ChangeRefinery
Assisted Refinement of High-Level IT Change Requests

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July 21st, 2009
Outline

Problem statement: IT Change Planning

Proposed solution

Conclusion and possible extensions
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ITIL Core

Continual Service Improvement

Change Management

Service Transition

Service Strategy

Service Design

Service Operation
ITIL Change Management

1. Create RFC
2. Change proposal (optional)
3. Record the RFC
4. Initiate requested
5. Review RFC
6. Change Management ready for evaluation
7. Assess and evaluate change
8. Change Authority ready for decision
9. Authorize Change
10. Change Management authorized
11. Plan updates
12. Change Management scheduled
13. Co-ordinate change implementation*
14. Change Management implemented
15. Evaluation report
16. Review and close change record
17. Closed
18. Update change and configuration information in CMS
Information Sources in Change Management

Policies: "Always backup before changing configurations!"

CMDB: J2EE application depends on DB server.

SLA: "Downtime may not exceed 1h!"

Operator: "To install a J2EE application, I need a Linux Server, JBoss/Geronimo and MySQL."

Business guy: "The website is slow!"
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Automated planning on a single slide

"Planning is the reasoning side of acting."
(Automated Planning: Ghallab, Nau, Traverso)

Ingredients:
- **States** describe static configurations of the planning world
- **Actions** define transitions between states

Planning problems:
- **Input**: Initial state of the world, desired goal state
- **Output**: Configuration of actions that links initial with goal state
State-based vs. Hierarchical Task Network (HTN) Planning

State-based planning

Initial state

Goal state

HTN planning

Goal task

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Partially ordered sets imply workflows

- In original HTN formalism, plans are sequentially ordered
- Formalism can be extended, such that plans are partially ordered sets, hence workflows
- Specification of decomposition templates allows to define parallel or sequential decomposition
Framework architecture

CMDB → Asset Mgm. → Service Mgm. → IT knowledge base

assert() rollback() query()

IT knowledge base → Change planner

PC() Temporal reasoner

isValid() Policy engine

Addf() Change catalogue → Policy repository

Change design UI
Change plan refinement example

1. SpeedUpWebApplication
   - InstallLoadBalancer
   - SetupServer
   - InstallJ2eeContainerSoftware
   - InstallJ2eeApplication
   - AddContainerToLoadbalancer

2. InstallJ2eeServer
   - InstallLoadBalancer
   - InstallJ2eeApplication
   - AddContainerToLoadbalancer
Temporal structure of change plans

- **SetupServer**: Time 10
- **InstallJ2eeContainerSoftware**: Time 10
- **InstallJ2eeApplication**: Time 10
- **AddContainerToLoadBalancer**: Time 5
- **InstallLoadBalancer**: Time 10

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HTN planning with policy-based pruning

HTN algorithm sketch

- Recursive depth-first search on the space of possible task network decompositions and variable bindings
- Backtracking from dead ends in case of ...
  1. no method or operator is defined for a task, or
  2. no valid variable bindings can be found
- Problem: Exponential time and space complexity

Policy-based pruning

Pruning means to forecast and avoid dead ends. We identify two classes of policies that restrict the HTN search space:

1. Constraints on allowed states of the IT infrastructure (CMDB)
2. Constraints on allowed structures of change plans
Policy-based pruning #1: Allowed infrastructure states

Policy: Only Oracle databases may be installed on Windows 2000 machines.

Diagram:

1. SetupDatabase
2. Windows2000Server
3. InstallDatabase

Allowed databases:
- Max DB
- Oracle
- MySQL
- MS SQL
Policy-based pruning #2: Allowed plan structures

Policy: Always backup databases before changing their configuration.
Policy-based pruning #2: Allowed plan structures

Policy: Always backup databases before changing their configuration.

- ✓ Backup ConfigureDatabase
- ✗ ConfigureDatabase Backup
- ✓ Backup T2 T3 DB
Policy-based pruning #3: Temporal policies

Policy (SLA): Change implementation may take only 50 minutes.
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Summary: Features and change planning assistance

The following features of our approach facilitate change plan design:

- **Information management components**
  - Configuration Management Database (CMDB): Hardware & Software entities, personnel, etc.
  - Change catalogue: Change recipes, best-practice knowledge
  - Policy repository: Policies and constraints on admissible changes & change activities

- **High-level specification of change (goal) tasks in RFCs**

- **Scale-invariant refinement of change plans from abstract through to low-level operational tasks**

- **Planning semantics ensure consistent assignment of configuration items to change actions**

- **Quantitative and qualitative temporal constraints as well as policies on infrastructure and plan structures are enforced and speed up the planning algorithm**
Possible extensions

- Dependency resolution: The ChangeLedge approach to change planning
- Advanced decision support through change plan metrics
- Advanced decision support through pre-compiled HTN planning trees
- Richer temporal information
- Hybrid state-space and HTN planning
- Managing multiple and concurrent changes
- Semantic web technology based knowledge base component
End.