Application

Application case

▶ Developing support service of car-mounted basic software for automobile parts manufacture

  ▸ Provide data for persuading manager's decision making

  ▸ Provide support service for product line develop team

Service Receivers

Service Provider

Support service

Manager

Product line development team
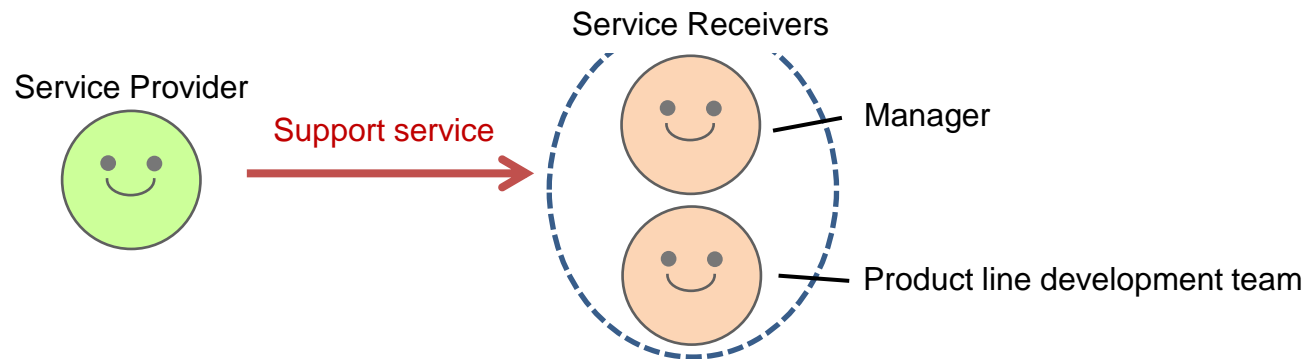
Purpose

▶ To verify proposed guideline can comprehensively organize tasks for example service

Procedure

1. Practitioner organize software development tasks in advance

2. Relate pre-organized development tasks sand tasks in proposed guideline

All actual business tasks are related to proposed guideline

	Before (Original tasks in SEMAT)	After (Applied to real biz tasks)
State	**Architecture Selected**	**Actor network selected**
Checklists#1	Criteria for selecting actors agreed	Criteria for selecting manager, product line development team and product development team agreed
Checklists#2	Actors are identified	Manager, product line development team and product development team identified

State	**Retired**	**Continuous Improvement**
Checklists#1	System for observing information about customers established	System for observing information about software users established
Checklists#2	Team for continuous improvement organized	Team for continuous improvement of software installation services organized
Checklists#3	Process for continuous improvement defined	Process for developing software installation services defined

Discussion

Effectiveness of the proposed method

▶ Proposed guideline could provide PSS designers perspectives for organizing actual business tasks

　▶ As an application, All the checklists of PSS design guideline could be associated with actual business tasks of car parts manufacturer

▶ Proposed guideline could also be used as a tool for identifying the PSS development barriers in advance

Remaining Issues

▶ Verify the checklists of the PSS guideline again by setting more concrete PSS design tasks

▶ Consider the PSS maturity level

　▶ Customize implemented tasks for individual companies

▶ Organize PSS subject (PSS designers) tasks

　▶ Proposed method regard PSS as design object and organize PSS design tasks

Summary and future work

Conclusion

▶ PSS design guideline for companies to realize PSS business are proposed

  ▸ Defined the PSS design perspectives that designers must consider to evaluate design progress and health

  ▸ Organized designer's tasks from each defined perspectives and provided the way to manage designer's tasks

Outlooks

▶ Apply the guideline to actual PSS business to verify effectiveness

▶ Develop task customize method for individual companies

▶ Organize other PSS designers tasks ex) organization, way of working

Thank you for your attention!

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