

A Framework for Integrating Business Processes and Business Requirements

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astro Outline



- motivation
- business requirements modelling
- from business requirements to business processes
- analysis support
- conclusions and future work

- New challenges
 - IT growth and internet development remove bounds on the **enterprises and customers collaborations**
 - Organization operates in **heterogeneous, competing** and **changing** environment
 - **Autonomy** and **flexibility** of partners participating in cross-enterprise business processes

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- Business Process Management in a broader sense
 - **universal interoperability** between applications
 - resolution of conflicts and changes in **business strategies**
 - **reduce costs** of integration and adaptation
 - *(CSC) Success in understanding and managing business processes can mean the difference between keeping and loosing your company*

astro Service-oriented Architecture

SOA and Web services infrastructure create an environment for interconnecting organisations and applications

- **SOA pros:**

- enables definition of **coarse-grained loosely-coupled** services
- supplies **interoperable** solution to application integration
- facilitates the **integration of applications** across enterprise boundaries
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- **SOA cons:**

- decentralized society of autonomous and changing actors
 - no control over partners services and processes
 - changes are autonomous, frequent, unpredictable

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- **SOA cons:**

- decentralized society of autonomous and changing actors
- lack of support for “strategic” descriptions of business models
 - different participants act on behalf of their own strategies and requirements
 - their requirements and expectations are often in conflict
 - changes in strategies should be aligned with the business process models

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- **SOA cons:**

- decentralized society of autonomous and changing actors
- lack of support for “strategic” descriptions of business models
- lack of analysis techniques supporting negotiation in collaborations and their modifications
 - correctness of the process composition
 - analysis of processes with respect to specific behavioral properties

astro Proposed Framework

- **Requirements modelling language**
 - to incarnate motivations and intentions behind a business process models
 - to represent “negotiation” aspects of collaboration
- **Integration of business requirements and business processes**
 - to visualise the implication of business strategies changes in the underlying processes and their compositions
- **Formal analysis techniques**
 - to increase the reliability of the models
 - to support the resolution of conflicts during the negotiation
 - to verify the conformance of the business processes with respect to the strategic descriptions

astro Language for Business Requirements

Basing on Tropos language (from Greek *trope*: easily adaptable).

- **Tropos** is **requirements-driven**:
 - focus on early phases of requirements analysis, aiming to the understanding of the operational environment of the software system.

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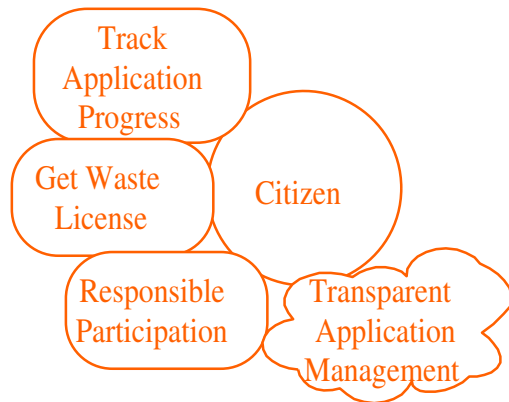
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- **Tropos** offers a set of **graphical notations** and of analysis techniques to support the designer in the development of the software system.
- **Formal Tropos** extends Tropos with a **formal specification** language and with **verification** based on Model Checking.

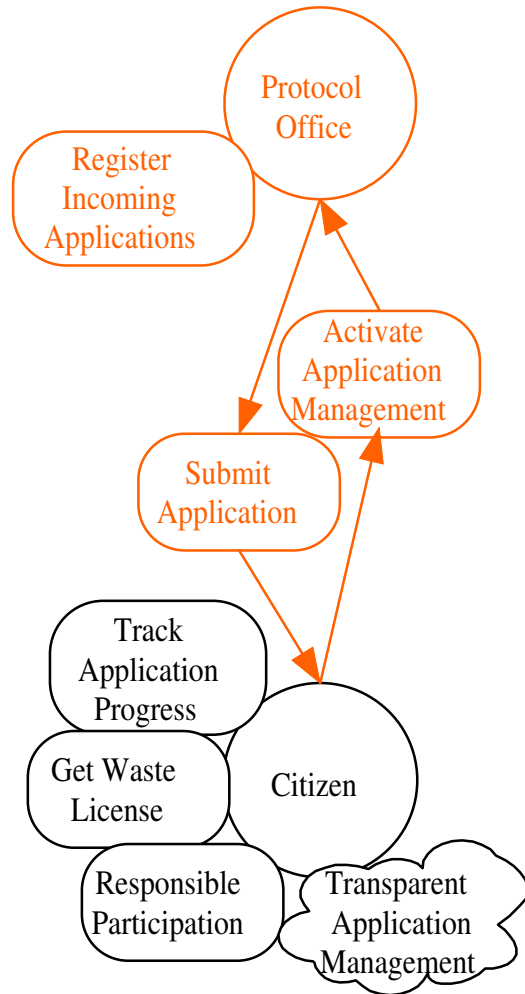
astro Case Study

- General domain: **Public Administration**
- Specific domain: **Environmental Protection Agency**
 - *Authorization for the establishment and operation of a waste disposal or recycling plant.*
 - A **citizen** (factory) submits an application to obtain the **license** for its waste disposal or recycling plant (incinerator, recycling facility, private landfill, . . .).
 - The **local government**, involving various agencies and experts, evaluates the proposal and authorizes the plant if it complies with high standards of environmental protection (norms and laws).
- Involves **many heterogeneous, distributed and autonomous actors**
- Takes into account **global requirements** for the composition and (probably conflicting) **local requirements** of different actors

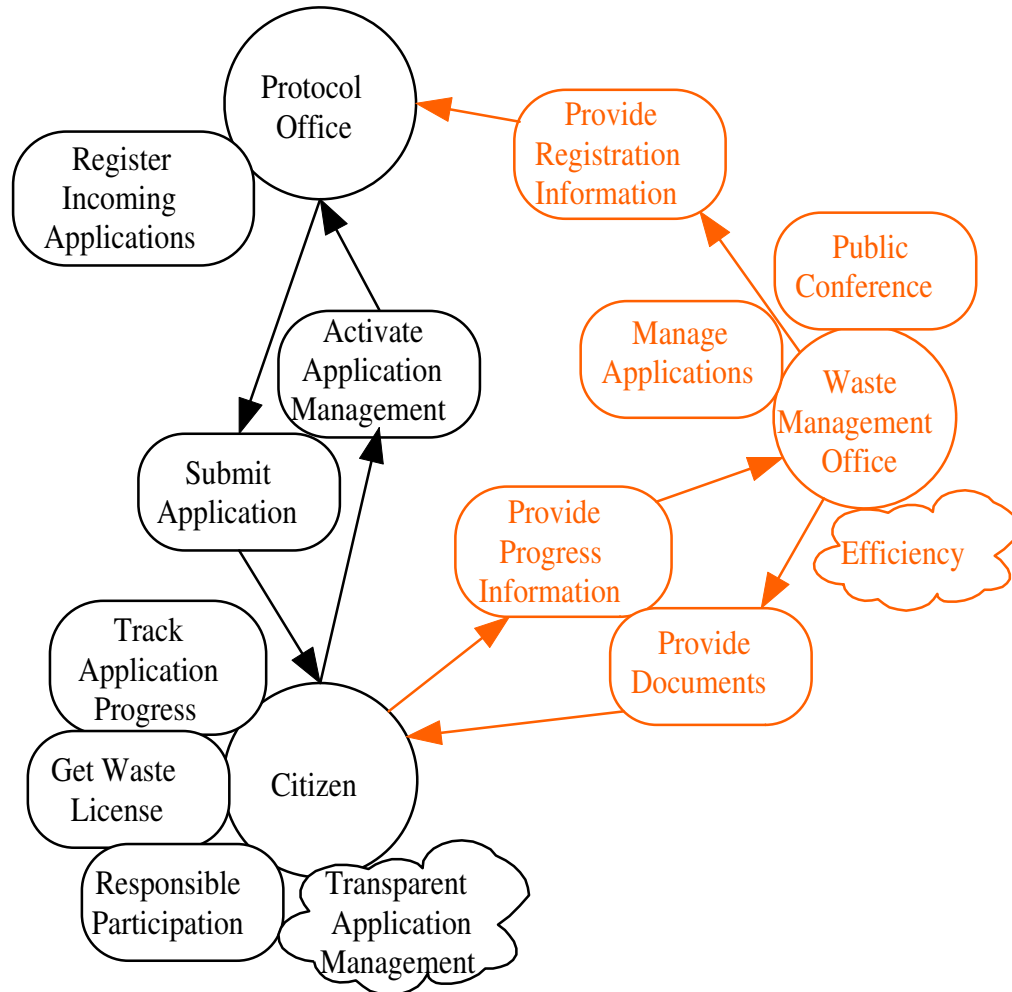
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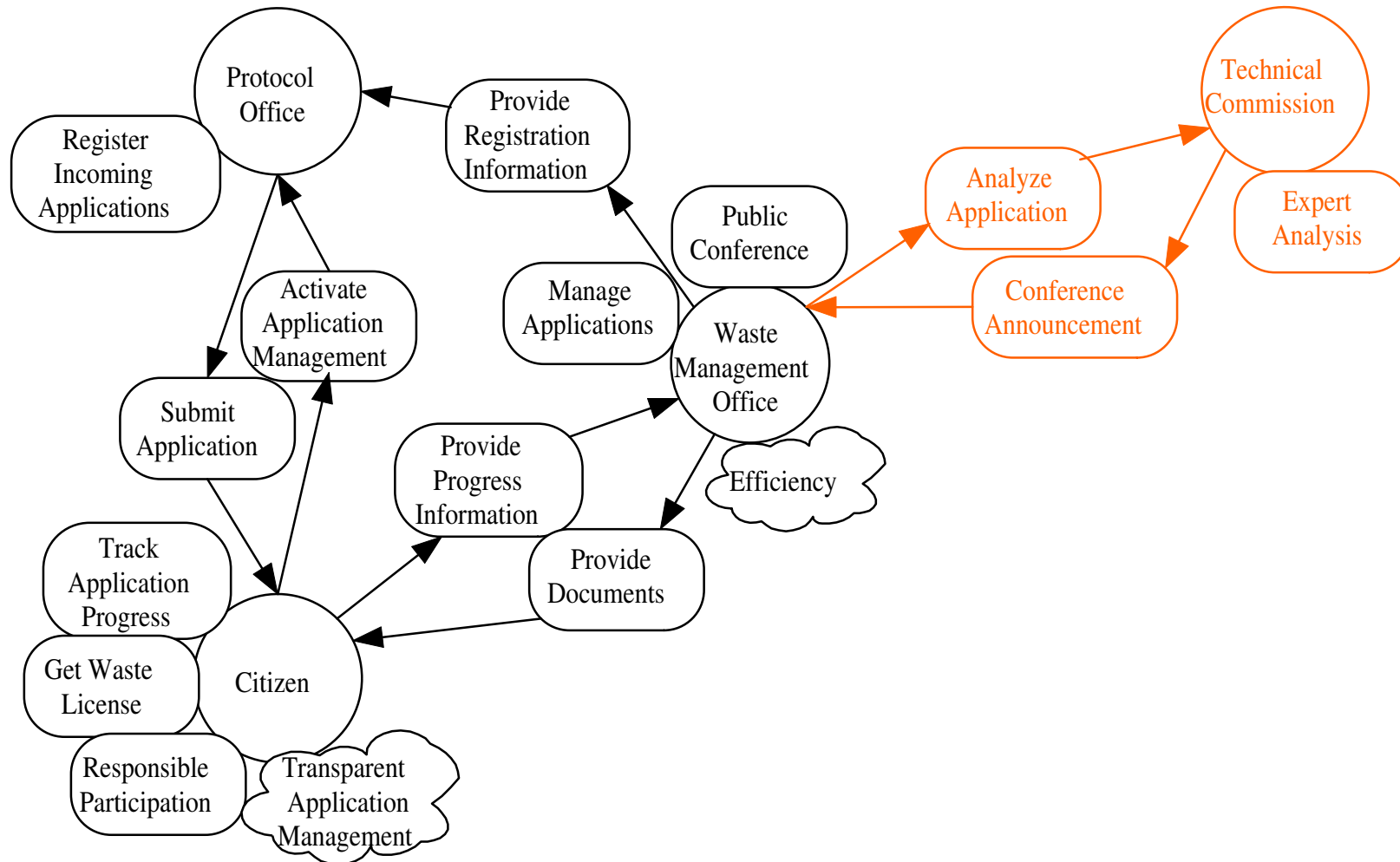
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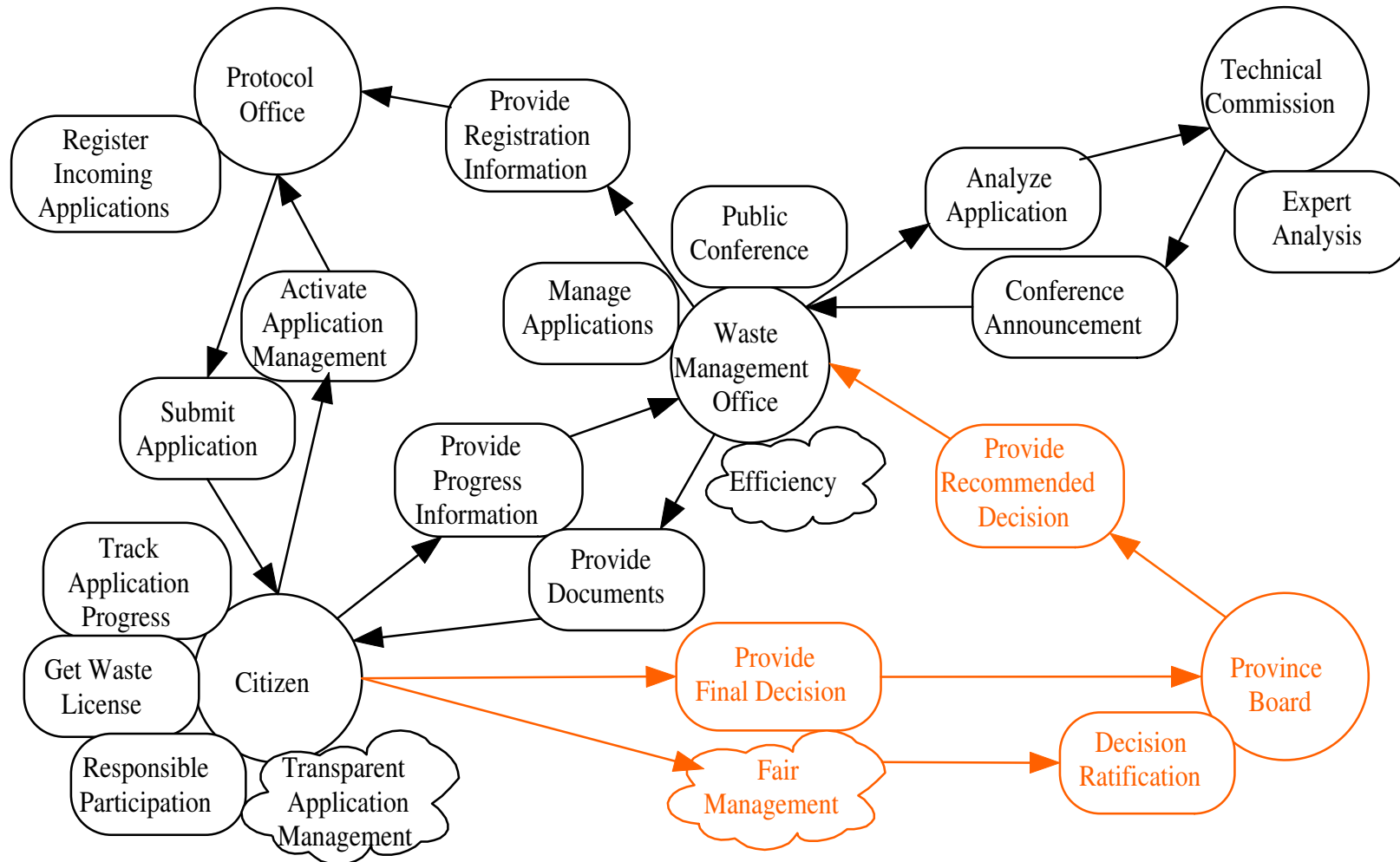
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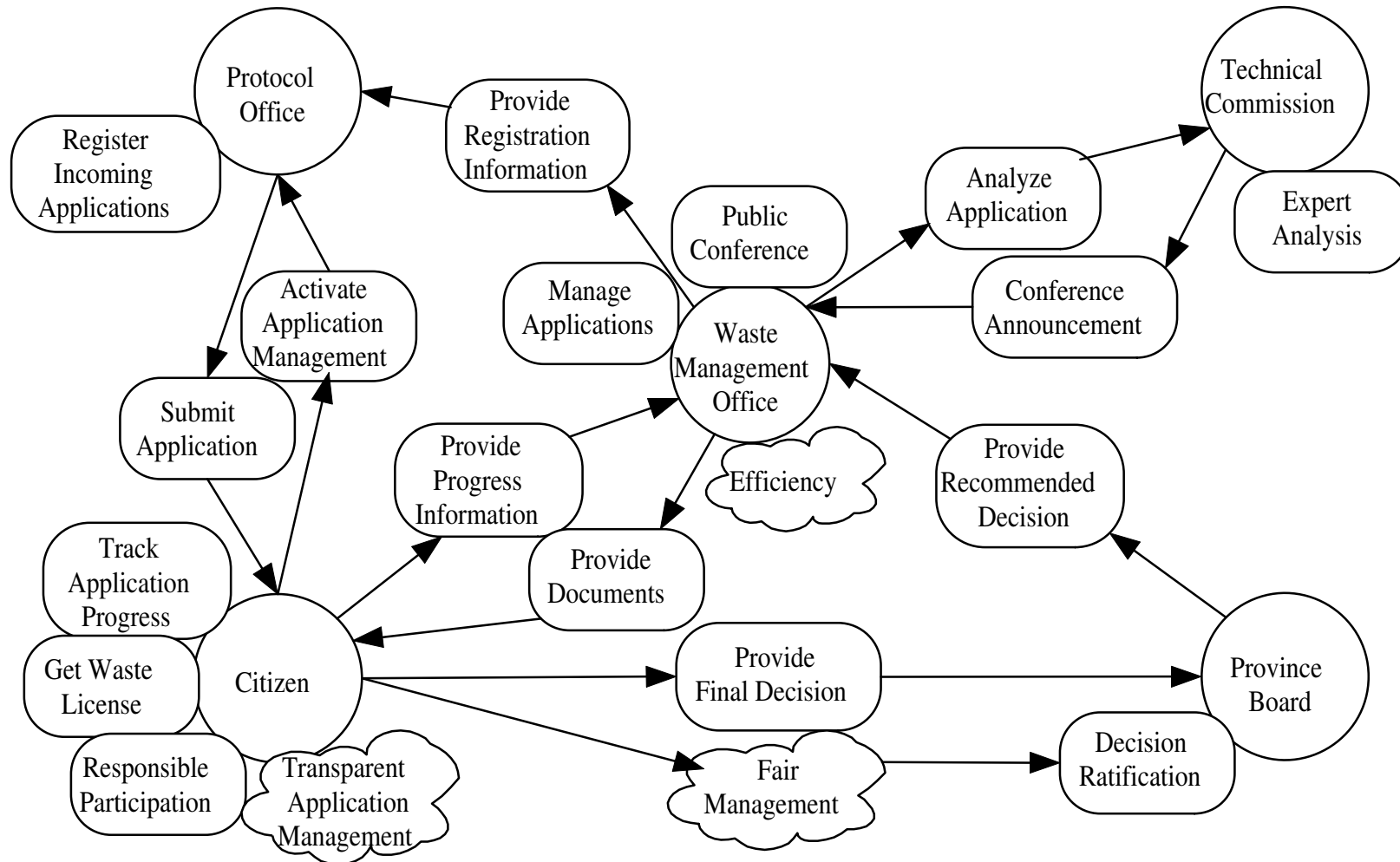


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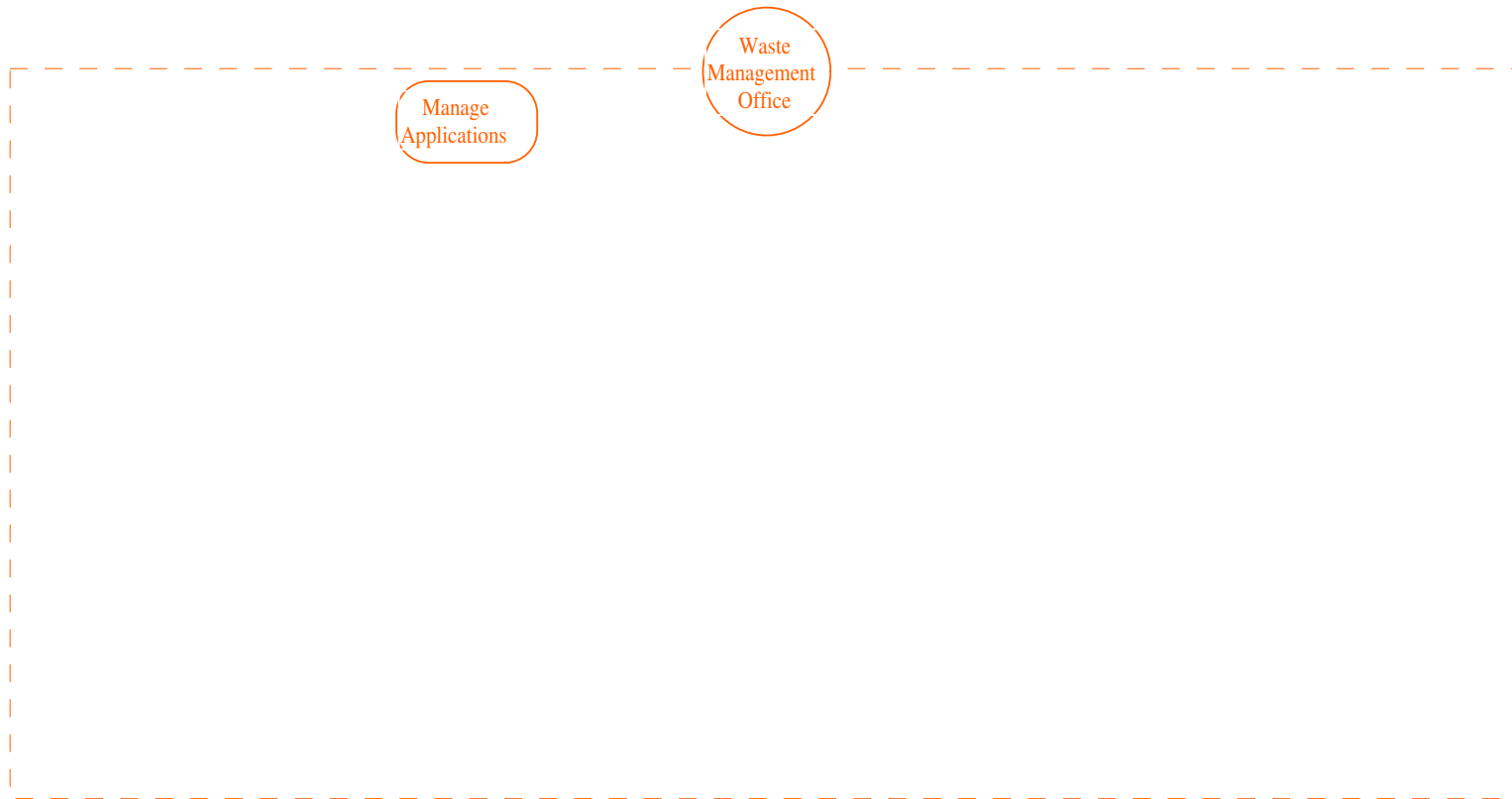
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Representation of requirements in collaboration

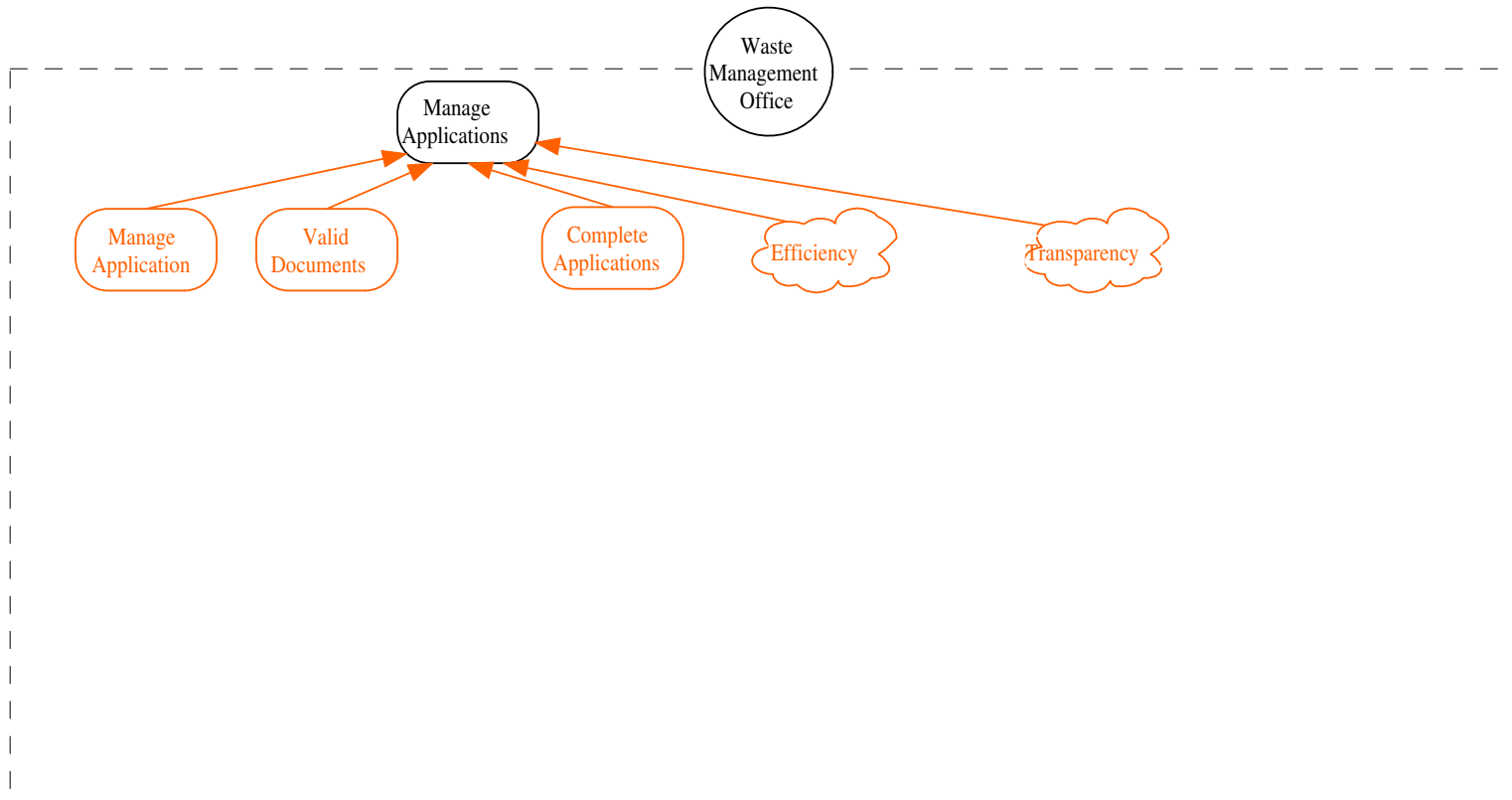




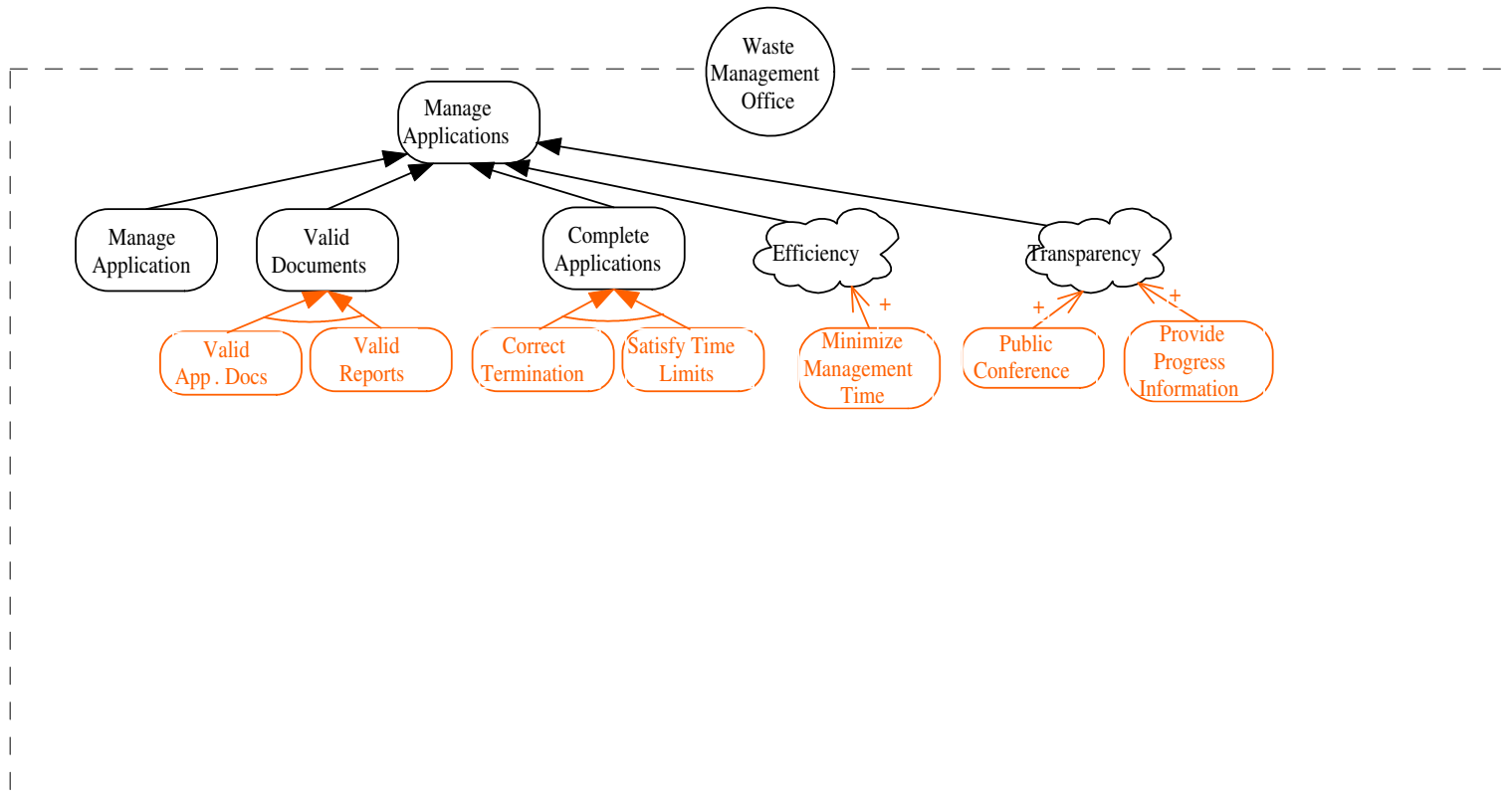
Business Requirements: Refinement



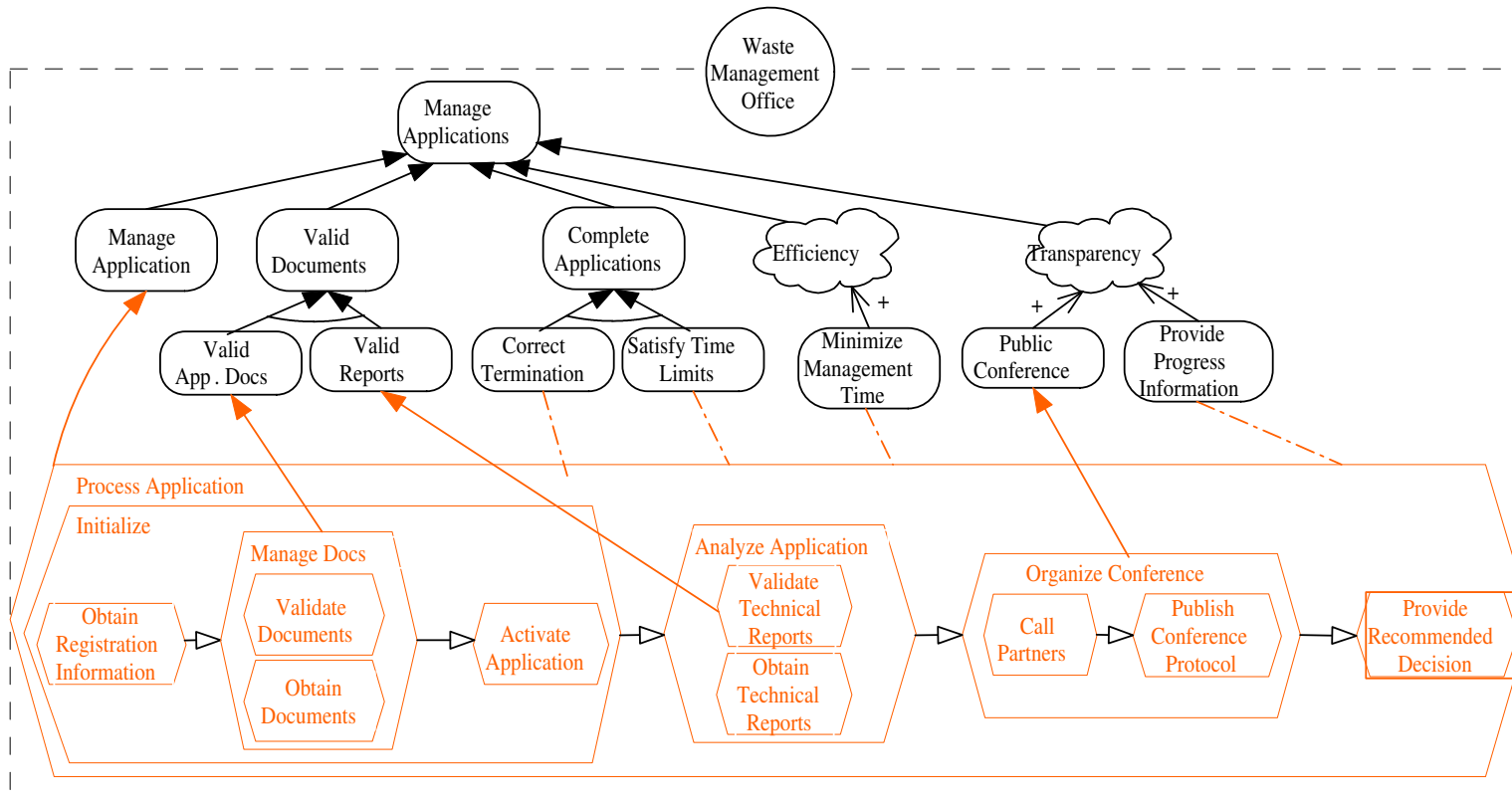
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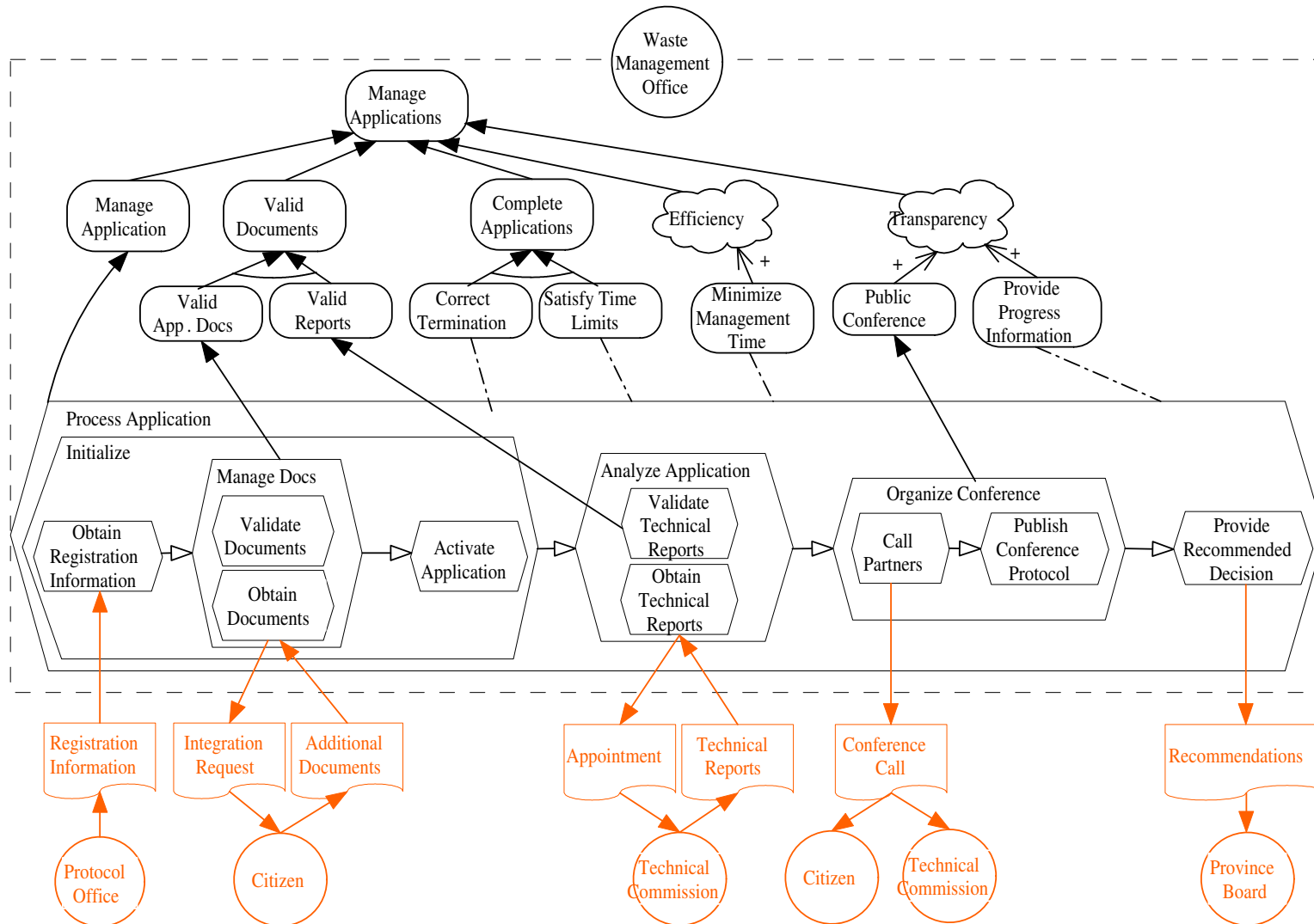
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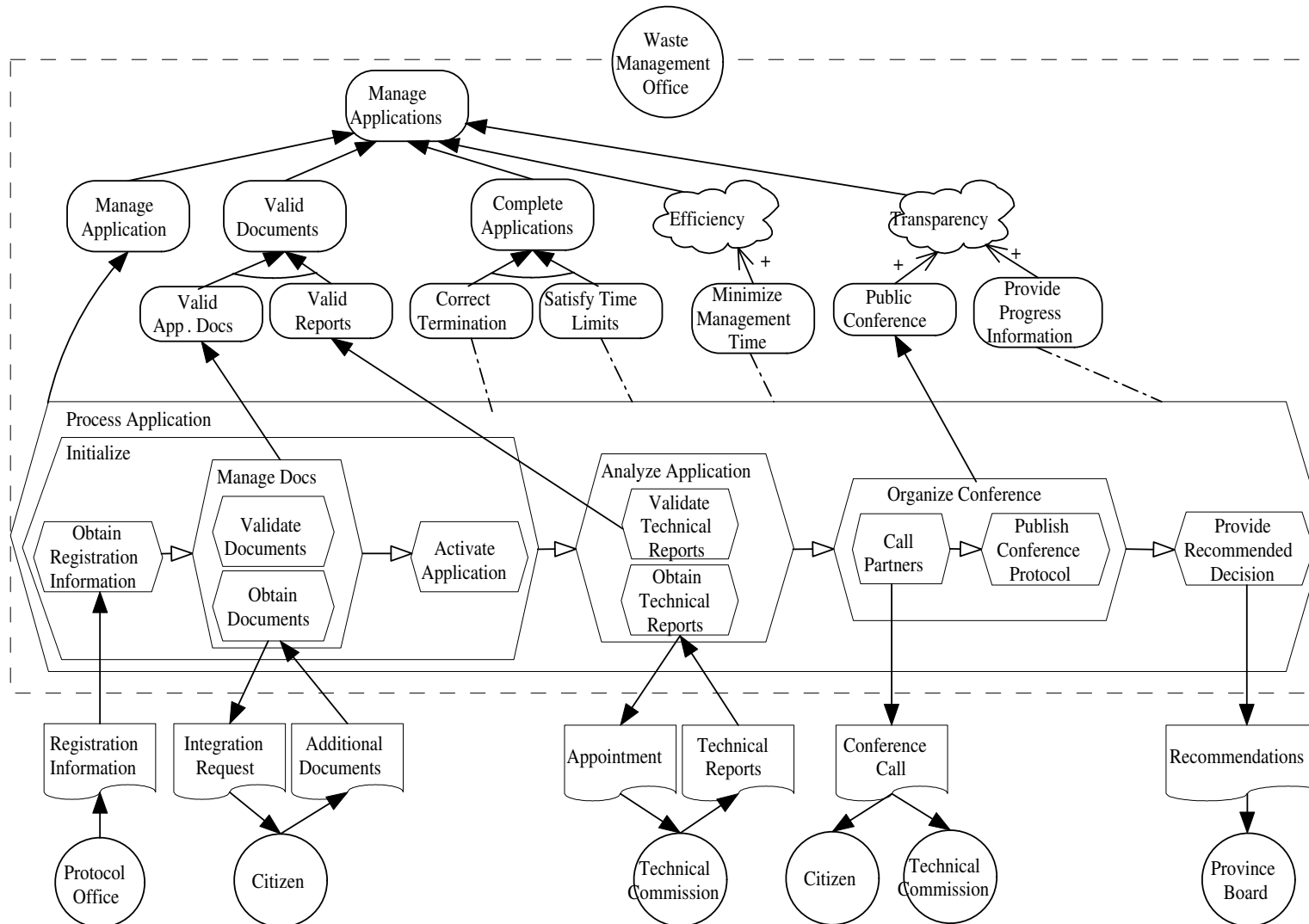
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Representation of local requirements

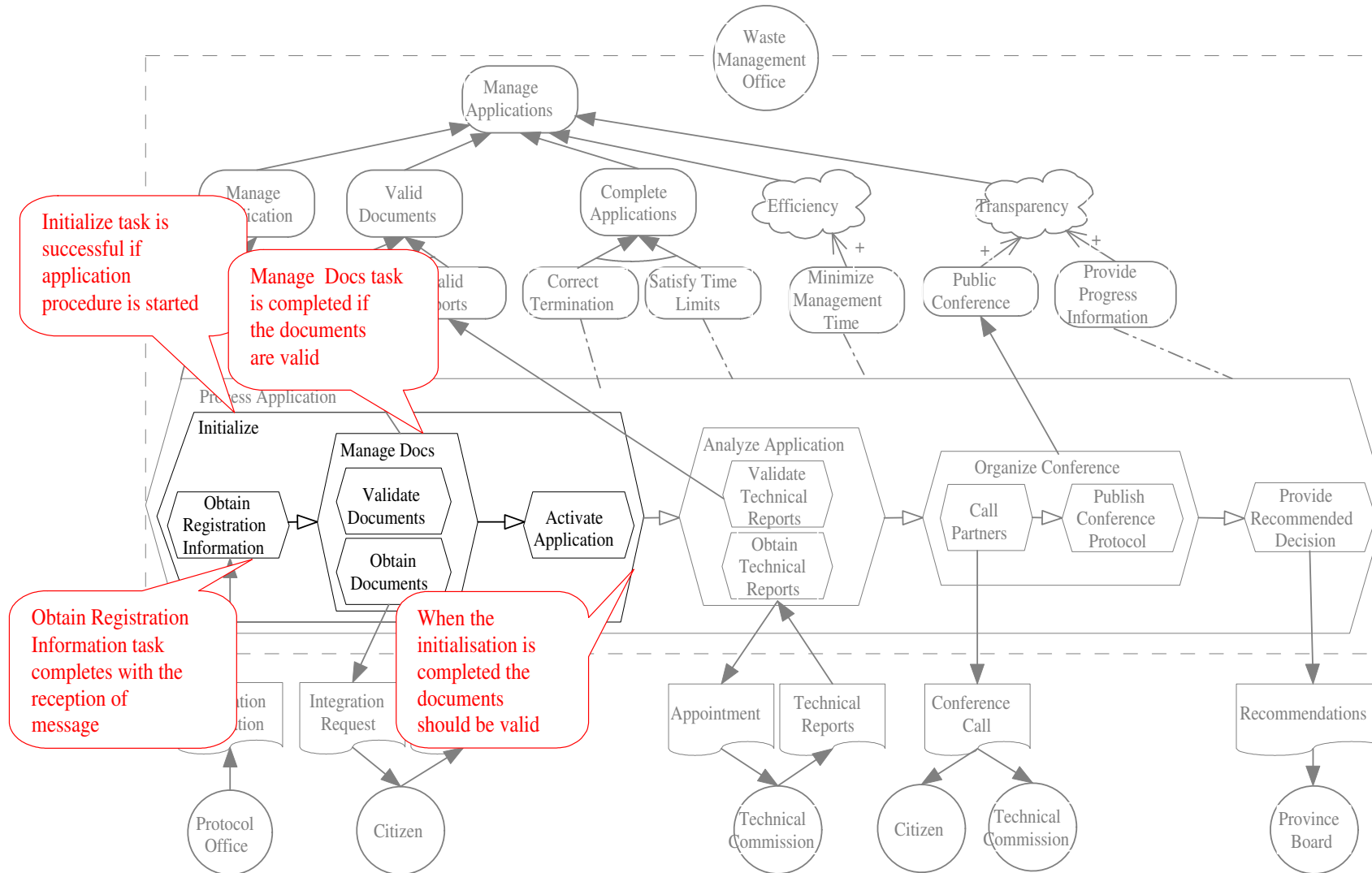
Strategic Level

Activity Level

Message Level

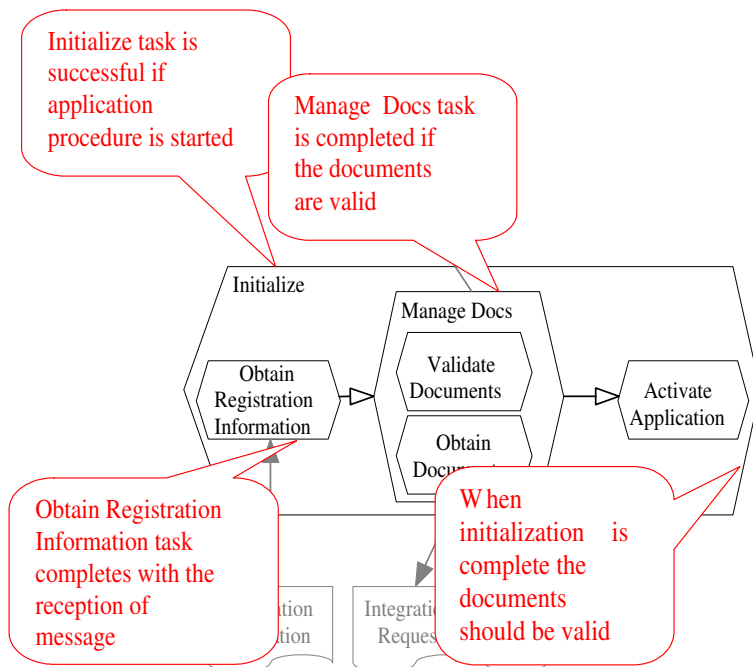


astro Business Requirements: Formal Properties



astro Formal Tropos

- classes representing actors, goals, activities and dependencies
- first-order linear-time temporal constraints on the evolutions of the model
- focus on **creation** and **fulfillment** of activities



Task Initialize mode achieve

Attribute docs: Documents

Fulfillment trigger

- *The initialization task completes with the application activation*

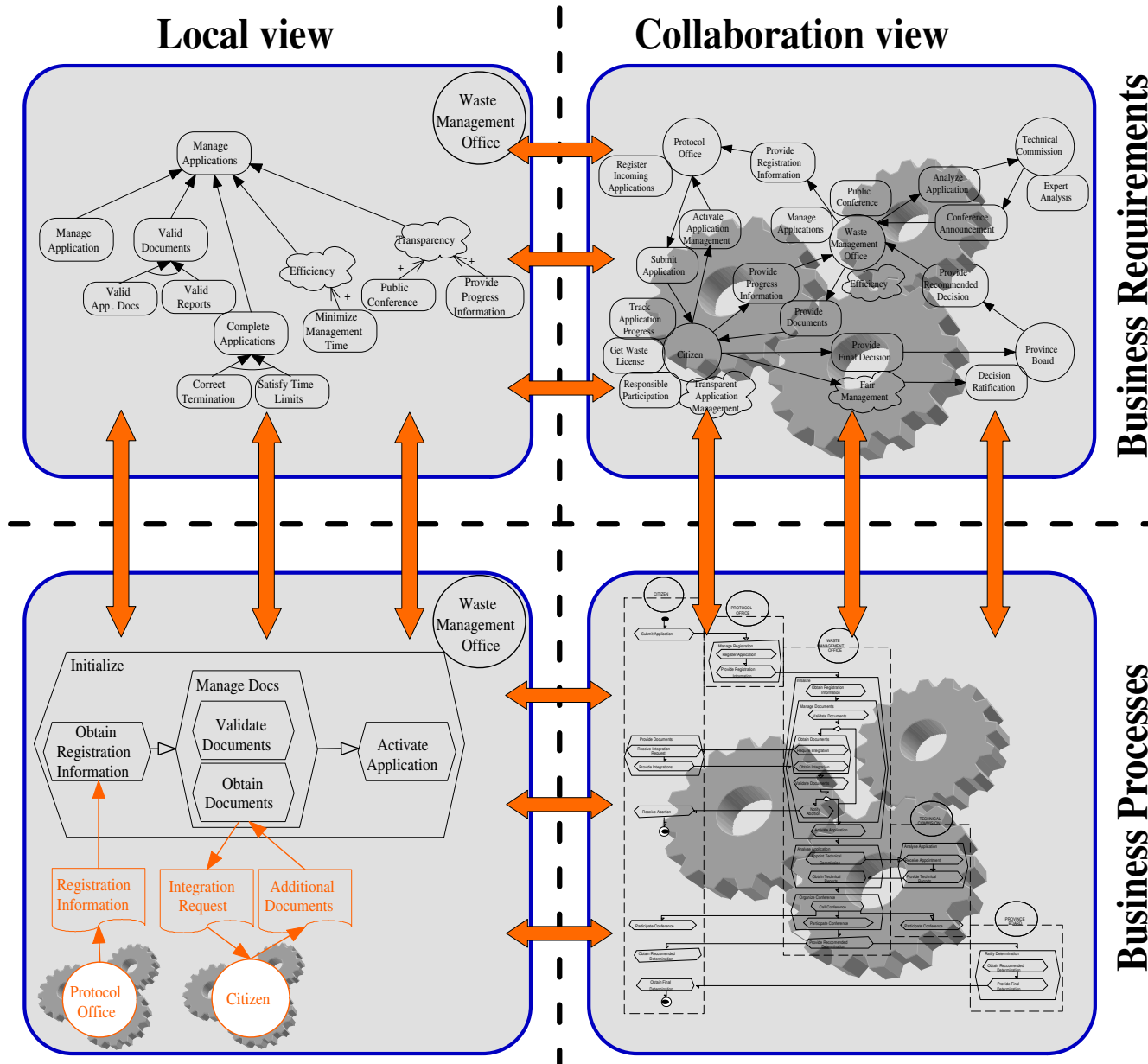
\exists aa: ActivateApp (aa.super = self \wedge **Fulfilled**(aa))

Fulfillment condition

- *when the initialization task completes, the documentation should be valid*

docs.valid

Integrating Requirements and Processes



astro Formal Verification

- Verification of business requirements
 - consistency checks: “the specification admits valid scenarios”;
 - possibility checks: “there is *some* scenario that respects **possibility** property”:
 $\exists \text{ in: Initialize (Fulfilled(in))}$
 - assertion validation: “*all* scenarios respect **assertion** property”:
 $\forall \text{ ri: RegInfo } (\forall \text{ wmo: WMO } (\text{ri.receiver} = \text{wmo} \wedge \text{ri.docs.valid} \rightarrow$
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- Process verifications
 - Deadlocks and livelocks freedom verifications

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- Process verifications
 - Deadlocks and livelocks freedom verifications
- Verification of process against requirements models
 - verify on the refined model **all possibilities and assertions of the formal requirements model**;
 - verify whether the refined model satisfies the **requirements specified in the Creation, Invariant and Fulfillment constraints**;
 - verify whether the **composition of processes** satisfies above properties.

astro Conclusions



Conclusions...

- **A methodology for business requirements modelling**
 - based on (extension of) Tropos modelling language
 - starting from strategic goals and constraints
 - refining business requirements into business processes

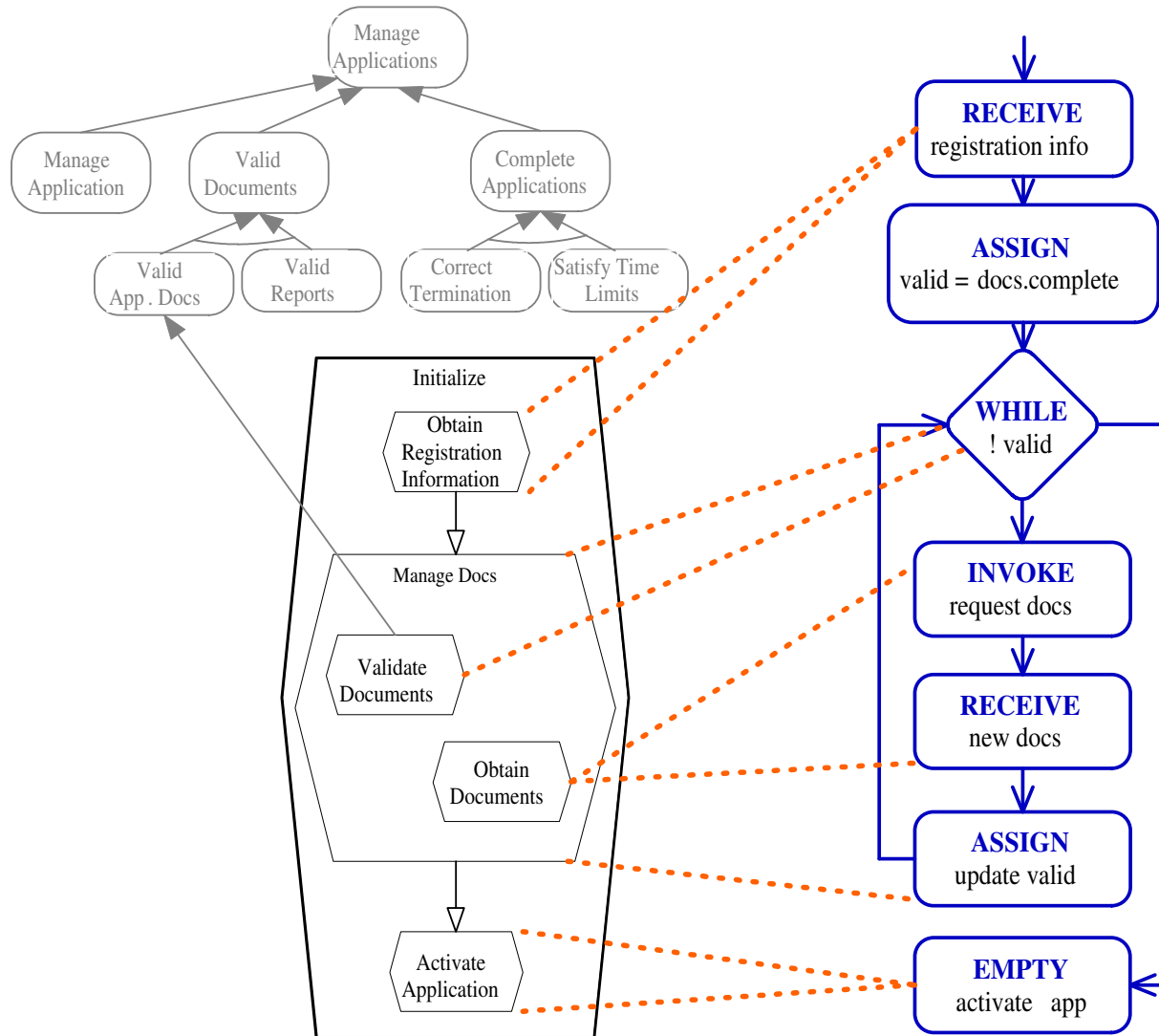
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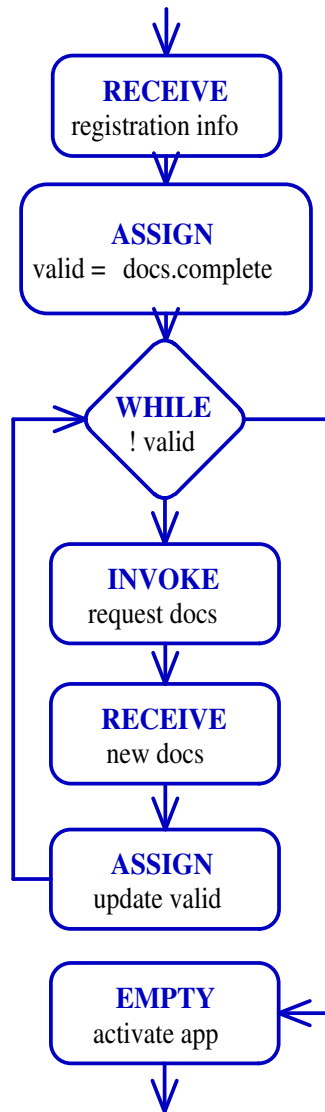
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- **Integration with Web service process definitions** (e.g. in BPEL4WS)
 - extraction of definitions for ports, messages, partners and process skeletons
 - explicit relations of tasks with the Web service process definitions
 - analysis of specifications on more detailed level

astro Extracting Web Service Processes



astro Extracting Web Service Processes



```

<sequence name="Initialize">
  <receive name="receive reg info"
    operation="manageApp" variable="vAppRequest"/>
  <assign>
    <copy>
      <from variable="vAppRequest " query="/docs/complete"/>
      <to variable="valid"/>
    </copy>
  </assign>

  <while condition=
    "getVariableData( 'valid' )==false() ">

    <invoke name="request documents"
      operation="docRequest" inputVariable="vDocRequest"/>

    <receive name="receive new docs"
      operation="docResponse" variable="vDocResponse"/>
    <assign>
      <copy>
        <from variable="vDocResponse" query="/docs/complete"/>
        <to variable="valid"/>
      </copy>
    </assign>
  </while>

  <empty name="activate application"/>
</sequence>

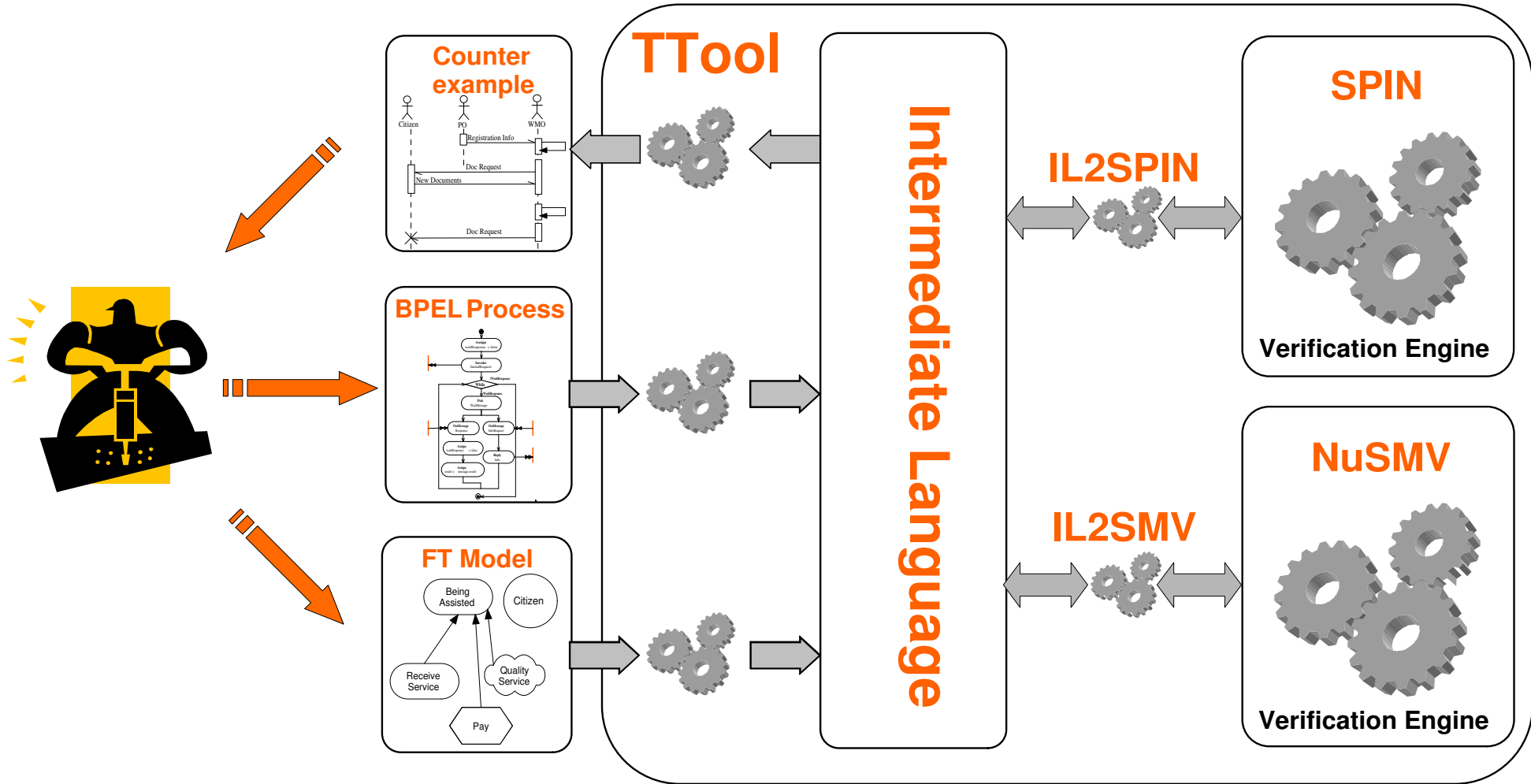
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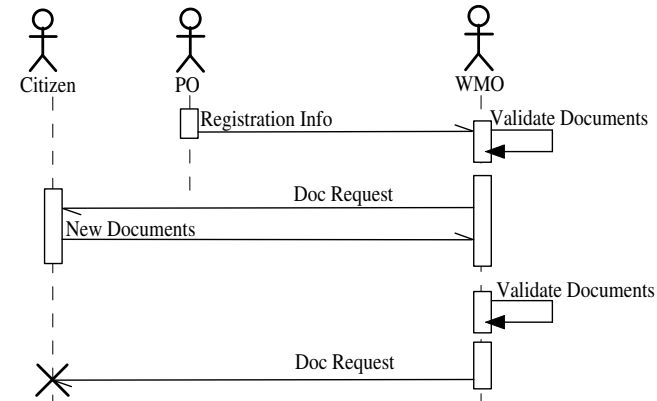
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 - extraction of definitions for ports, messages, partners and process skeletons
 - explicit relations of tasks with the Web service process definitions
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- **Support for analysis techniques**
 - consistency of requirements
 - correctness of processes
 - correspondence between processes and strategic goals and constraints

astro Formal analysis: T-Tool

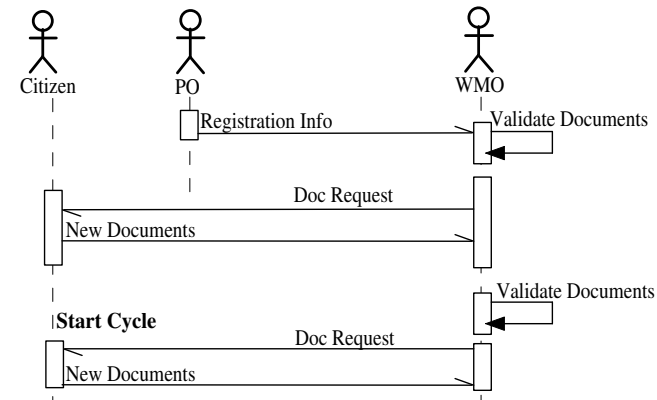


astro Formal Verification: Examples

Deadlock: WMO re-requests documents but the Citizen does not respond



Livelock: WMO re-requests documents repeatedly and the Citizen sends incomplete docs infinitely

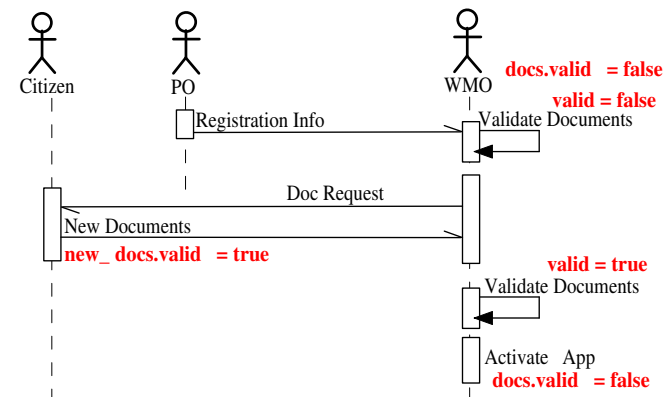


Processes against requirements:

when initialisation completes the documents should be valid

\forall in: Initialize (**Fulfilled**(in) \rightarrow in.docs.valid)

missed assignment



astro Future Works

Future works...

- Complete intermediate language for better capturing the needs of the business domain
 - better focus on activity level description
 - better integration of processes with requirements models
- Experiment with alternative verification techniques and tools
- Improve BPEL code extraction and generation
- Integration with the planning techniques for the process synthesis to enable adaptation of processes to changes in requirements



Thank You!