Path simulation in BPMN workflow using resource aggregation

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PLAN

1- Research context
2- Material and methods
3- Pathway of performance aggregation
4- Pathway of displaying results
5- Pathway of the general methodology
<table>
<thead>
<tr>
<th>1- Research context</th>
<th>Organisation’s goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process automation (with workflows)</td>
<td>Bridge the gap between business requirements and technology</td>
</tr>
</tbody>
</table>

GOAL IS
1- Research context

Summary of the state of the art

Requirements gathering  Modeling  Simulation  Implementation

Researchers focused on control flow and data flow and less attention has been devoted to the resources used

Contribution to a methodology for process automation based on resource analysis
2- Material and methods

MDE: Model Driven Engineering

- MODEL DRIVEN ENGINEERING (MDE):
  - Software engineering methodology where models are the core asset
  - To describe smoothly ideas and business needs from a high level of abstraction to the concrete solution.

Models + Transformations = Software

"Design once, build it on any platform"
### Material and methods

**Model Driven Service Engineering Architecture (MDSEA)**

- **MDSEA** is a model driven engineering methodology that includes resources in the early steps of modelisation.

**Physical means:** resources are the tangible goods used in a process to carry out its activities.

**Human resources:** individuals who work to fulfill their tasks according to their role within a process.

**IT resources:** all hardware, software and infrastructure used to accomplish the work required in a process.
2- Material and methods

Business Process Management Notation (BPMN)

BPMN is the **de-facto** standard for process modeling for many reasons:

- Common understanding by all users
- A standardized notation
- Model portability
- Maintained by OMG
2- Material and methods

eBPMN simulation language

- eBPMN language aims to:
  - Allow **non-functional simulation** through **process resources** by using **text annotation**
  - Take into consideration **composite resource**
  - Merge modelling and simulation at the same step using a model-driven method **to automatically build executable simulation code from BPMN**
  - Guaranty the compatibility of the model by **not modifying the BPMN metamodel** and implementing eBPMN according to the **BPMN execution semantics**
<table>
<thead>
<tr>
<th>PROPOSITION</th>
<th>eBPMN enhancement</th>
</tr>
</thead>
</table>

- Enhancing eBPMN language by:
  - Distinguishing resources type
  - Aggregating resource performance
  - Providing the simulation results of each path instead of each task only
3- Pathway of performance aggregation

Aggregation of resource performance

**LEVEL 0**
Model operational detail of a process

**LEVEL 1**
Break down each task into an atomic subtask

**LEVEL 2**
Aggregate resource performance

---

**Model operational detail of a process**

**Break down each task into an atomic subtask**

**Aggregate resource performance**

---

**Pathway of performance aggregation**

1. **LEVEL 0**
   - OR
   - R1
   - R2
   - R3

2. **LEVEL 1**
   - AND
   - R1
   - R2
   - R3

3. **LEVEL 2**
   - SEQ
   - R1
   - R2
   - R3

---

**Configuration**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Time</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEQUENTIAL</td>
<td>$\sum_{i=1}^{r} T_i$</td>
<td>$\prod_{i=1}^{r} R_i$</td>
</tr>
<tr>
<td>AND</td>
<td>Max($T_1, \ldots, T_i$)</td>
<td>$\prod_{i=1}^{r} R_i$</td>
</tr>
<tr>
<td>OR</td>
<td>Max($T_1, \ldots, T_i$)</td>
<td>Min($R_1, \ldots, R_i$)</td>
</tr>
</tbody>
</table>
3- Pathway of performance aggregation

Model operational detail of a process

Break down each task into an atomic subtask

Aggregate resource performance

Aggregation of resource performance

LEVEL 0

LEVEL 1

Task 1

Task 2

LEVEL 2

Pathway of performance aggregation
3- Pathway of performance aggregation

<table>
<thead>
<tr>
<th>LEVEL 0</th>
<th>LEVEL 1</th>
<th>LEVEL 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model operational detail of a process</td>
<td>Break down each task into an atomic subtask</td>
<td>Aggregate resource performance</td>
</tr>
</tbody>
</table>

Pathway of performance aggregation:

- **LEVEL 0**: Model operational detail of a process
- **LEVEL 1**: Break down each task into an atomic subtask
- **LEVEL 2**: Aggregate resource performance

Diagram:

```
Task 1 ≡ R1 → R2 → R3 → Task 2 ≡ R1 & R2
```

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3- Pathway of performance aggregation

Model operational detail of a process

Break down each task into an atomic subtask

Aggregation of resource performance

LEVEL 0

LEVEL 1

LEVEL 2

Pathway of performance aggregation

Aggregation of resource performance

Model operational detail of a process

Break down each task into an atomic subtask

Aggregate resource performance

Task 1

R1 → R2 → R3 → \sum_{i=1}^{d} D_i → Task 2

\sum_{i=1}^{d} D_i → Task 2

Max(D1, ..., D_i)
4- Pathway of displaying results

Options of displaying simulation’s result

LEVEL 0

Global Results Using Resource Aggregation

LEVEL 1

Global results including the type of each resource

LEVEL 2

Detailed results (for each task or each resource)
5- Pathway of the general methodology

Process automation methodology based on resources
LEVEL 0 – Requirements gathering

• Clarify functional requirements
• Clarify non-functional requirements
• Identify resource needs
• Distinguish resource’s type
• Identify the performance characteristics of each resource
LEVEL 1 – High Level Model using BPMN

- Model in a more formal way the process to be automated

- Distinguish resources using only the different types of tasks of BPMN (user task, manual task service task, etc.)
LEVEL 2 – Operational Model using BPMN

- Model functional operation of the process without implementation details using BPMN
- Model resources of each task using eBPMN
- Assign to each task its resources
LEVEL 2 – Operational Model using BPMN

- Defining atomic resources
- Defining composite resources
- Assign the composite resource to the task
LEVEL 2 – Operational F Model using BPMN

Choose the paths to investigate by using the user choice or probability method.
LEVEL 2 – Operational F Model using BPMN

- Choose the paths to investigate by using the user choice or probability method
5- Pathway of the general methodology

LEVEL 3 – F Model simulation using eBPMN

- Carry paths verification to make sure they are reachable and compliant with functional requirements

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PATH REACHABILITY

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1. Start ==> AssessStore ==> FillTemplateFile ==> FillEvaluationRequest ==> SaveDataEvaluation ==> ValidateRequestMethods ==> SaveDataMethods ==> RequestQualityValidation ==> SaveDataQuality ==> CheckLegalConditions ==> SaveDataALegal ==> AssessLegalConditions ==> SaveDataARLegal ==> ValidateRequestEvaluation ==> SaveDataMFranchise ==> NotifyEvaluatorAndOperators ==> End

2. Start ==> AssessStore ==> FillTemplateFile ==> FillEvaluationRequest ==> SaveDataEvaluation ==> ValidateRequestMethods ==> SaveDataMethods ==> RequestQualityValidation ==> 

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LEVEL 4 – Operational NF Model using eBPMN

- adding in details of the non-functional requirements of each type of resource

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LEVEL 4 – Operational NF Model using eBPMN

**Pathway of the general methodology**

**INTRODUCTION**

**MODEL**

**DRIVEN**

**APPROACH**

**PROCESS**

**SIMULATION**

**CONCLUSION**

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**FUNCTIONAL AND NON-FUNCTIONAL BPMN M&S AT DESIGN TIME**

**Ougaabal** and al. | WETICE’18

**FUNCTIONAL AND NON-FUNCTIONAL BPMN M&S AT DESIGN TIME**

**Ougaabal** and al. | NICST’19

**DISTINGUISHING RESOURCE TYPE IN BPMN WORKFLOWS AT SIMULATION PHASE**
Global Simulation Result

<table>
<thead>
<tr>
<th>Start Event 1</th>
<th>Assess Store</th>
<th>Fill Excel Template</th>
<th>Fill Evaluation Request</th>
<th>Save Data Evaluation</th>
<th>Validate Request Methods</th>
<th>Save Data Methods</th>
<th>Validate Request Quality</th>
<th>Save Data Quality</th>
<th>Check Legal Conditions</th>
<th>Save Data Legal</th>
<th>Assess Legal Conditions</th>
<th>Save Data Legal</th>
<th>Validate Request Evaluation</th>
<th>Save DataR Legal</th>
<th>Franchise</th>
<th>Notify Evaluator and operators</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Service Time</td>
<td>................</td>
<td>8780.753 min</td>
<td>Mean Waiting Time</td>
<td>................</td>
<td>5639.485 min</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Global simulation result of each type of resource

```
PATH STATISTICS: RESOURCE TYPE DETAILS

LEVEL 4 – Operational NF Model using eBPMN

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### Path

Start Event I-->Assess Store-->Fill Excel Template-->Fill Evaluation Request-->Save Data Evaluation-->Validate Request Methods-->Save Data Methods-->Validate Request Quality-->Save Data Quality-->Assess Legal Conditions-->Save Data R Legal-->Validate Request Evaluation-->Save Data R Franchise-->Notify Evaulater end operators-->End

Mean Service Time: 8000.168 min
Mean Waiting Time: 5700.690 min

### Resources Path

Type Resources:

- **Human Resources:**
  - Mean Service Time: 7900.133 min
  - Mean Waiting Time: 4000.226 min

- **IT Resources:**
  - Mean Service Time: 8000.35 min
  - Mean Waiting Time: 5700.690 min
```

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5- Pathway of the general methodology
Detail simulation result

```plaintext
### Element name: InterfaceLegalOpinion

Resource Type: Interface
Final state: Active (with probability 1.0000)
Mean of service time: 1830.000 min
Mean of waiting time: 600.000 min
```

LEVEL 5 - Implementation

• Describe in more detail how the implementation of a system uses a particular type of resource

• Decide on the precautions to be taken in order to increase the reliability of the process as much as possible
Conclusion

- Proposing a process automation methodology based on resource analysis
  1. Distinguishing resource’s type
  2. Aggregation resource’s performance
  3. Display path simulation results

Works limitation

- Using text annotation for non-functional properties
- Non-functional requirements are limited to service time and reliability
- Finding a way to establish the relation between the non-functional properties