Contracts in the Swedish Crisis Management System

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Presentation

- Swedish Crisis Management System
- Examples of Contracts and Operations
- Challenges, Problems and Approach
- Contracts for Controlling Business Processes in Dynamic Environments (Björn Bjurling, Pablo Giambiagi 2008)
  - Contract Language
  - High Level Petri Nets as a model for contracts
  - Interpretation of contracts
Project

- Contracts for shared limited resources in crises
- Swedish Emergency Management Agency
  - 2007 to 2009
- Collaboration with Swedish Agencies
- SICS: Applied research in Computer Science
  - Applying rights management to civil security area
Swedish Crisis Management System

• Crisis:
  – Unexpected, requires immediate action
  – Affects many citizens and fundamental societal functions
  – Extreme Stress on Resources
  – Threatens fundamental values
  – E.g. Natural disasters, Invasion, Accidents, Pandemics

• Crises can be Local, Regional, or National
  – or International
Swedish Crisis Management System

• Areas of coordination
  – Transport, Toxics, Protection & Rescue, ...

• Responsible agencies
  – E.g., Protection and Rescue
    • National Police Board
    • Aviation Authorities
    • Coast Guard
    • Rescue Services
    • Customs
    • National Medical Board
Swedish Crisis Management System

- Decentralized Crisis Management
  - Government appoints agencies,
  - Which in turn appoint resource and service providers
- The responsibility for the critical services are distributed among independent actors
  - Resources and capabilities
  - Planning
- Swedish crisis management relies to a great extent on independently made agreements
- Can this go wrong?
  - Yes, sometimes:
    - Lack of resource sharing agreements (e.g. the storm Gudrun 2005)
    - Delay in activating a resource (Tsunami 2004)
    - Difficulty in interpretation of contracts (Gothenburg 1995)
Challenges

• Trend towards outsourcing and collaboration
• Resource usage management
  – resource modelling
  – usage modelling
• Dynamic gearing-up of a crisis
  – mandate issues
  – Bridging the gap between central planning and service execution
  – Flexible organisations
    • orchestrations and choreographies
• Analysis of sets of contracts
Problem Formulation

• How can we know that a set of independent agreements form an adequate crisis management capability?
  – Can required resources be activated (supply, mandate, know-how)?
  – Can conflicts arise among resource users?
  – Is there a need for appointing more resources or capabilities?

• How extend access rights to usage rights for controlling crisis engagements?
Approach

• **Main assumptions**: a set of agreements implicitly encodes a workflow representation of the Swedish crisis management. The workflow can be controlled through contracts.

• **Approach**: we want to make that workflow explicit by
  – Formalizing the contracts used in crisis management
  – Translating the contracts into a workflow formalism, (we have used High Level Petri Nets)
  – Using HLPN techniques to analyse the workflow model

• **Question**: does a given set of contracts yield an adequate crisis management capability?
Contracts (what to capture)

• Subjects are appointed to provide a resource or a capability for the completion of a service. Subject to
  – Time constraints
  – Resource usage constraints

• A subject has a given capacity w.r.t resources or capabilities
  – abstract measures for simplicity
Contract Language

• Sorted first order fragment, with subjects, services, resources, capabilities, time points, and measures as constant symbols.

• Function symbols:
  – begin, end (svc -> time)
  – appointed (svc X rcs -> subject)
  – requires, returns (svc X rcs -> measure)
  – capacity (subject X rcs -> measure)

• operators and binary relations on the real and the natural numbers.
Contract examples

- s.appointed(c) = a
- s.requires(c) = 10, s.returns(c) = 10
- s.requires(r) = 4, r.returns(r) = 0
- s.begin > s’.end
- s.end < t1.

- A contract is a set of contract formulas, where exactly one is an appointment formula.
- A crisis management plan is the union of a set of contracts.
Formalization

\[ s.\text{appointed}(c) = a \]
\[ s.\text{requires}(c) = 10, \]
\[ s.\text{returns}(c) = 10 \]
\[ s.\text{begin} > s'.\text{end} \]
\[ s.\text{end} < t1. \]

\[ s.\text{appointed}(r) = b \]
\[ s.\text{requires}(r) = 4 \]
\[ r.\text{returns}(r) = 0 \]
Example

- \( A.\text{capacity}(r) = 10 \)
- \( C_1 = \{ s_1.\text{app}(r) = A, s_1.\text{req}(r) = 5, s_1.\text{ret}(r) = 5 \} \)
- \( C_2 = \{ s_2.\text{app}(r) = A, s_2.\text{req}(r) = 7, s_2.\text{ret}(r) = 0, H \} \)
- where \( H \) is a contract formula
  - \( H = s_1.\text{end} < s_2.\text{begin} \) (OK for \( A \))
  - \( H = s_2.\text{end} < s_1.\text{begin} \) (not OK for \( A \))
  - \( H \) is neither of the two above. (potentially not OK for \( A \), since \( s_1 \) and \( s_2 \) may run in parallel)
Conclusion and Future Work

• Applied research in a real and active application domain
• Seems to be an interesting area for contracts research
• Main Problem: does a set of agreements about appointments, resources, and capabilities form an adequate crisis management capability
  – formalizing the problem in terms of contracts
  – extracting workflows from sets of agreements
• Future Work:
  – Field studies with Swedish agencies
  – Extending the language (and the semantics)