Social Specifications of Business Processes with Azzurra

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Business Processes Modeling and Execution

- Business processes (BPs) define how an organization conducts its business
 - Remark: not just within the organization (inter-organizational BPs)
- **BP modeling** is concerned with the representation of BPs
 - Typically, as a set of interrelated activities
- Some BP modeling notations (e.g., BPEL) natively support BP execution
 - Which activities are to be performed and by whom
 - Workflow engines enable BP execution

Activity-Centric BP Modelling

 The mainstream approach: a BP is <u>modeled</u> in terms of activities and control flow



- BP execution: a workflow engine assigns activities to performers
 - Performers have **no freedom** on the activities to execute
 - The execution **strictly** follows the defined control-flow

Declarative BP Modeling



- + **More flexibility** (precedence constraints, no control flow)
- + Possibility to create custom links based on temporal logic
- Still defined in terms of activities

BPs Are Interaction-Centric

- However, a BP is a multi-party interaction among participants
 - The sequencing of activities is a consequence of the data flow
 - Participants are interested in **fulfilling their commitments...**
 - ...but want to retain **freedom** on how they fulfill these commitments
- Neither activity-centric nor declarative BP modeling focuses on interaction



BPs Are Interaction-Centric

- Example: take the commitments of doctor Sarah in a hospital
 - C₁ (to the head clinician): "make the daily round"
 - C₂ (to the nurse Mara): "prescribe medication to patient Tom"
 - C₃ (to the secretary): "fill in weekly report before 4PM"
- As long as she fulfills C₁, C₂, and C₃, she can act freely!



Commitments are the baseline for our proposal: the Azzurra Language

Azzurra Modeling Language: Key Concepts

- Agent: John, Sally, Sarah, Mara
- **Role**: Orthopedist, Radiologist, Nurse, Laboratory
- Commitment: promise with contractual validity from a <u>debtor</u> to a <u>creditor</u> that, if an <u>antecedent</u> is brought about, a <u>consequent</u> will be brought about
 - Antecedent and consequent are **state of affairs**

C(Orthopedist, Radiologist, XRayRequested, XRayExecuted)

- Sets of commitments are organized in protocols
 - Roughly, one protocol corresponds to one business process

Azzurra Graphical Syntax



Basic Syntax, by Example

Protocol parameters: agents that are bound when the protocol is instantiated

protocol Treatment (**key** hospnr, pt : Patient, sp : Specialist) { **ag-variables:** rc : RehabCentre, ra : Radiologist, or : Orthopedist, su : Surgeon, nu : Nurse;

commitments:

init \rightarrow C₁ : C(sp, pt, \top , Examined \cdot Diagnosed \cdot Dehospd) final NoXRayNeeded \rightarrow C₂ : C(or, sp, \top , SlingMade) XRayRequested \rightarrow C₃ : C(ra, sp, \top , XRayPerformed)

As soon as the protocol is instantiated As the LHS occurs, the commitment in the RHS shall be created

Advanced Syntax: Commitment Refinements

- These primitives refine an <u>individual commitment</u>
- **Deadline:** a commitment shall be fulfilled within a timeout
- Authorizations
 - **Delegation** of a commitment to another agent (by the debtor)
 - Assignment of a commitment to another agent (by the creditor)
 - **Cancellation** of a commitment (by the debtor)

Advanced Syntax: Constraints & More

Cardinality constraints per role

- Max number of concurrent commitment instances
- Max number of concurrent commitment instances of a given commitment class
 - e.g. the doctor cannot commit to visit more than 3 patients
- Separation of duties
 - Two commitments shall have different debtors
- Compensation
 - If the commitment is violated, another shall be brought about
 - e.g., if the doctor damages a patient's leg, he will have to refund him

Executing (Enacting) a Protocol

• A protocol enactment is a sequence of exchanged messages!



Enactment 1: XRays are not needed, a sling is made!

An Alternative Enactment



Enactment 2: XRays are needed, however, just a sling is made!

Runtime Compliance

Algorithm 1: Protocol Enactment

- Interprets a set of events
- Creates protocols instances and the commitments therein or
- Updates the state of the existent protocols and commitment instances

Algorithm 2: Commitment Compliance Checking

- Checks whether an occurred event (from a particular protocol instance) violates some constraints within its protocol specification
 - E.g., deadlines for commitment creation and satisfaction, delegations, assignment and cancellation constraints, cardinality constraints per role, separation of duties constraints

Modeling Tool and Algorithms Implementation

Modeling Tool

• Eclipse application, built on top of GEF (Graphical Editing Framework and XText frameworks



Protocol View (textual)

Social View (graphical)

Compliance Algorithms

• Prototype Java Tool that uses Drools Rule Engine

Azzurra Evaluation on Scenarios

Scenarios from Medical Domain

- Fracture Treatment Scenario
- Transient Ischemic Attack (TIA) Clinical Guideline (CG) Scenario
- Comparison between Azzurra and BPMN in the representation of the TIA CG Scenario in terms of
 - Flexibility
 - Expressiveness
 - Compliance checking

Outcomes of Azzurra Evaluation on TIA CG Scenario

Flexibility: no ordering constraints requirements in the domain

- **BPMN:** the existence of ordering constraints in BPMN imposes the need of exhaustive specification of all possible sequences (paths)

+ **Azzurra:** only requires the specification of criteria for commitment satisfaction (all possible paths that satisfy are implicitly specified)

Expressiveness

- Specifying obligations and prohibitions
 - BPMN: only allows the specification of obligations
 - + Azzurra: allows the specification of both obligations and prohibitions

Outcomes of Azzurra Evaluation on TIA CG Scenario

Expressiveness

• Specifying conflicting activities

- **BPMN:** activities are modeled as unrelated activities (external rules must be defined)

+ **Azzurra:** conflicting activities can be modeled as mutual exclusive states of affairs

Compliance checking

- **BPMN:** compliance is defined in terms of the execution of activities

+ Azzurra: compliance is defined in terms of commitment fulfillment (through different alternative activities)

Conclusions

- Activity-centric BP modeling and execution is too inflexible
- BPs are situated social activities (see Cooperative work)
 - Thus, interaction among parties is first-class
- Our language is centered around the notion of commitments and protocols
 - The agents are free to act, as long as they comply with their commitments
 - **Decoupling** between an **agent's** construction and execution and the process (**protocol**) specification and enactment

Future Work

Language Definition

- Improve graphical notation
- Investigate the joint usage of Azzurra specifications and operational business process models (e.g. BPMN, business artifacts)
- Introduce the representation of enterprise goals together with commitments
- Runtime framework: develop an enactment engine that support remedies to non-compliance
- **Further evaluation**: Conduct empirical evaluation of Azzurra with industrial cases studies

Thank you!

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Questions?

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