Experience of Adopting MLM engine for Drug-Drug Interaction

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Introduction

- Background
  - Efforts for nationwide dissemination of standard CDSS in Korea
  - We developed a prototype MLM engine, MLMPlusX
  - Problems in dissemination of MLM engine
    - Widespread questions about
      - possibility of successful operation
      - Safety
      - Usefulness
- Purpose
  - Develop, apply, and evaluate an Arden Syntax based MLM engine for practical use to prevent medical errors
- Refined our previously developed MLM engine
- Applied and validated the MLM engine
  - Adopted to a development server of Seoul National University Bundang Hospital (SNUBH), for drug-drug interaction (DDI) domain

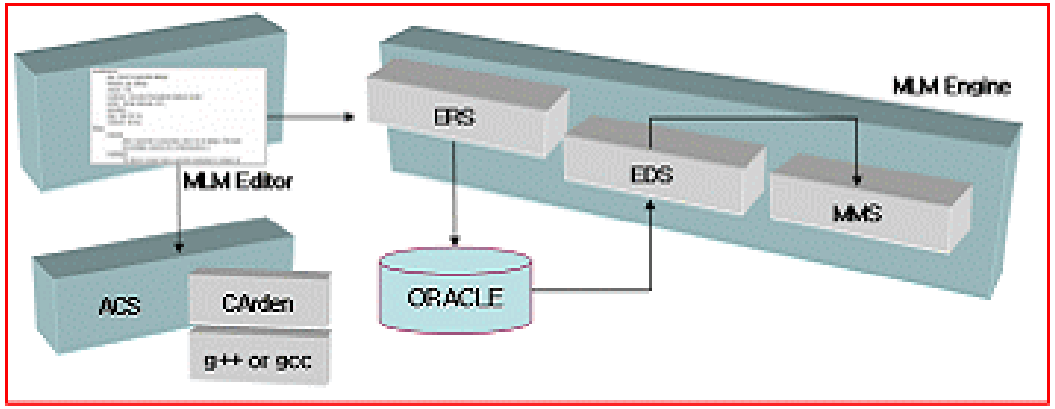
Preparation phase

- Focused on giving trust to the adopting institution and on understanding each other's system
- Tried to sufficiently communicate each other during nine months
  - Communication between MLM engine developers and system engineer group in SNUBH, ezCaretech Co. LTd.
  - Communication channel : temporal meetings, messengers, phone, and email
- Derived requirements
- Improved MLM engine design
- Decided to adopt our MLM engine to a development server in SNUBH

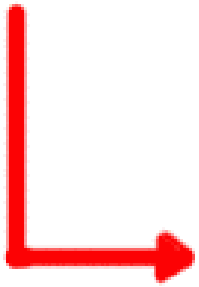
Refinement of MLMPlusX

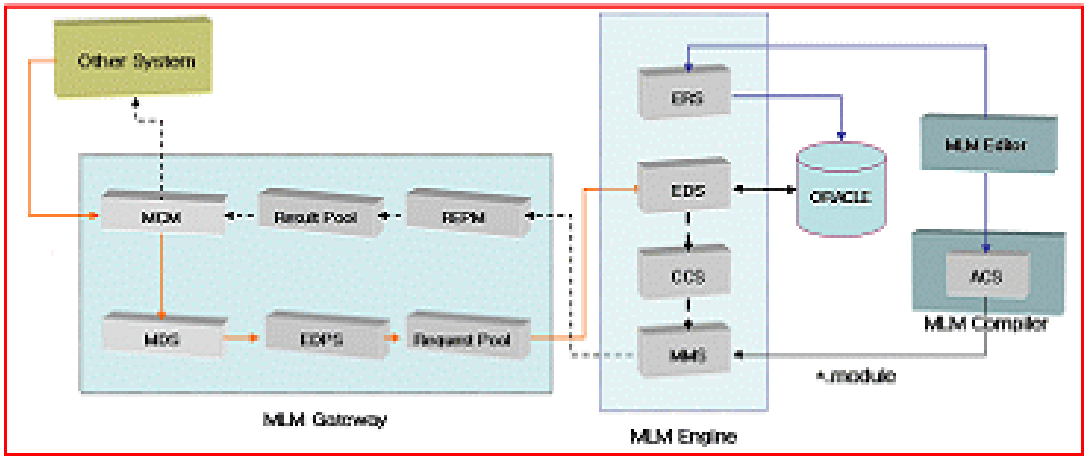
- MLMPlusX
  - Our previous version of MLM engine
  - Core running environment for the Arden Syntax based decision supports
- Refined the MLMPlusX for practical use in HIS environment
- Improved interface to other systems it interacts
- Separated engine components independently
- Improved performance, accuracy, and reliability
- Simplified MLM system configuration setting work
- Added a MLMGateway
  - A middleware that handles HIS events between HIS and MLM engine
  - Added to minimize modification cost on the existing HIS application processes
- Changed event detection method

MLMPlusX and Refined MLM Engine



MLMPlusX





Refined MLM engine

Integration

- Integrated our improved MLM engine to development server in SNUBH
  - It was fast and simple work
  - Two person did it in three days
- Built DDI knowledge base
  - Converted 930 DDI rules used in SNUBH into 930 Arden Syntax MLMs

Evaluation

- Evaluated our MLM engine to validate possibility in practical use
- Method
  - Compared our engine with locally developed DDI system in SNUBH (local CDSS)
  - Metrics
    - Performance
    - Knowledge building and management cost
    - Integration and migration
    - Usability
- Evaluation environment
  - Zeon dual core 3.0GHz CPU, 4G memory, 80G SATA HDD

Evaluation Results : Performance

Input order	Avg. response time in MLM engine (ms/order)	Avg. response time in local CDSS (ms/order)
order -1	1.343	0.300
order -2	1.546	0.169
order -3	1.703	0.076
order -4	1.847	0.109
order -5	2.507	0.044
order -6	2.847	0.046
order -7	2.660	0.205
order -8	2.689	0.046

Evaluation Results : Knowledge Building and Management Cost

Measurement	Result	Evaluation
Knowledge building cost in MLM engine : time spent in building 980 DDI rules	1601 ms	low

Measurement		Result	Evaluation
Cost for Knowledge modification	MLM Engine	Directly modify the Arden Syntax by a domain expert Or, automatically converts to modified MLM if a domain expert enters modified information through DDI editing tool	low
	Local CDSS	A domain expert enters modified information through DDI editing tool	low
Cost for adding a new pattern MLM to knowledge base	MLM Engine	A domain expert directly writes a new MLM Or, an informatician writes a new MLM informed by a domain expert	low
	Local CDSS	A developer should program a new knowledge informed by a domain expert	**high**

Evaluation Results : Integration and Migration, Usability

- Integration and migration results

Measurement	Result
Time spent in integrating MLM engine to a development server of SNUBH	3 days
Number of persons participated in MLM engine integration work	2 persons
Modification list generated in MLM engine integration process	Only values of variables in a configuration file

- Usability results

Measurement	Result
Number of modifications in user interface when adopted MLM engine	0
Modification list in user interface when adopted MLM engine	none
Possibility of user interface improvements when adopted MLM engine	possible

Discussion and Conclusion

- Refined MLMPlusX for practical use
- Established the work process of integration process
- Applied the MLM engine to SNUBH development server of SNUBH
  - Built Arden Syntax knowledge base for DDI rules used in SNUBH
- Validated our system by comparing with DDI system used in SNUBH
- The evaluation showed promising results
  - Though performance was lower than local CDSS, it can be solved by modifying MLM engine design
  - Knowledge management cost was expected to be lower
  - There was no reduction in usability
  - The integration work was simple and fast
- Future work
  - Adoption of our system in real-time HIS

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