

An Analysis of Agent-Oriented Engineering of e-Health Systems

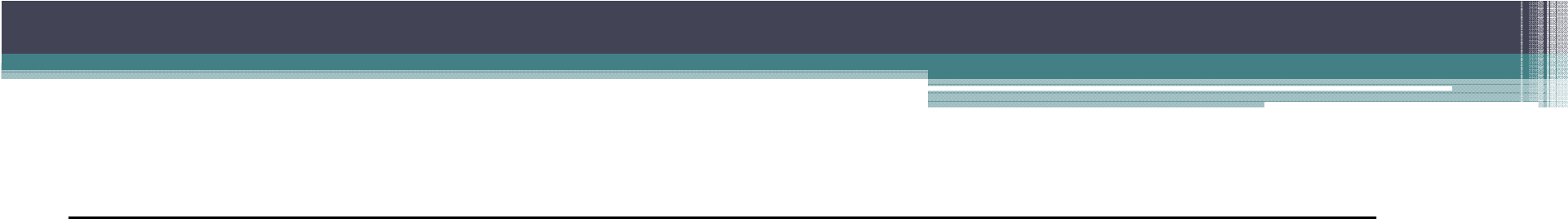
Emilia Garcia

**Gareth Tyson , Simon Miles, Michael Luck,
Adel Taweel, Tjeerd Van Staa, Brendan Delaney**



UNIVERSITAT
POLITÈCNICA
DE VALÈNCIA

KING'S
College
LONDON



To what extent is **AOSE** an approach that is appropriate to the development of **e-health systems**?

Overview

- Analysis + case-study:
 - e-Health system: ePCRN-IDEA
 - Challenges in e-Health system development
 - AOSE methodology: ROMAS methodology
- Discussion
- Conclusions

e-Health system: ePCRN-IDEA

- Clinical trials are experiments by which the efficacy of medical treatments are explored.
- They involve recruiting patients with specific characteristics to undergo new treatments.
 - Difficulty to find patients with these requirements
 - Time restrictions.
- **ePCRN-IDEA** is a new system under deployment in the UK healthcare system to enable **real-time recruitment** of patients for clinical trials.

Phase 1: Create and distribute clinical trial

- Research body creates a **new clinical trial** injecting it through a service called the Central Control Service (CCS)
 - CSS is hosted at King's College London (KCL).
 - The CCS stores trials within a large database in a pre-defined format that all researchers must adhere to.
- Associated with each trial is a **list of potentially eligible patients**
 - These lists are generated by the General Practice Research Database (GPRD)
- The trials and their eligibility lists are distributed to software agents (called **LEPIS agents**) that operate on clinicians' PCs at each participating clinic.

Phase 2: Real-time eligible patients detection

- During consultations LEPIS agents compare the patient information against the eligibility lists of all known trials.
- If a patient is found to be eligible for a trial,
 - The GP is notified
 - If the patient is interested, the system loads a **Random Clinical Trial (RCT)** website allowing the patient's recruitment to be completed.

e-Health system: ePCRNI-IDEA

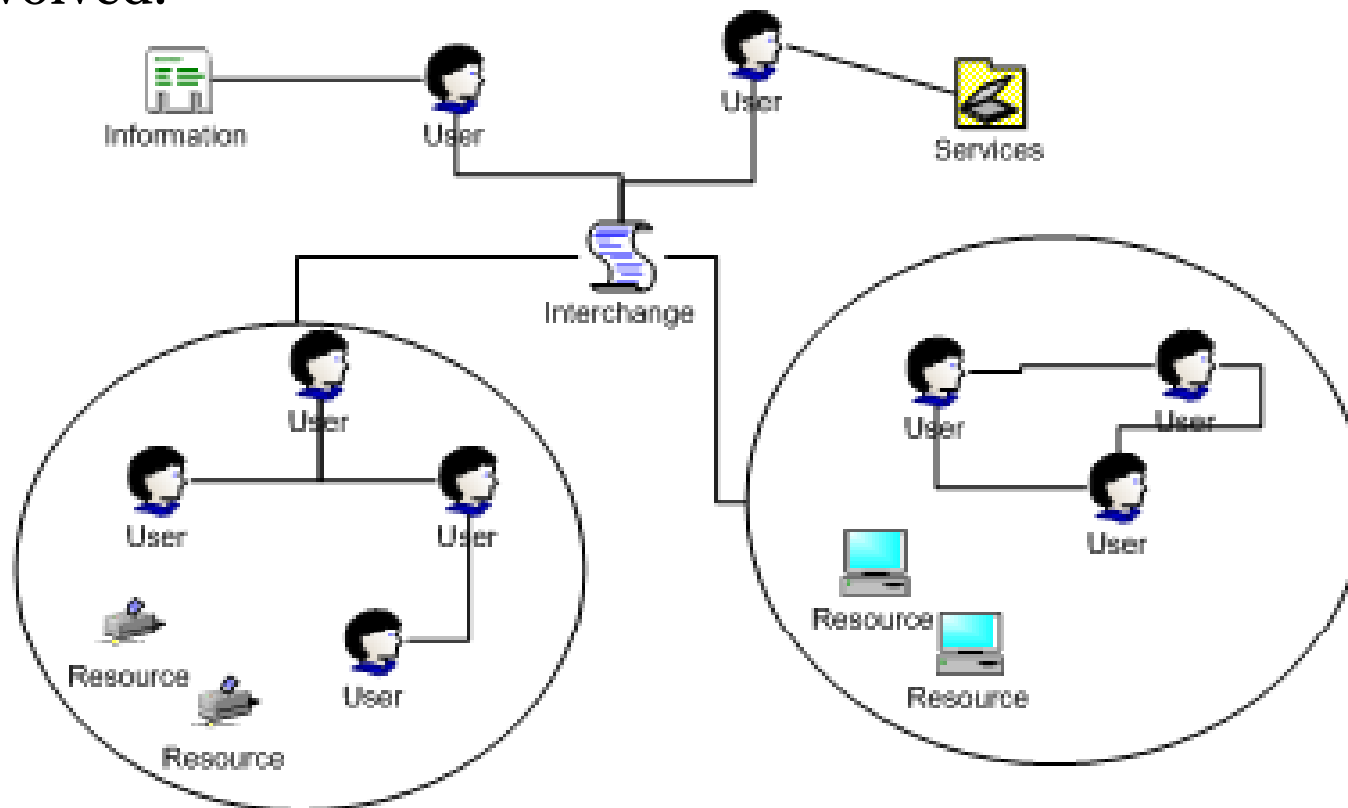
- The following organizations are involved:
 - The research bodies
 - Create clinical trials
 - King's College of London (KCL)
 - Store trials in a pre-defined format
 - Update clinic's software information about trials and eligible patients
 - General Practice Research Database (GPRD)
 - Create list of potential eligible patients
 - Participating clinics
 - Real-time patient's information
 - Direct contact between GP and patients

Challenges

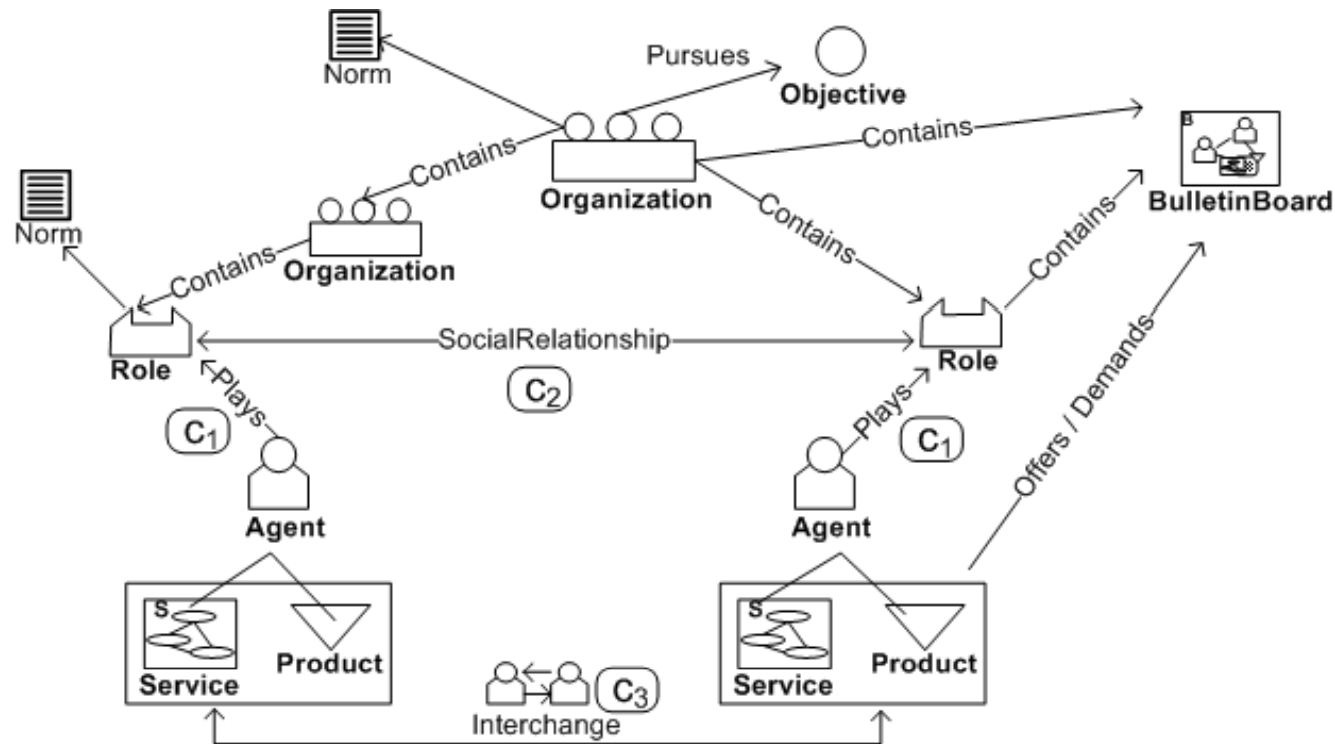
- Integration of Independent Systems.
 - Distributed Data
 - Interoperability (techniques, processes, semantics)
 - Trustworthiness
- Regulation of Independent Systems
- System Evolution.
 - New legislation, software and medical techniques
 - Adherence of new clinics

ROMAS methodology

- Regulated Open Multi-Agent Systems
 - heterogeneous and autonomous agents
 - that coexist in a complex social and legal framework
 - that address conflicting objectives of the many stakeholders involved.

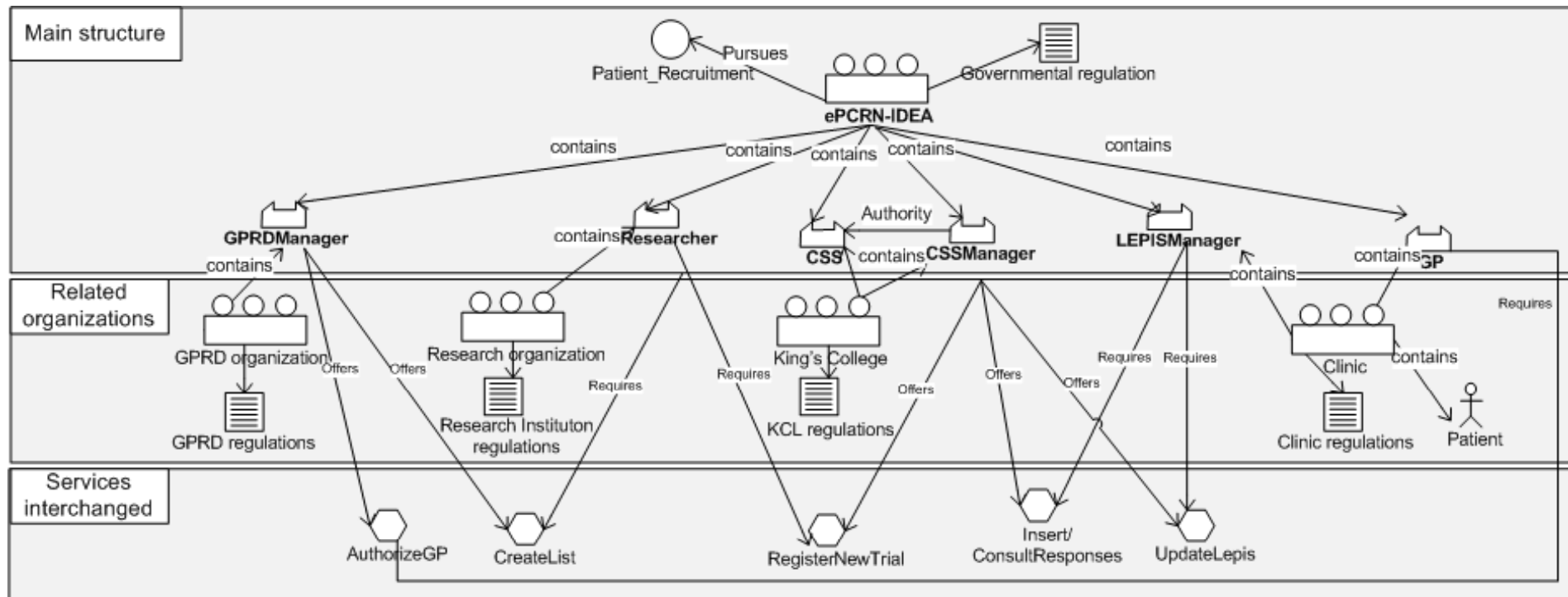


ROMAS overview



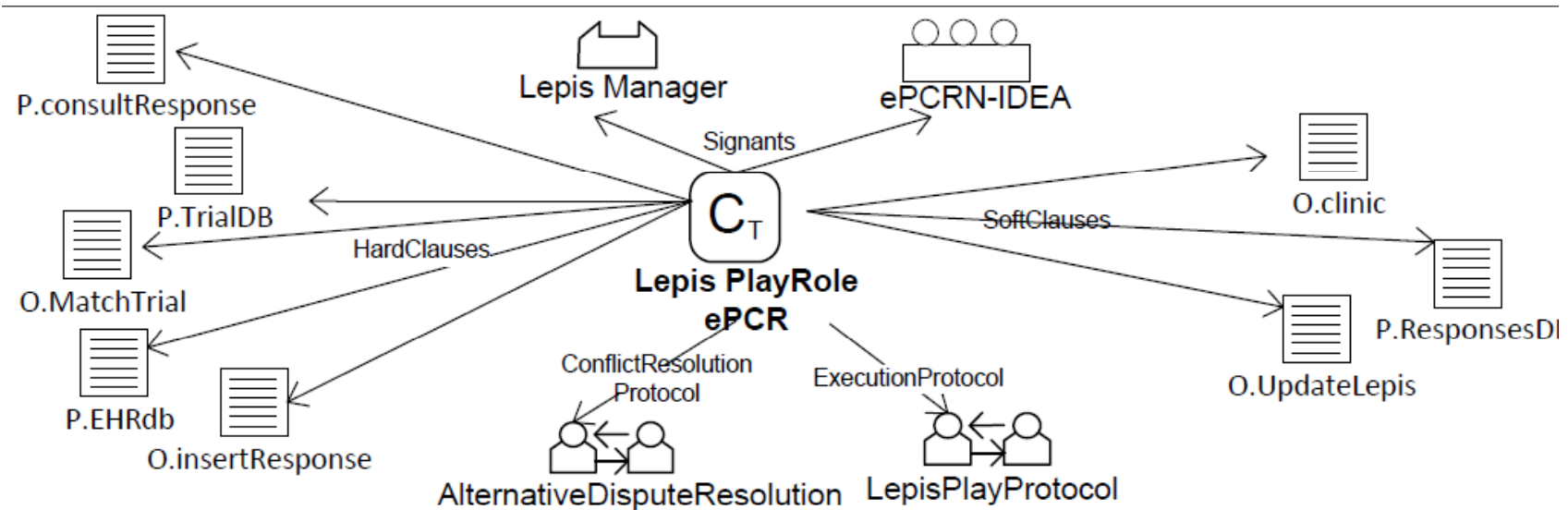
- ▶ Social structure and coordination
- ▶ Normative context:
 - Norms
 - Contracts
 - Social contracts
 - Contractual agreements

ePCRN-IDEA with ROMAS



Challenges	AOSE concepts
Integration of Independent Systems	Organizations, roles, agents
- Distributed data	Organizations, agents
-Interoperability	Services
-Trustworthines	Contracts, norms
Regulation of independent systems	Norms and social contexts
System evolution	Services, contracts, norms

ePCRN-IDEA with ROMAS



NORM ID	NORM DESCRIPTION (Deontic,Target,Activation,Expiration,Action,Sanction,Reward)
O.MatchTrial	(OBLIGED, Lepis, Event(changesEHR), -, Match_Trial_Historical,-,-)
O.UpdateLepis	(OBLIGED, Lepis,DAILY, -, Request(UpdateLepis service),-,-)
P.EHRdb	(PERMITTED, Lepis, -,-, Read(EHR database),-,-)
P.TrialDB	(PERMITTED, Lepis, -,-, Read(Lepis trial database),-,-)
P.ResponsesDB	(PERMITTED, Lepis, -,-, Write(Lepis patient responses database),-,-)
P.consultResponse	(PERMITTED, Lepis, -,-, Request(ConsultPatientAnswer service),-,-)
O.insertResponse	(OBLIGED, Lepis, GPInsertResponse, -,Request(InsertPatientResponse service),-,-)
O.clinic	(OBLIGED, Lepis, -,-, Pertain(Clinic),-,-)

Discussion: Beneficial features of AOSE

- Assumption of autonomy
- Allowance for openness
- Explicit norms
- High level of abstraction concepts

Discussion

- The integration of specific e-Health **terminology** in the AOSE design process would facilitate the comprehension of the domain experts.
- Although AOSE covers the analysis and design phases, there are not specific **guidelines** for capturing good practices for medicine and healthcare.

Conclusions

- The use of high level **AOSE concepts**, such as organizations, roles, services, norms and contracts, is beneficial to analyze and design health systems.
- The use **AOSE techniques** will produce flexible systems that can deal with the dynamics of the normative and technological environment.

Future work

- Integrate e-Health terminology with AOSE methodology
- Guidelines for capturing good practices for medicine and healthcare

Emilia Garcia

mgarcia@dsic.upv.es