Selecting an E-Process using Case-Based Reasoning
(A hybrid method for E-Process selection)

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Introduction

What is:

- E-commerce
- eCIS
- Software Process - is a framework or reference model for the development of computer applications such as information systems.
- E-Process - is the software processes required for developing an eCIS.

Introduction

What is:

- MADM – Multi-criteria/attribute decision making
- SCM – Social Choice Methods
- CBR – Case Based Reasoning
- AHP – Analytic Hierarchy Process
- VBA – Value-Benefit Analysis

Introduction

Factors that impact on eCIS development:

- Wide variety of users
- Volatility of user group
- Unknown group
- High degree of interaction with other IS

Introduction

eCIS factors that impact on e-Process selection:

- Productivity,
- Quality, and
- Case specifics

Introduction

Efficiency of the eCIS development can be controlled by

- quantifying software process and
- addressing software quality features such as efficiency, maintainability, portability etc.

Introduction

E-Process selection must meet following characteristics:

- Light weighted - applied in smaller organizations and by staff without expertise of e-Process selection methodology;
- Support in building e-Process selection expertise;
- Use step-wise procedure that seems natural to staff; and
- Should be scalable with respect to the number of e-Process selection cases that staff have to deal with.

Fundamentals of e-Process selection method

- Guidelines and standards e.g. ISO 15504 for software process selection
- Software Process Improvement Capability Determination (SPICE), which is a "framework for the assessment of software processes".

Fundamentals of e-Process selection method

Candidate areas from which we are reusing method chunks are:

- Multi-attribute decision-making (MADM),
- Social choice methods (SCM), and
- Case-based reasoning (CBR).

Case-Based Reasoning (CBR)

- Use previous experiences
- Look for similar situations
- Store, retrieve, organise previous cases in a Case Base
- Develop similarity measure

CBR rests on the assumptions that

- *very similar problems uses very similar solutions;*
- *problems tend to recur if one does not change significantly ones life or living conditions.*

CBR

- Each case has case content consisting of:
  - a problem,
  - a solution, and
  - an outcome

Normal CBR steps (4R's)

- Retrieve a number of most similar cases;
- Reuse the cases to attempt to solve the problem;
- Revise the proposed solution if necessary;
- Retain the new solution as a part of a new case.

Our implementation of CBR

First decide on possible e-Process – retrieve similar cases – if similar enough – use the solution.

If no solution found then apply CBR

Our implementation of SCM part

Use Borda rule to find relevant features for pre-selection. (margin *m(P , P')* is the number of times *P* is preferred over *P'* in pair-wise comparisons minus the number of times *P'* is preferred over *P*)

SCM is applied - e-Processes are ranked pair-wise by each of the involved staff (e.g. dedicated experts, project leaders, developers).

Knowledge Base (Case base)

- Different methods available to store previous cases
- Identification of the "real world" problem
- Representation the key components
- Develop the inference mechanism with
  - knowledge base with the cases of solved problems
  - mechanism to retrieve and adapt cases

Knowledge containers (Richter)

- Vocabulary used;
- Similarity measure;
- Case-base;
- Solution transformation.

Specific Aspects of our Selection Method

- Similarity measure
- Case-base

Similarity measure

$$Sim(Q,C) = \sum_{f \in F} w_f * \sigma_f(q_f, c_f).$$

- *wf* - constituent feature weight,
- *σf* - the similarity measure applied to feature *f* of Q and C
- *f* - the set of all features.

Similarity measure

Three types of similarity measures:

- exact similarity measure, i.e., the similarity score is 1 if = or 0 if not=;
- difference based similarity measure; and
- complex similarities, i.e., all other similarity measures.

Case-base

- A case base has been developed using AHP and VBA
- Different levels used for comparison
- Case-base information consists of:
  - eCIS specification
  - High-level quality aspects
  - Lower-level quality aspects
  - Weights assigned to aspects
  - Choices made

Case-Base High-Level Quality Aspects

- e-Process charactistics
- Quality aspects of e-Process
- Costs for using e-Process
- Domian impact
- Usability
- Compatibility
- Maturity

Case-Base
Example Low Level quality aspects

- Quality concepts of the e-Process:
  - *Readability*, i.e. the degree to which the notation prescribed for use in the e-Process is easy to read.
  - *Reliability*, i.e. the degree to which the e-Process is designed in such a way that errors in the development process are avoided or identified and fixed prior to system deployment.
  - *Robustness*, i.e. the degree to which the e-Process continues to aid developers in case of unexpected events occurring.

Concise presentation of method

- Use SCM to select an e-Process. (Verify by inspecting latest cases for which that selection was applied.)
- If the selection can be verified, then use this one. Otherwise:
  - Use SCM to identify the feature set to be used.
  - Rank the features (according to whether no preference, light preference, moderate preference, strong preference, or extreme preference is given to one feature over another one) in a pair-wise fashion and use the AHP to obtain feature weights.
  - Score the case at hand with respect to the features selected.
  - Use CBR to identify the case most similar to the case at hand and use the e-Process used in that case.
- Store in the case-base the new case together with the solution as well as a brief solution assessment (obtained post project completion).

Concise presentation of method

The example problem

- Applied at a packaging company developing new eCIS
- Current IT people – 5
- Experience in development - 3
- Web site development – 1
- Two old cases –
  - Case 1 used storyboarding and user profiling
  - Case 2 used RUP

Concise presentation of method
The example problem

Top Level Aspect Quality	Weight of quality	Example Problem 1	Case Base Example	Similarity Value Case 1	Case Base Example	Similarity Value Case 2
	A	B	C	A × |B-C|	D	A × |B-D|
e-Process aspects	0.20	0,300	0,100	0,040	0,143	0.031
Quality concepts	0.22	0,048	0,148	0,022	0,213	0,036
Cost	0.3	0,150	0,250	0,030	0,251	0,030
Domain impact	0.1	0,143	0,040	0,010	0,204	0,006
Usability	0.04	0,238	0,338	0.004	0,123	0,005
Compatibility	0.05	0,048	0,050	0.000	0,022	0,001
Maturity	0.09	0,073	0,074	0,000	0,062	0,001
				0,106		0,110

Concise presentation of method

- Used only 2 cases instead of whole case base to determine 4 top contenders
- Now apply to lower level aspects for 2 cases

Concise presentation of method
The example problem

Quality Aspect	Weig ht of quality aspect	Example pro blem	Case Base exa mple 1	Simila rity value (Case 1)	Case Base exa mple 2	Simila rity value (Case 2)
Completeness	1	0,60	0,12	0,48	0,20	0,40
Understandability	1	0,17	0,50	0,33	0,17	0,00
Visibility	1	0,58	0,12	0,46	0,19	0,39
Supportability	1	0,60	0,12	0,48	0,20	0,40
Maintainability	1	0,19	0,19	0,00	0,56	0,37
Readability	1	0,54	0,18	0,36	0,18	0,36
Reliability	1	0,19	0,19	0,00	0,56	0,37
Robustness	1	0,19	0,56	0,37	0,19	0,00
Development Budget	1	0,13	0,38	0,25	0,38	0,25
Run ning Costs	1	0,13	0,38	0,25	0,13	0,00
Infrastructure	1	0,40	0,13	0,27	0,40	0,00
Enterprise Culture	1	0,50	0,17	0,33	0,17	0,33
Technology	1	0,54	0,18	0,36	0,18	0,36
Geographic Intera ction	1	0,10	0,50	0,40	0,30	0,20
IT Strategy	1	0,58	0,12	0,46	0,19	0,3 9
Business Strategy	1	0,54	0,18	0,36	0,18	0,36
Team Experience	1	0,40	0,13	0,33	0,40	0,00
Domain Know ledge	1	0,54	0,18	0,36	0,18	0,36
E-Process know ledge	1	0,19	0,03	0,16	0,58	0,39
Development Time	1	0,60	0,12	0,48	0,20	0,40
Functionality	1	0,60	0,12	0,48	0,20	0,40
Manageability	1	0,60	0,12	0,48	0,20	0,40
Quality assurance	1	0,55	0,18	0,37	0,18	0,38
Adjustability	1	0,60	0,12	0,48	0,20	0,40
Exchangeability	1	0,38	0,13	0,25	0,13	0,25
Map ability	1	0,10	0,30	0,20	0,30	0,20
Stability	1	0,54	0,11	0,4 3	0,18	0,36
Tool support	1	0,17	0,50	0,33	0,17	0,00
Documentation	1	0,40	0,14	0,26	0,40	0,00
				9,77		7,72

Concise presentation of method
Decision and conclusions

CASE 1 WINS

Conclusions and future work

- A decision model has been proposed to select development processes for eCIS
- Software tool needs to be improved
- Further research into other models e.g. AHP and using Weightings
- Case base needs to be expanded to include more examples