Accountability

from the social sciences to software engineering

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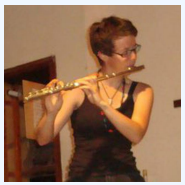
Katherine May  (former student)

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Outline

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What is accountability?

- a chamelion in the shadow of blame
- the relational nature
- characteristic of a certain kind of governance
- difference with responsibility

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- the GDPR and the Dean example
- limits of responsibility and blame
- punishment vs remedy
- Garfinkel's view
- from blame to self-regulation

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The technical part

- MOCA: an information model of accountability
- ARFIN organizations
- Explainability and robustness
- Programming agents, the special case of exception handling

Accountability?

A constellation of views

- *Social Sciences*: Ethnomethodology, Harold Garfinkel, Rawls & David;
- *Political Sciences*: Anderson, Government of Canada, Grant & Keohane, Melvin Dubnick, Bovens;
- *Tort Law*: Goldberg and Zipursky
- *Social Psychology*: Tetlock;
- *Philosophy*: Robert Nozick, Stephen Darwall.
- ...

Accountability → Blame

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Types of blame cultures:

1. Legalistic
2. Stigma
3. Giri
4. Prejudicial

Moral pushes and pulls

Robert Nozick (philosopher) distinguishes ‘moral pulls’ from ‘moral pushes’:

- **moral push**: emphasizes the person who is the subject of a moral life, their character and motivation
- **moral pull**: emphasizes the entities in the world outside of the moral agent as a source of value that generates obligations which exert a pull on the agent

Accountability and Setting [14]

Accountability as deriving from the combination of moral pushes and pulls:

Setting	**Moral Pulls**	**Moral Pushes**
Legal	Liability	Obligation
Organizational	Answerability	Obedience
Professional	Responsibility	Fidelity
Political	Responsiveness	Amenability

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How do these relate to blame?

Accountability and Blame

- **liable**: legally blameworthy (if not satisfying obligation)
- **answerable**: blameworthy (if not obedient)
- **responsible**: be in control so that you will not be blamed by those who trust you
- **responsive**: that adapts (amenable: capable of submission)

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In moral philosophy terms: **second-personal** rather than **first-** (me thinking of myself) or **third-personal** (coming from the outside) (Darwall [13])

Example (public administration)

Co-existing accountability systems in the [24]

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Sometimes seen as systems for managing expectations.

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Grant & Keohane [21]

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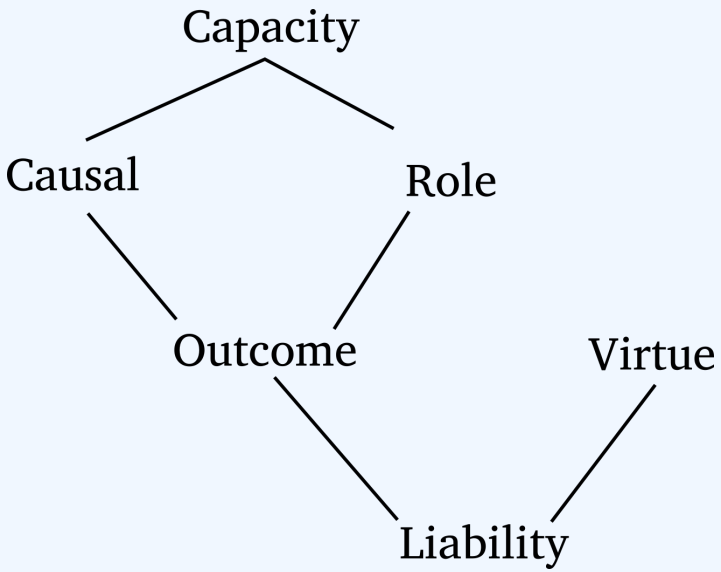
6. **Liability**: Smith should take responsibility for his victims' families' losses, but his employer will probably be held responsible for them as Smith is insolvent and uninsured.

Ontology of Responsibilities



Parenthetical: Responsibility

In MAS literature:

- "one being responsible for a task" is understood as "the one who carries out the task" (survey by Feltus [18], see also [30])
- Goal decomposition and distribution (e.g. [8])
- In [7] we see a responsibility as an agent being "a recipient" for (and being moved by) some institutional event

Back to Accountability

- “Accountability presupposes a relationship between power-wielders and those holding them accountable where there is a general recognition of the legitimacy of (1) the operative standards for accountability and (2) the authority of the parties to the relationship (one to exercise particular powers and the other to hold them to account). ”

Why at all accounting for something?

Example: Can the Dean sleep quiet dreams?

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OBLIGATIONS/SANCTIONS
(Blame culture approach)

Organization Engineering Problems

- **Lack of capability**: an agent who does not have the capability to do something will not do it even if obliged (and sanctioned upon failure);
- **Convenience**: a rational agent that finds a sanction more acceptable than satisfying an obligation to do a task, that does not comply with the agent's goals, will not abide by the obligation (and will not explain the reasons).

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Blame is not enogh

Sanction does not add capability nor it increases the responsabilization of the agents.

Well-known in Sociology

Durkheim [16], Parsons [23], Garfinkel [19], etc.

- obligation insufficient to explain social action,
- an agent acts **voluntarily** if the act is **desirable** for the agent
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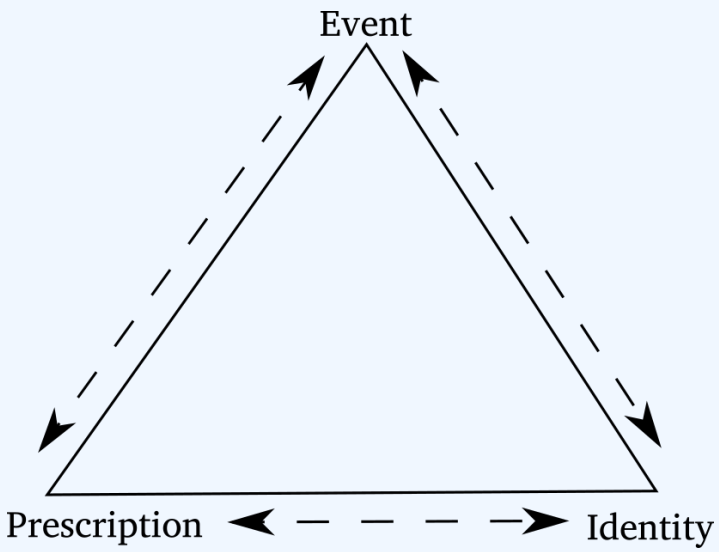
Triangle Model of responsibility [25]

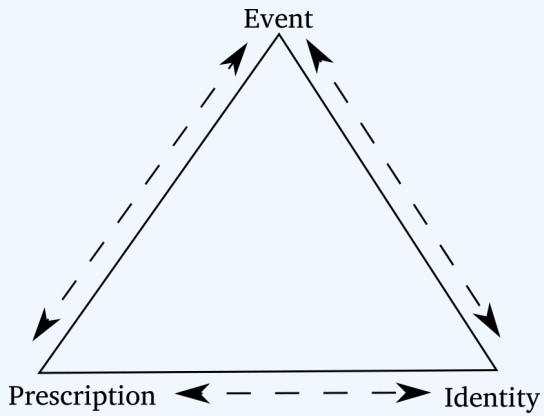


Schlenke et al.

An individual perceives a responsibility when the links are strong: identity-event, event-prescription, prescription-identity.

INSIDE THE AGENT

Triangle Model of responsibility: Example



identity: Luca the doorman,
prescription: should open the door,
event: the bell rings.

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Departments feel responsible

Each Dept. verifies compliance

Answer is: YES!

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- How to gather information for solving the problem and avoiding similar situations in the future?
- A lot of information about the Department's organization is available but the one we need is hidden and must be found.

- Lack of an adequate representation
- Accountability hidden into some kind of collective responsibility – sometimes called “many hands problem”.
- Governance of the system and its functioning as a whole are compromised.

Punishment vs Remedy
Tort Law (Goldberg & Zipursky [20])

Legal wrong: violation of a directive

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Criminal Law

- **simple directive**:
  For all x, x shall not A
- empowers the state to hold wrongdoers accountable
- **Accountability$\rightarrow$ punishment**

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Tort Law

- **relational directive**:
  For all x and for all y, x shall not do A to y
- **empowers private parties** to initiate proceedings designed to hold tortfeasors accountable
- **Accountability**: the successful victim will have the right to exact a remedy, and courts will apply **principles of remedy**

Responsibility is not enough
Something is missing

Ethnomethodology, a Radical View, H. Garfinkel [19]

Distinctive feature of Garfinkel's approach to social order:

"people organize their actions and interactions as concerted by making them 'accountable' - that is, reciprocally recognizable. Thus, social activities are performed as observable and reportable phenomena. [...]

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Why?

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Agents do not share the same conception of legitimacy.

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Action is not devised so as to be reportable.
Agents do not share the same conception of legitimacy.
Information is hidden, not always accessible.

Modeling Accountability

Key Aspects

1. *Accountability implies agency.*
   Without the qualities to act “autonomously, interactively and adaptively," i.e. with agency, there is no reason to speak of accountability because we would be talking of a tool, and tools cannot be held accountable [26].

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3. *Accountability does not hinder autonomy.*
   It makes sense because of autonomy in deliberation [2, 25, 27, 11].

4. *Accountability requires control.*
   Control is the capability, possibly exercised indirectly via other agents, of bringing about events [22] (omissions, i.e. not acting, can be seen as non-achievements).
5. *Accountability requires observability.*
   In order to make correct judgments, a forum must be able to observe the necessary relevant information.

7. *Accountability requires a mutually held expectation.*
   It is a directed social relationship that serves the purposes of sense-making and coordination in a group of interacting parties, all of whom share an agreement on how things should be done [19, 27, 2].

   Both parties must be aware of such a relationship.

8. *Accountability is rights-driven.*
   One is held accountable by another who, in a certain context, has the claim-right to ask for the account [12, 21].

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Responsibilization through Accountability

- **Explicitly represent**: who is accountable of what and towards whom, and conditions of the claim-right;
- **Legitimacy**: Agents accept accountabilities.

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- How to gather information for solving the problem and avoiding similar situations in the future?
  By requesting the proof
- It is always clear and accepted who should return accounts to whom and when: sort of additional explicit "infrastructure"

Organization Engineering?

Accountability acceptance exposes the responsibilities agents perceive (previously hidden):

- enables reasoning
- increases system robustness

On legitimate requests:

- **Lack of capability**: the agent will either not play the role or will explain its lack of skill when asked;
- **Convenience**: agents will explain the conflict between their goal and the assigned task.
- **Behave up to the standard**: agents can be asked proofs also when goals are achieved!
  Certification, when “how things are done” matters.

From Blame to Self-regulation

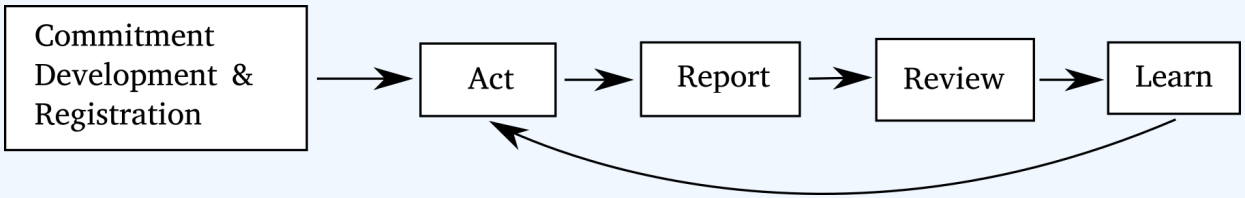


Figure: A general scheme for accountability frameworks inspired by [1], appeared in [6].

The Power of Accounts

Account is more constructive than blame

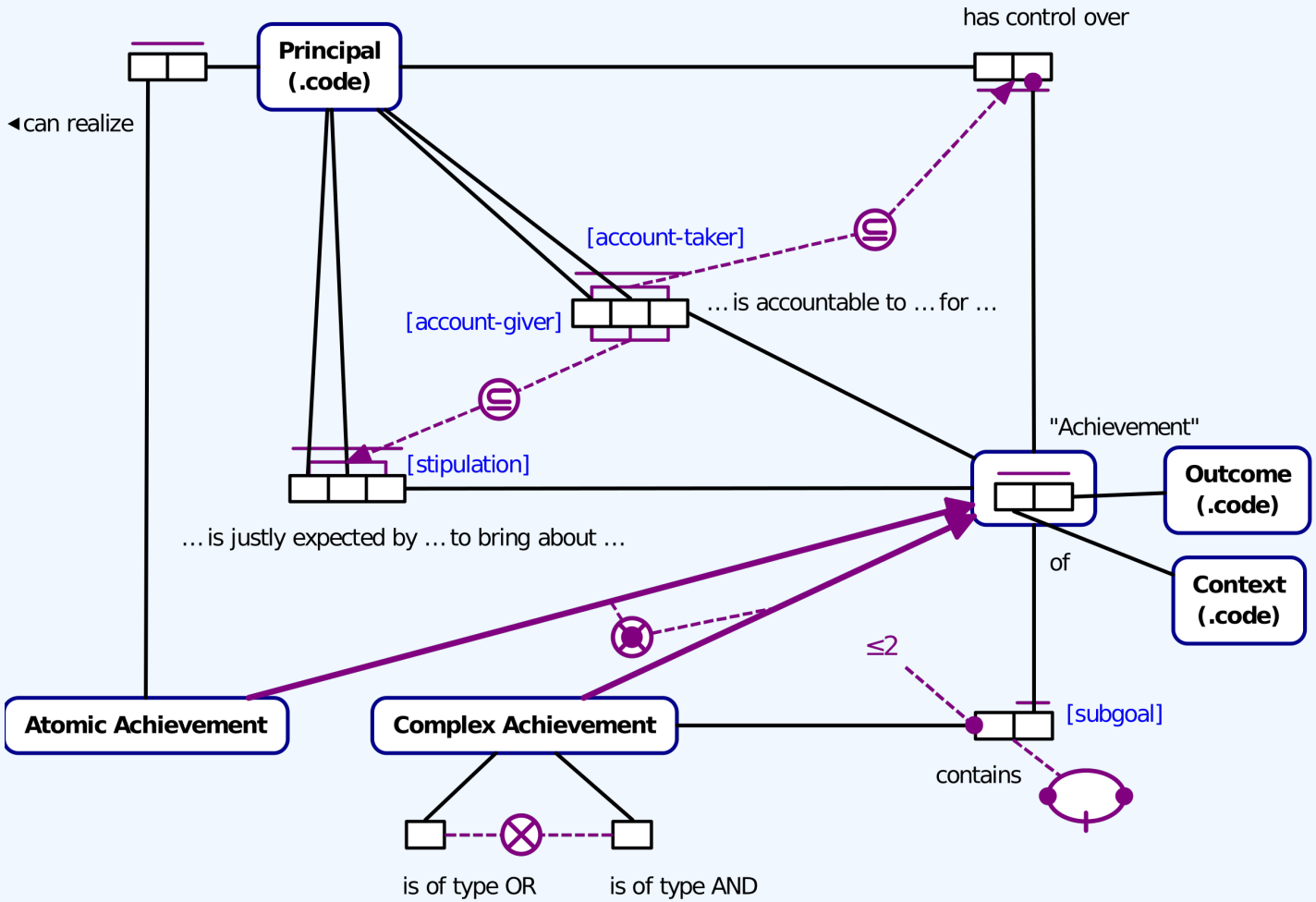
Being Technical

MOCA Information Model (to appear)

MOCA is an information model

- It describes what kind of data (**facts**) must be available to develop systems that, in any situation of interest arising in a group of interacting agents, allow the identification of account-givers.
- The model is provided in Object-Role Modeling (**ORM**) because accountability has a relational nature.
- Improves the proposal in [5].

MOCA:
ORM Model for Computational Accountability



1. **Accountability**: *Principal is accountable to Principal for Achievement*. It has three roles and can only exist if some of its elements are present both in a relationship of expectation (… *is justly expected by … to bring about* …), and in one of control (… *has control over …*).
2. **Expectation**: *Principal is justly expected by Principal to bring about Stipulation*.
3. **Control**: *Principal has control over Achievement*. Control expresses contextual autonomy in that a Principal can effectively decide whether or not to bring about an Achievement and act on that decision.

On control

If one of the following conditions holds, then the Fact type [Principal] has control over [Achievement] exists:
1. If [Principal] can realize [Achievement], that [Principal] has control over [Achievement]
2. If [Principal] appears in an accountability fact type as [account-taker] for [Achievement], that [Principal] has control over [Achievement]
3. If [Complex Achievement] is of type AND and contains two [Achievement]s and a [Principal] has control over both [Achievement]s, that [Principal] has control over [Complex Achievement]
4. If [Complex Achievement] is of type OR and contains two [Achievement]s and a [Principal] has control over at least one of the [Achievement]s, that [Principal] has control over [Complex Achievement]

ARFIN Organizations (Baldoni et al. [7])

Agent organization

A process being collectively executed by a number of agents. Agents produce and answer to institutional events, and need to coordinate to accomplish the organizational goal.

ARFIN organization

An organization that includes 4 elements: *accountability specification*, *responsibility distribution*, *accountability fitting*, and *norms*.

- An **accountability specification** is a set **A** of accountabilities $A(x, y, r, u)$ with:
  - x: account-giver;
  - y: account-taker;
  - r: context in which y can hold x to account;
  - u: condition concerned by the account.

A(x, y, r, u) is grounded on control and expectation:

- **expectation** is naturally conveyed with the accountability itself,
- **control** is recursively verified on the structure of u: x controls u either directly (it is in position of causing u) or indirectly by relying on accountabilities. by other parties.

Properties of the A/R specification

Control in an accountability specification

- **Control** $\xi(x, r, u)$: a recursively defined property over **A**, saying that in **A**, x has control of u when r holds.
- Recursive rules:
  - $\xi(x, r, u)$ in **A** if $u/r = \top$;
  - $\xi(x, r, u' \wedge u'')$ in **A** if $\xi(x, r, u')$ in **A** and $\xi(x, r, u'')$ in **A**;
  - $\xi(x, r, u' \vee u'')$ in **A** if $\xi(x, r, u')$ in **A** or $\xi(x, r, u'')$ in **A**;
  - $\xi(x, r, u)$, where $u/r = u' \cdot u''$, in **A** if $\xi(x, r, r \cdot u')$ in **A** and $\xi(x, r \cdot u', r \cdot u' \cdot u'')$ in **A**;
  - $\xi(x, r, u)$ in **A** if there exists $\mathsf{A}(y, x, r', u) \in \mathbf{A}$ such that $\xi(x, r, r')$ in $\mathbf{A} - \{\mathsf{A}(y, x, r', u)\}$.

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Control over **atomic conditions** cannot be checked from the accountability specification only. It depends on the **responsibility assumptions** by the agents who enact the roles.

Responsibility assumption

A responsibility assumption is a declaration, by an agent, to be considered in the position for causing a certain condition [3].

Responsibility assumption

Responsibility is necessary to control. It **implies** that the agent is *available* to provide a feedback. However, there is no notion of who has the right to ask for the feedback and when.

Responsibility **does not** imply that:

- the agent is *expected* to provide any feedback (that is accountability's job),
- the agent has the capabilities for carrying out what intended.
- a capable agent will always be willing to carry out what intended, and will not fail in the quest.

Origin of Responsibilities

- **Role responsibilites**: deduced from the norms connecting roles to goals;
- **Agent responsibilities**: derived from constraints posed on the organization by the agents for playing roles.

- An **accountability specification** is a set **A** of accountabilities $\mathrm{A}(x, y, r, u)$.
- **Responsibility assumptions** are denoted as $\mathrm{R}(x, q)$: agent x declares to accept to be considered in the position of causing q. Since agents not necessarily will accept obligations, responsibility assumptions (provided by the agents themselves) allow identifying agents who are receptive of the obligation.
- The **normative system** generates obligations, permissions, etc. depending on the occurrences of events in the physical and in the institutional world.

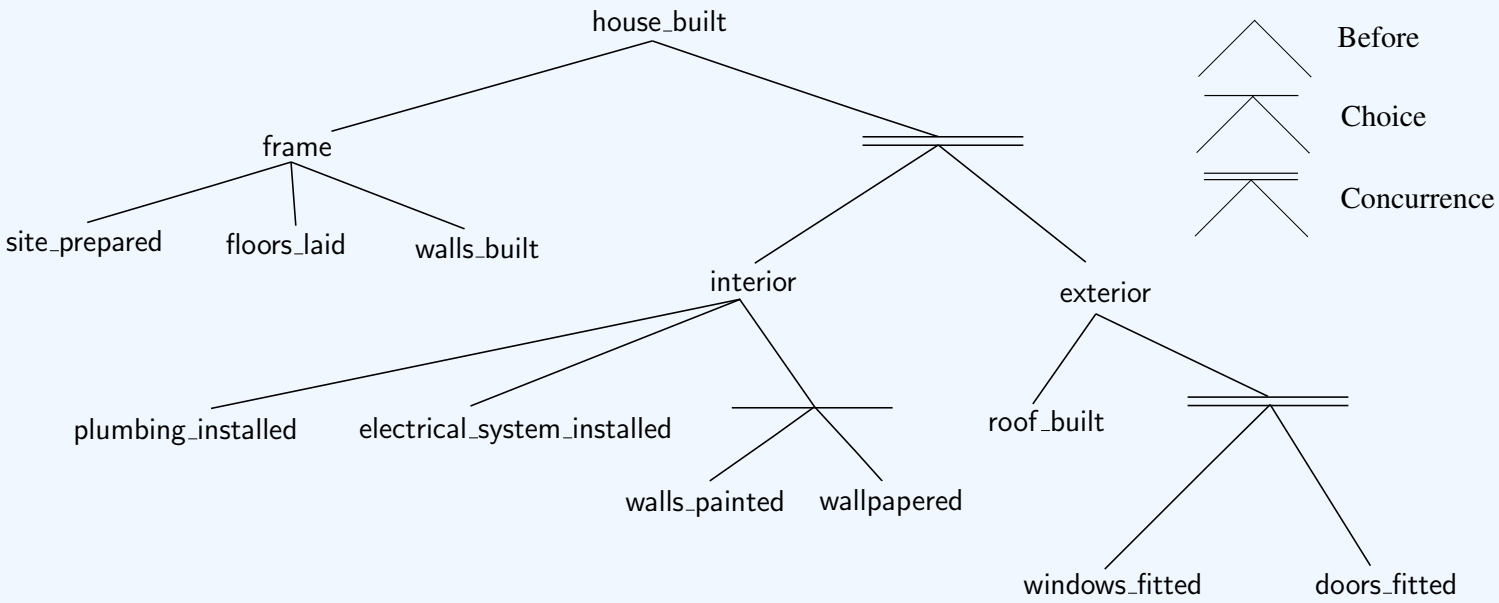
- Accountability and responsibility are **properties** that emerge in carefully designed software systems.
- When we use accountability/responsibility as **engineering tools**, we constrain the ways in which software is designed and developed.

Accountability and Responsibility in Agents' Organizations

Baldoni et al. [3]

- Consider the description of how a complex goal can be obtained via *functional decomposition*

An Example: Building House



Moise-like functional decomposition for the building house scenario

Accountability and Responsibility in Agents' Organizations

The Idea [3]

- Functional decomposition
- Complement such a decomposition with:
  - an accountability specification **A** (a set of $\mathrm{A}(x, y, r, u)$).

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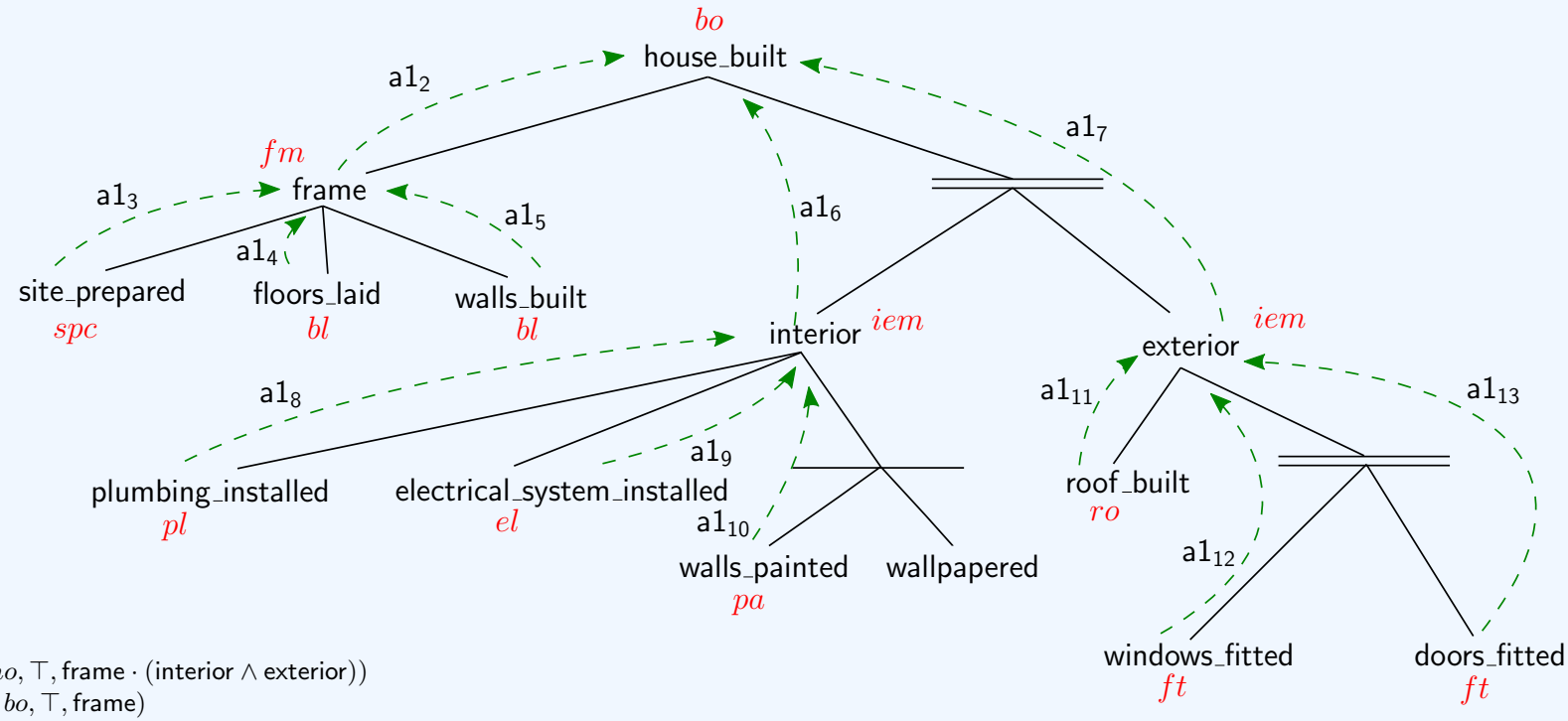
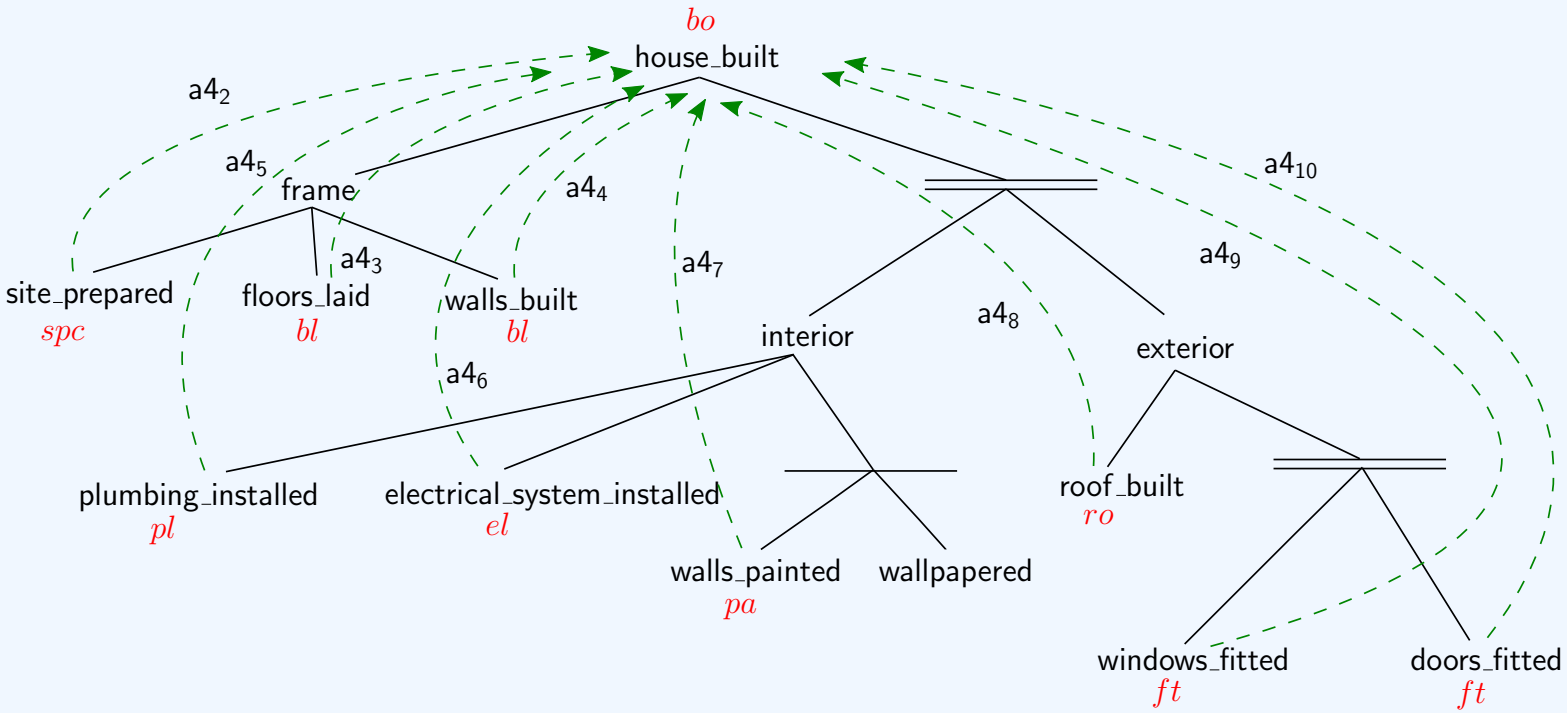
Many **A** for a same functional decomposition

Complementing with Accountability Specification (1)



$a1_1$. A($bo, ho, \top$, frame · (interior ∧ exterior))
$a1_2$. A($fm, bo, \top$, frame)
$a1_3$. A($spc, fm, \top$, site_prepared)
$a1_4$. A(bl, fm, site_prepared, site_prepared · floors_laid)
$a1_5$. A(bl, fm, site_prepared · floors_laid, site_prepared · floors_laid · walls_built)
$a1_6$. A(iem, bo, frame, frame · interior)
$a1_7$. A(iem, bo, frame, frame · exterior)
$a1_8$. A(pl, iem, frame, frame · plumbing_installed)
$a1_9$. A(el, iem, frame · plumbing_installed,
frame · plumbing_installed · electrical_system_installed)
$a1_{10}$. A(pa, iem, frame · plumbing_installed · electrical_system_installed,
frame · plumbing_installed · electrical_system_installed · walls_painted)
$a1_{11}$. A(ro, iem, frame, frame · roof_built)

Complementing with Accountability Specification (2)



a4₁. A($bo, ho, \top$, frame · (interior ∧ exterior))
a4₂. A($spc, bo, \top$, site_prepared)
a4₃. A(bl, bo, site_prepared, site_prepared · floors_laid)
a4₄. A(bl, bo, site_prepared · floors_laid, site_prepared · floors_laid · walls_built)
a4₅. A(pl, bo, frame, frame · plumbing_installed)
a4₆. *and so forth ....*

Accountability and Responsibility in Agents' Organizations

The Idea

- Functional decomposition
- Complement such a decomposition with two more specifications:
  - an accountability specification **A**;
  - a responsibility distribution **R** (a set of responsibility assumptions $\mathrm{R}(x, q)$).

Accountability Fitting

Accountability Fitting $\mathbf{R} \rightsquigarrow \mathbb{A}$ ("$\mathbf{R}$ *fits* $\mathbb{A}$")

Given:

- $\mathbb{A}$: a set of accountability specifications;
- **R**: a responsibility distribution (a set of responsibility assumptions);

We say that $\mathbf{R} \rightsquigarrow \mathbb{A}$ when $\exists\, \mathbf{A} \in \mathbb{A}$ such that $\forall\, \mathrm{A}(x, y, r, u) \in \mathbf{A}$, $\exists\, \mathrm{R}(x, q) \in \mathbf{R}$ such that, for some actualization $\widehat{q}$, $(u/r)/\widehat{q} \equiv \top$.

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An organization is properly specified when the *accountability fitting* $\mathbf{R} \rightsquigarrow \mathbb{A}$ holds.

Properties of the **A**/**R** specification

Accountability specification must be **closed under control**

Let **A** be an accountability specification, **A** is *closed under control* if $\forall\ \mathrm{A}(x, y, r, u) \in \mathbf{A}$, such that u/r is not atomic, we have $\xi(x, r, u)$ in **A**.

Control of atomic conditions derives from the responsibility distribution **R**

Responsibilities fitting Accountability Specifications

r1. R(bo, frame · (interior ∧ exterior))
r2. R(fm, frame)
r3. R(spc, site_prepared)
r4. R(bl, floors_laid · walls_built)
r5. R(iem, interior ∧ exterior)
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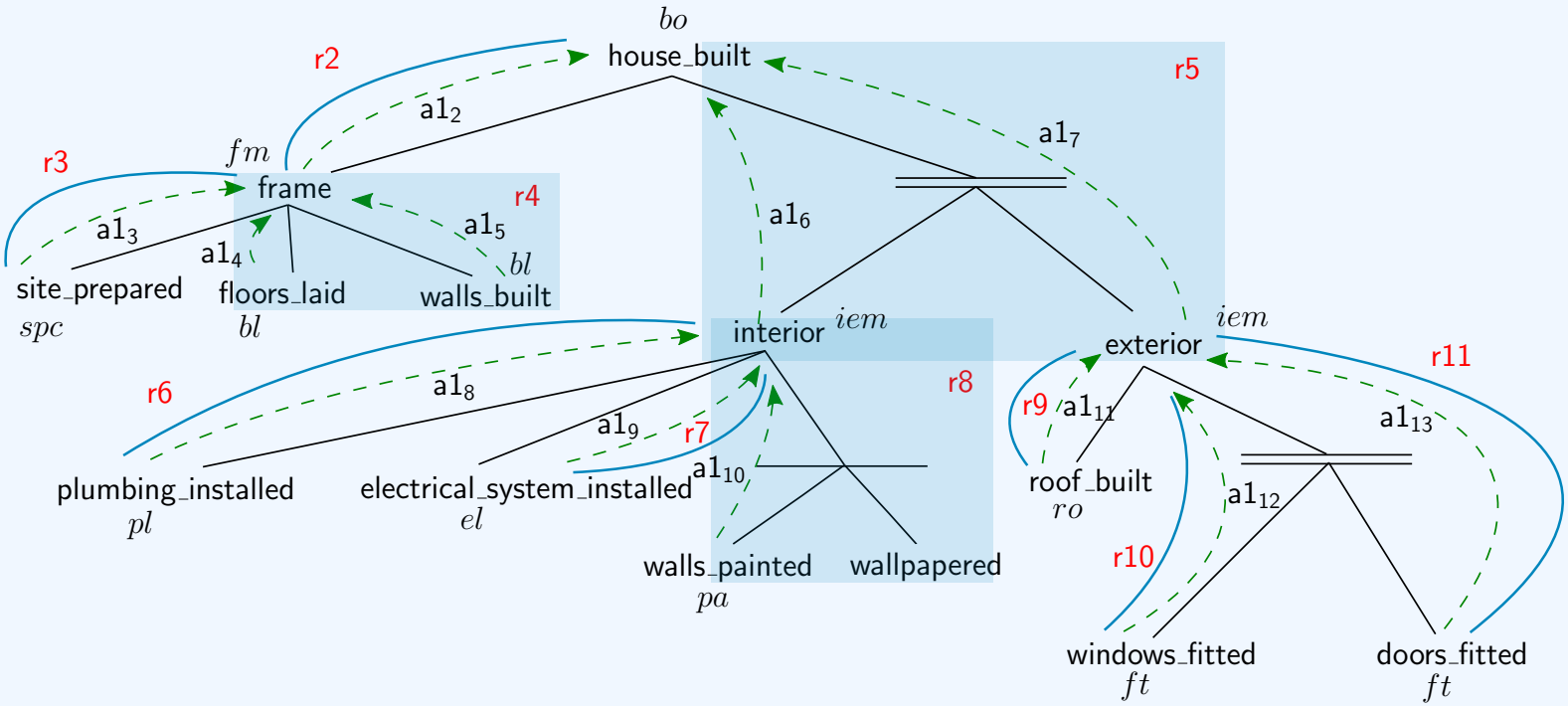
r11. R(ft, doors_fitted)

Responsibilities fitting Accountability Specifications



r1. R(bo, frame · (interior ∧ exterior))
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Properties of the A/R specification

Proposition

Given a set of accountability specifications $\mathbb{A}$, and a responsibility distribution **R** such that **R** $\rightsquigarrow \mathbb{A}$, then, there exists $\vec{e}$ (sequence of events) such that:

1. $\vec{e} = \widehat{q}$ where $q = \bigwedge_{\mathrm{R}(x,q_i)\in\mathbf{R}} q_i$
   $\widehat{q}$ is an actualization of the responsibilities

When **R** fits **A**, then the agents taking on the responsibilities in **R** can actually achieve the original, complex goal by following the accountability relationships in **A**.

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   $\widehat{q}$ is an actualization of the responsibilities
2. $\vec{e} \in \|\boldsymbol{A}_i\|$, for some $\mathbf{A}_i$ in $\mathbb{A}$.
   $\|\mathbf{A}_i\|$ is the set of event sequences that "satisfy" all the accountabilities in $\mathbf{A}_i$

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What do we gain?

Current agent organizations ...

- Lack of an easy way, for the agents and for the designers, to check who has control over the situation.

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Difficulty for the agents to identify who should give restitution to whom for a certain state of the organization

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Despite the presence of norms, the organization has no guarantee that agents will provide the accompanying proofs, induced by their responsibilities

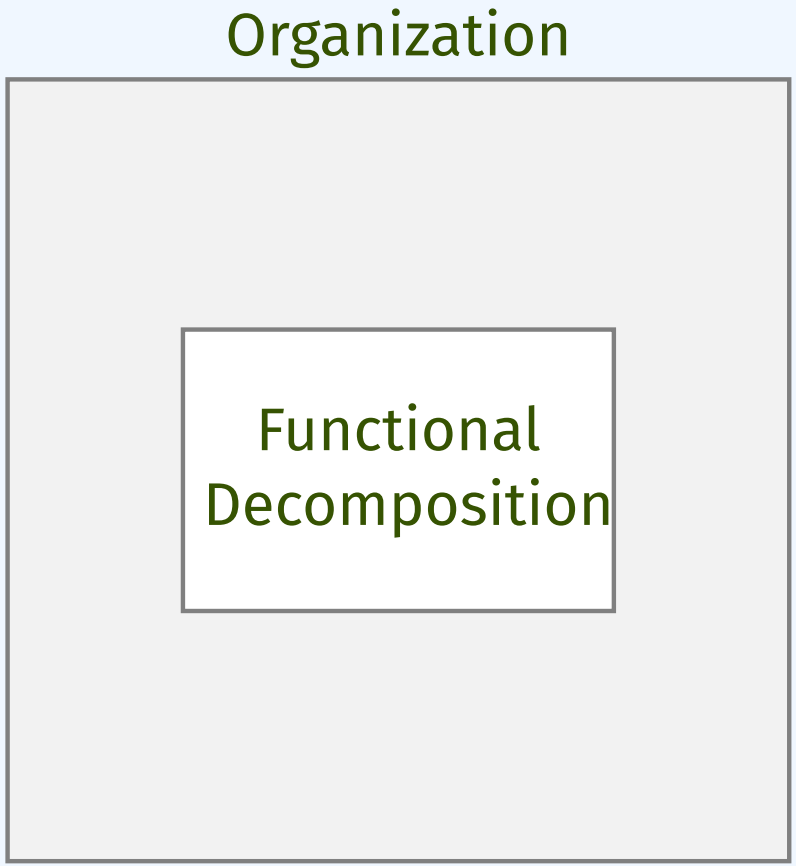
ARFIN: Robustness

- In case expected outcome is achieved, accompaining proofs can be asked and obtained; the process can be certified.
- In case of unexpected outcomes, it is up to the account-takers to tackle the received proofs by applying principles of remedy: they will start a different behavior aimed at achiving the goal in another way.
- The chosen accountability specification “defines” how **robustness** is realized.

ARFIN

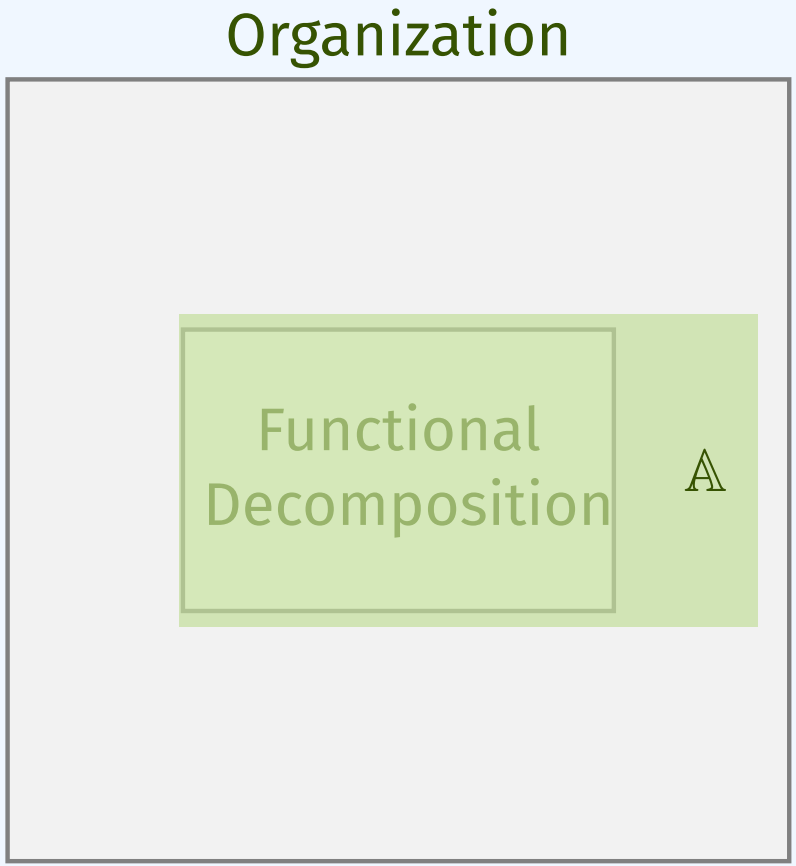
- The *coordination* relies on the **explicit assumption of responsibility and accountabilities** from agents
- **Rational Agent** takes on the responsibility for tasks it can perform
- Obligation is a “signal” produced by the organization which is recognized by the agent by virtue of responsibility and accountability.
- Agents are held to account by providing a proof (e.g., a trace of execution events)
- The system as a whole is **explainable**.

In a picture



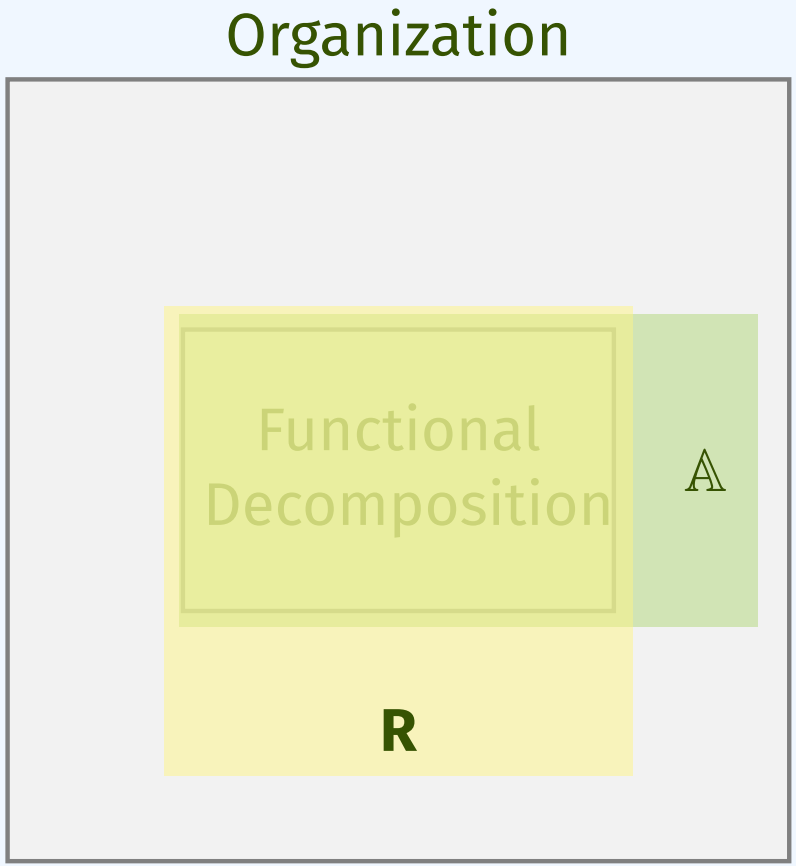
design time

In a picture



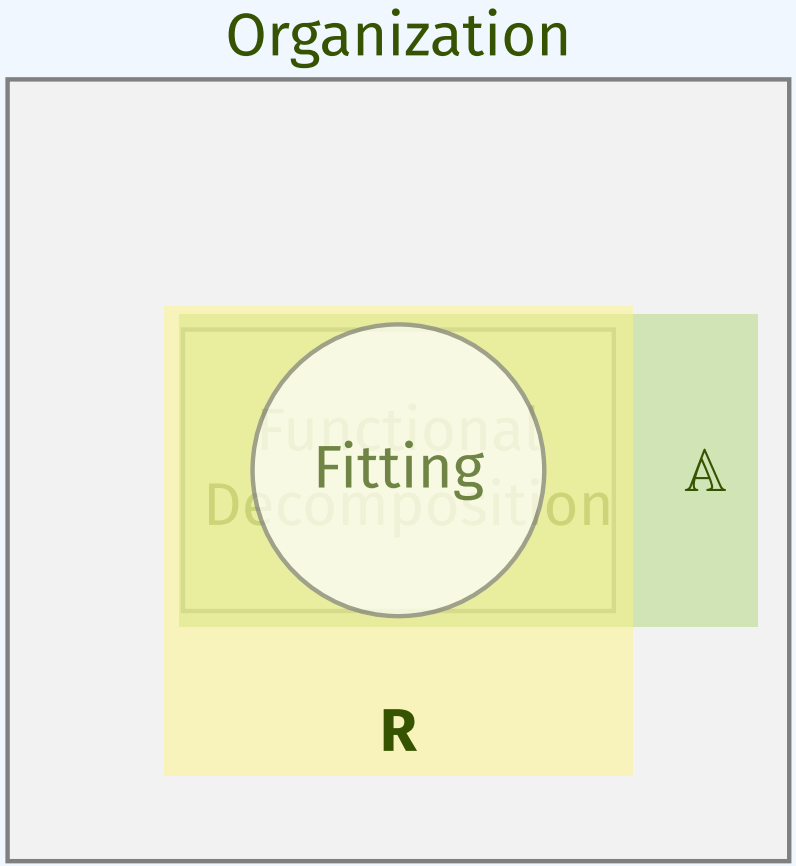
design time

In a picture



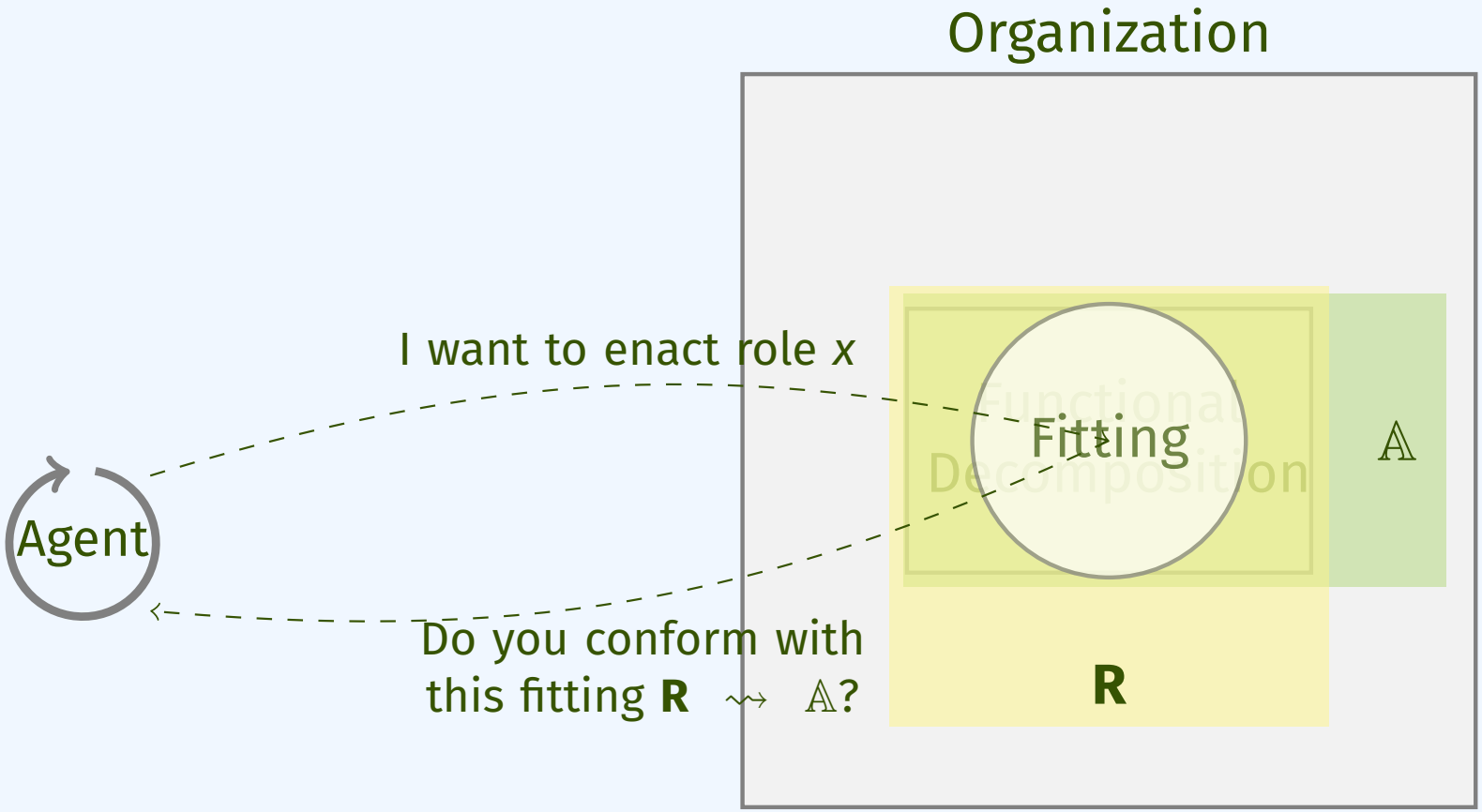
design time

In a picture



design time

In a picture



execution time

Programming Agents

(Preliminary work)

Exception Handling as Special Case (Baldoni et al. [4])

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Used in many programming languages:

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Exception Handling as Special Case (Baldoni et al. [4])

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Exception Handling as Special Case (Baldoni et al. [4])

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- **Agents??**
  We can try to use accountability specifications!

Projection over a Role

Definition

Given:

- the fitting $\mathbf{R} \rightsquigarrow \mathbb{A}$,
- a role x in its scope,

the **projection of the fitting over** x is defined as $\mathbf{R}_x \rightsquigarrow \mathbf{A}_x$ where:

- $\mathbf{R}_x \equiv \{R(x,q) | R(x,q) \in \mathbf{R}\}$,
- $\mathbf{A}_x \equiv \{A(x,y,r,u) | A(x,y,r,u) \in \mathbf{A}\}$,
- for every $A(x,y,r,u) \in \mathbf{A}_x$, there is $R(x,q) \in \mathbf{R}_x$, such that $(u/r)/\widehat{q} \equiv \top$ holds for some actualization $\widehat{q}$ of q.

Each pair $\langle R(x,q), A(x,y,r,u)\rangle$ in $\mathbf{R}_x \rightsquigarrow \mathbf{A}_x$, is mapped into an AgentSpeak(ER) g-plan:

+!be_accountable(x, y, q) <: drop_fitting(x, y, q) {

Well-Doing e-plan

+obligation(x, q) : $r \wedge c$

<- $body_q$.

Wrong-Doing e-plan

+oblUnfulfilled(x, q) : $r \wedge c'$

<- $body_f$.

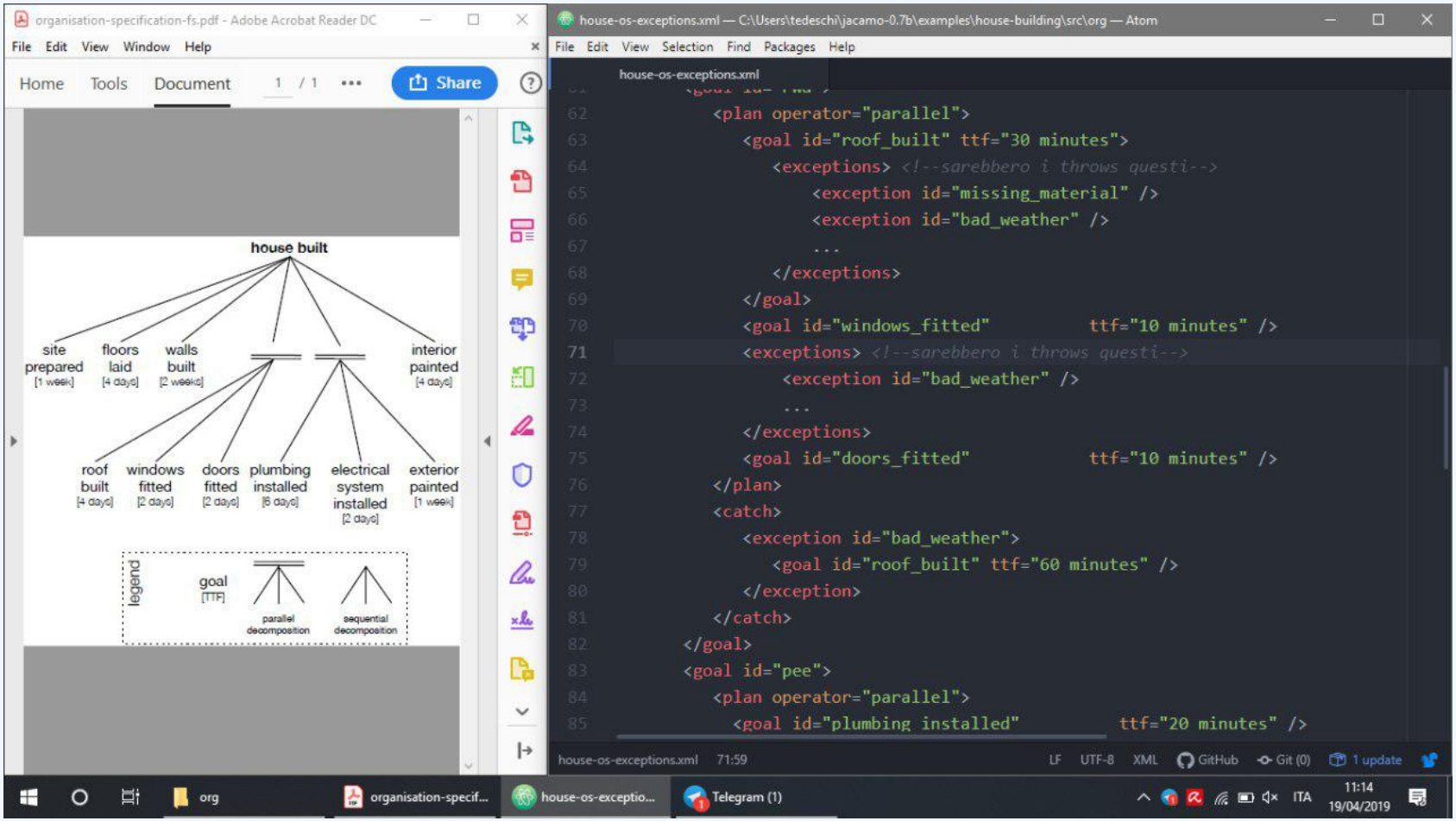
}

So that: (1) $body_q$ satisfies the *fitting-adherence* condition (see below); (2) $body_f$ includes sending an explanation for the failure from x to y.

Fitting Adherence

Let $\|body_q\|_u$ denote the set of sequences of events generated by the execution of $body_q$, restricted to the events that are relevant for the progression of u.

$body_q$ satisfies the *fitting-adherence* condition if:
$\exists$ sequence $s \in \|body_q\|_u$ such that $s \equiv \widehat{q}$ and $(u/r)/\widehat{q} \equiv \top$.


organisation-specification-fs.pdf - Adobe Acrobat Reader DC
File Edit View Window Help
Home Tools Document 1 / 1 Share
house built
site prepared [1 week]
floors laid [4 days]
walls built [2 weeks]
interior painted [4 days]
roof built [4 days]
windows fitted [2 days]
doors fitted [2 days]
plumbing installed [5 days]
electrical system installed [2 days]
exterior painted [1 week]
legend
goal [TTF]
parallel decomposition
sequential decomposition
house-os-exceptions.xml — C:\Users\tedeschi\jacamo-0.7b\examples\house-building\src\org — Atom
File Edit View Selection Find Packages Help
house-os-exceptions.xml
<plan operator="parallel">
<goal id="roof_built" ttf="30 minutes">
<exceptions> <!--sarebbero i throws questi-->
<exception id="missing_material" />
<exception id="bad_weather" />
...
</exceptions>
</goal>
<goal id="windows_fitted" ttf="10 minutes" />
<exceptions> <!--sarebbero i throws questi-->
<exception id="bad_weather" />
...
</exceptions>
<goal id="doors_fitted" ttf="10 minutes" />
</plan>
<catch>
<exception id="bad_weather">
<goal id="roof_built" ttf="60 minutes" />
</exception>
</catch>
</goal>
<goal id="pee">
<plan operator="parallel">
<goal id="plumbing installed" ttf="20 minutes" />
house-os-exceptions.xml 71:59 LF UTF-8 XML GitHub Git (0) 1 update
org
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11:14
19/04/2019

Conclusions

Conclusions

- Accountability and Responsibility as specification elements complementing the functional decomposition of a complex task
- Accountability captures coordination
- Responsibility captures capability
- Possible application domains:
  - Requirements engineering
  - Agent typing system
  - Design checking: does the set of responsibilities allow achieving some organizational goal?
  - Certification

Self-regulation in civil social organizations

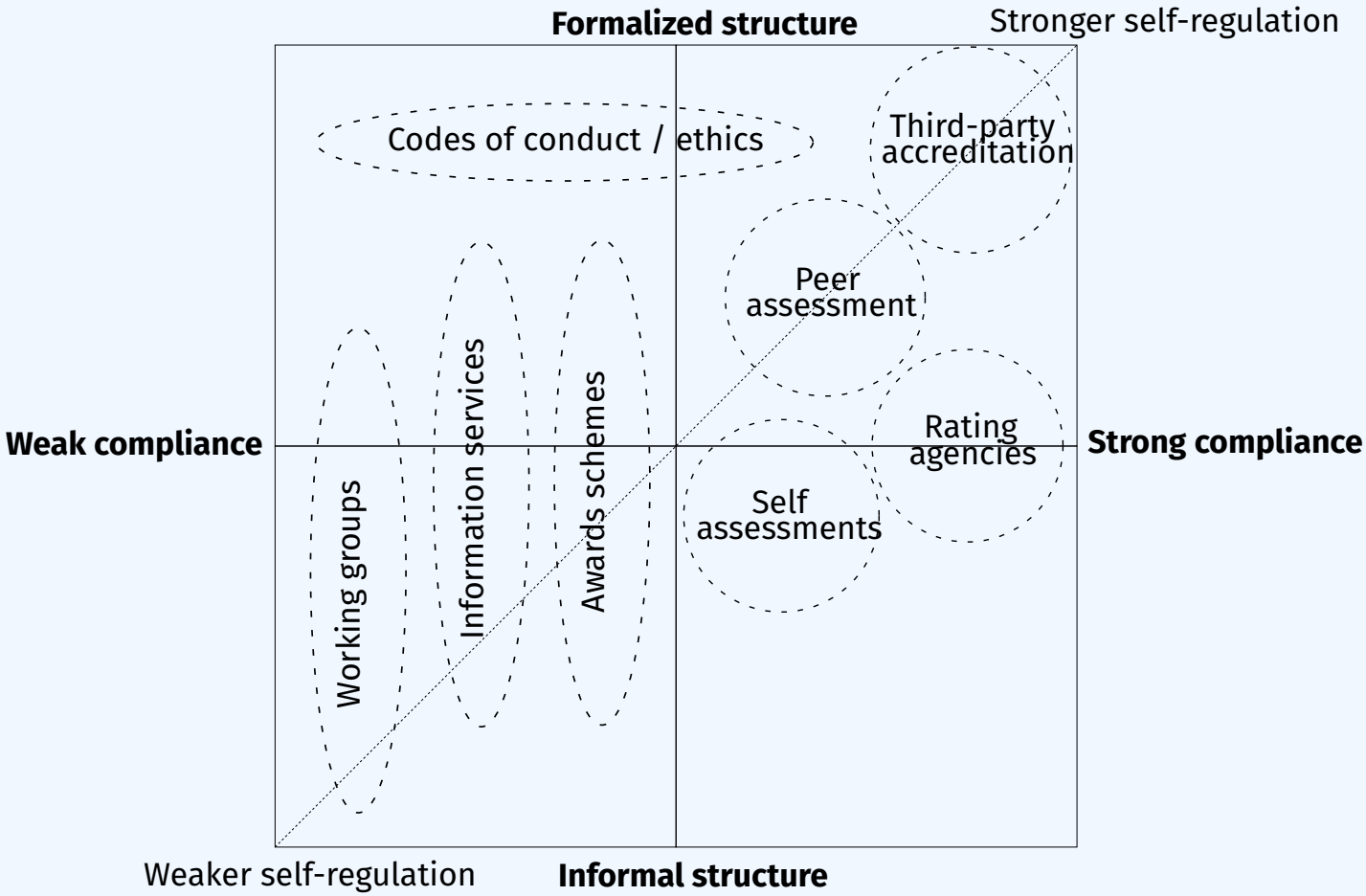

Figure: Types of self-regulatory initiatives within individual civil social organizations [29].

Some advertisement ...

PRIMA 2019

https://prima2019.di.unito.it/

PRIMA 2019: Important Dates

- Paper submission: June 30th, 2019 (11:59PM UTC-12)
  - Notification: August 25th, 2019
  - Camera-ready: September 5th, 2019
- Workshop proposal submission: May 27th, 2019
- Tutorial proposal submission: June 15th, 2019
- Conference dates: October 28th-31st, 2019

Main track + Social science track

WESAAC Organizers: Thanks for the opportunity you gave us!

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Questions?

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