Dynamic Generation of Agent Communities from Distributed Production and Content-Driven Delivery of Knowledge

AAAI Spring Symposium on Agent-Mediated Knowledge Management (AMKM-03)

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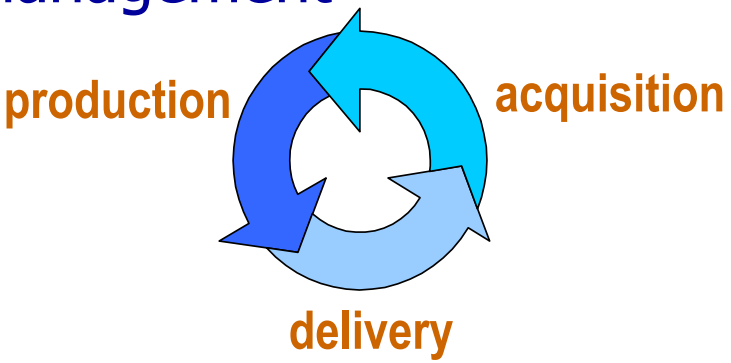
1. Introduction
2. Multi-agent collaborative production
   - Features and structure
   - Interaction within marts
   - Consolidation protocol
3. Case study
   - Course of the protocol
   - Results
4. Dynamics of markets
5. Conclusions

1. Introduction

- Collaborative knowledge management
  - KM processes
  - Distributed system
  - Collaborative creation
  - Task coordination needed
- Creation or production
  - Different interaction policies: compete, cooperate, negotiate
  - Structured interaction
- Delivery
  - Content-driven
  - Communities of interest

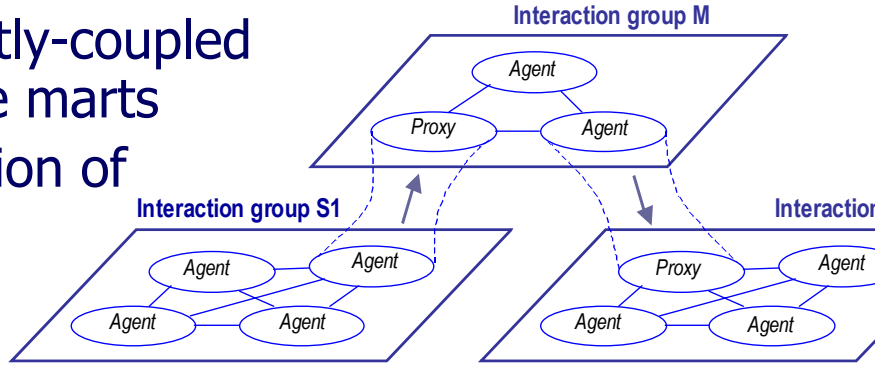


2. Multi-agent collaborative production

- Producers' collaboration (e.g. instructional designers)
  - Asynchrony
    - Development, exchange and evaluation of proposals are asynchronous.
    - Different pace of creation
  - Different levels of knowledge (Domain-level knowledge)
  - Decision privileges (e.g. lecturers vs. assistants)
  - Conflicts
- Multi-agent architecture motivation
  - Facilitates coordination when collaborating (e.g., compose a new educational resource)
  - Allows different interaction styles (e.g., compete, cooperate, or negotiate)
  - Organizes interaction in distributed, but interconnected domains of interaction

System features

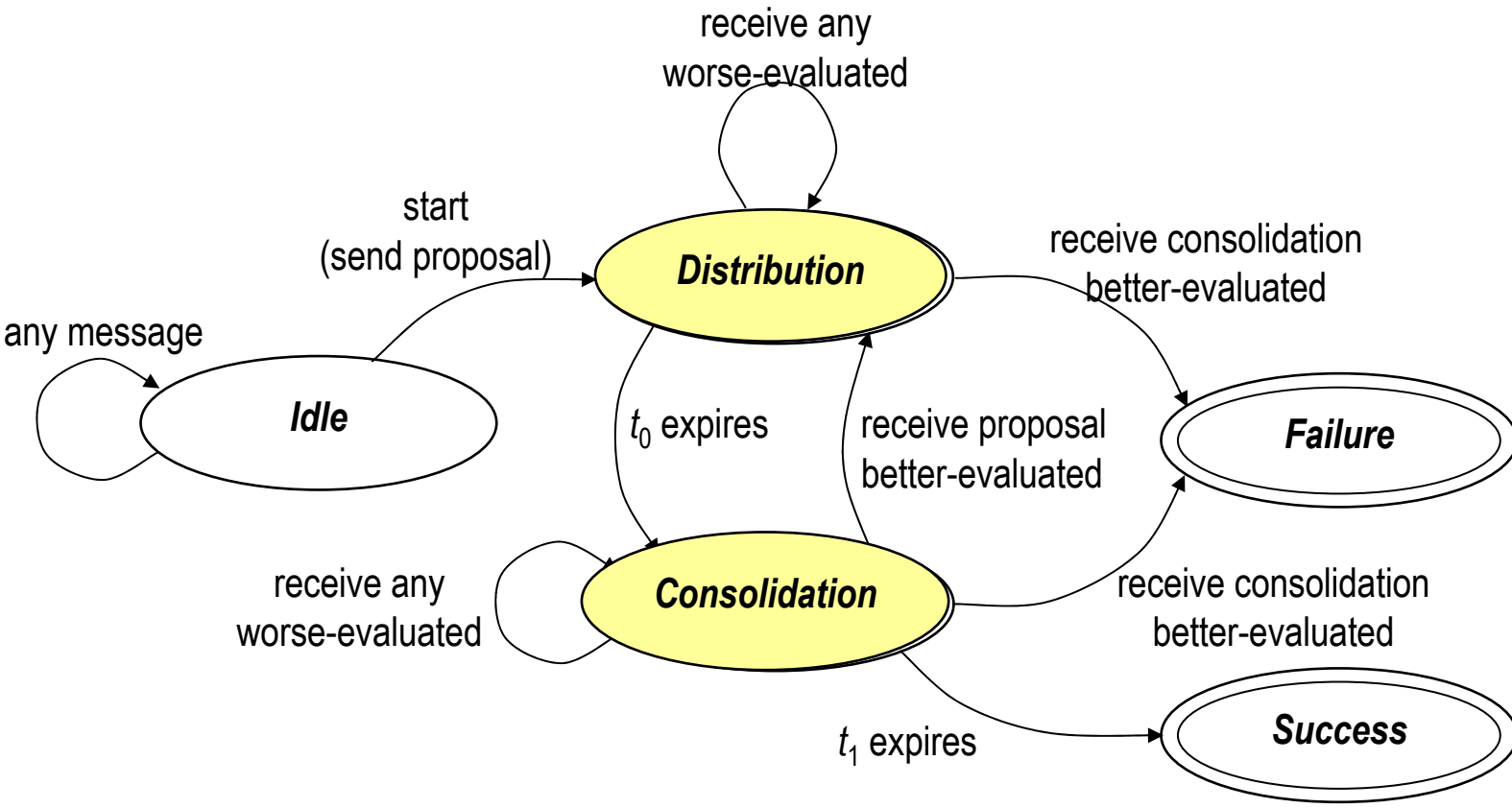
- From a functional perspective…
  - Consolidation of knowledge that is produced
- From a structural perspective…
  - Multi-tiered structure
  - Agents operate in tightly-coupled hierarchical knowledge marts
  - Progressive consolidation of knowledge
- From a behavioural perspective…
  - Affiliation of agents into marts
  - Evolution of marts



Interaction within marts

- Principles
  - Agent rationality modeled as preference relationships *k1* > *k2* or relevance functions *u*(*k*)
  - Relevant aspects modeled as RDF triples (object, attribute, value):
    - Submitter's hierarchical level
    - Fulfilment of goals
    - Time-stamp
- Message exchange
  - Message types
    - **proposal** (knowledge, interaction)
    - **consolidate** (knowledge, interaction)
  - Multicast, reliable transport facility

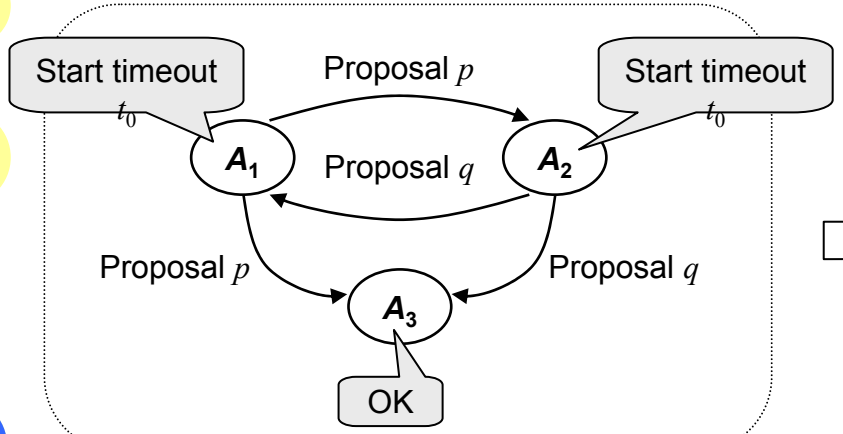
Consolidation protocol



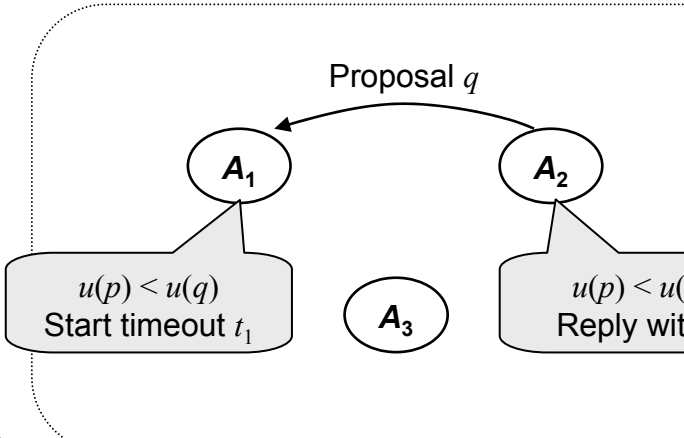
3. Case study

- Learning Object
  - Course titled "Introduction to XML"
- Roles
  - 3 instructional designers, represented by agents *A*1..*A*3
  - *A*1 is a docent coordinator
- Task
  - Development of the TOC
  - *A*1 submits p, *A*2 submits q, *A*3 does nothing
- Proposals
  - **p** = Proposed manifest file with 6 chapters
  - **q** = Modified manifest file, divides up chapter 5 in two
- Evaluation criteria
  - Fulfillment of objectives
  - Actor's rank

Course of the protocol

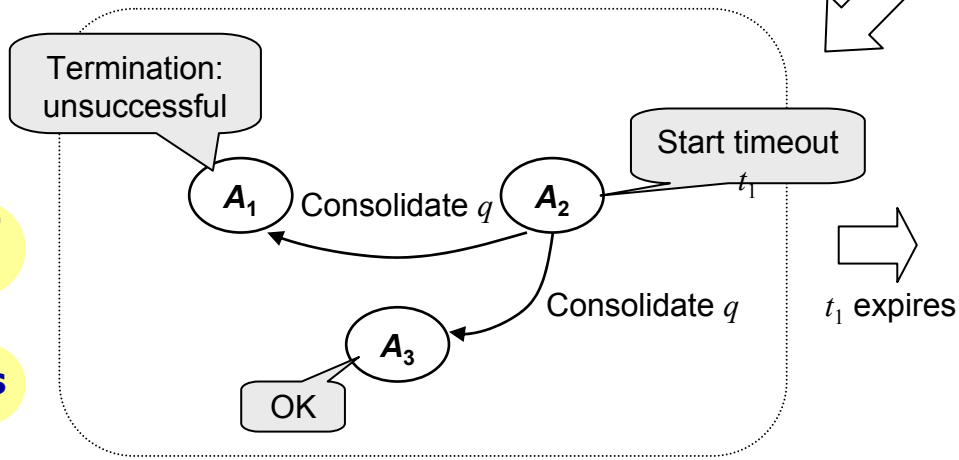


Initial exchange of proposals



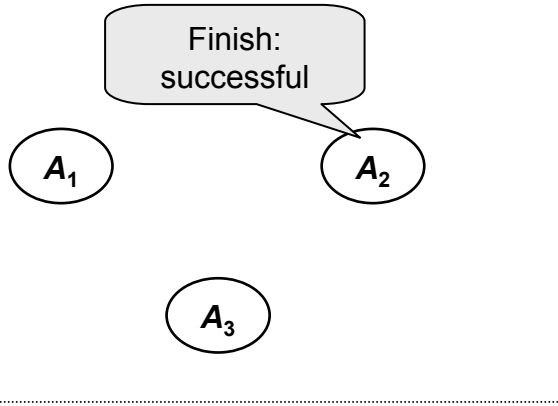
After receiving proposals

t_0 expires



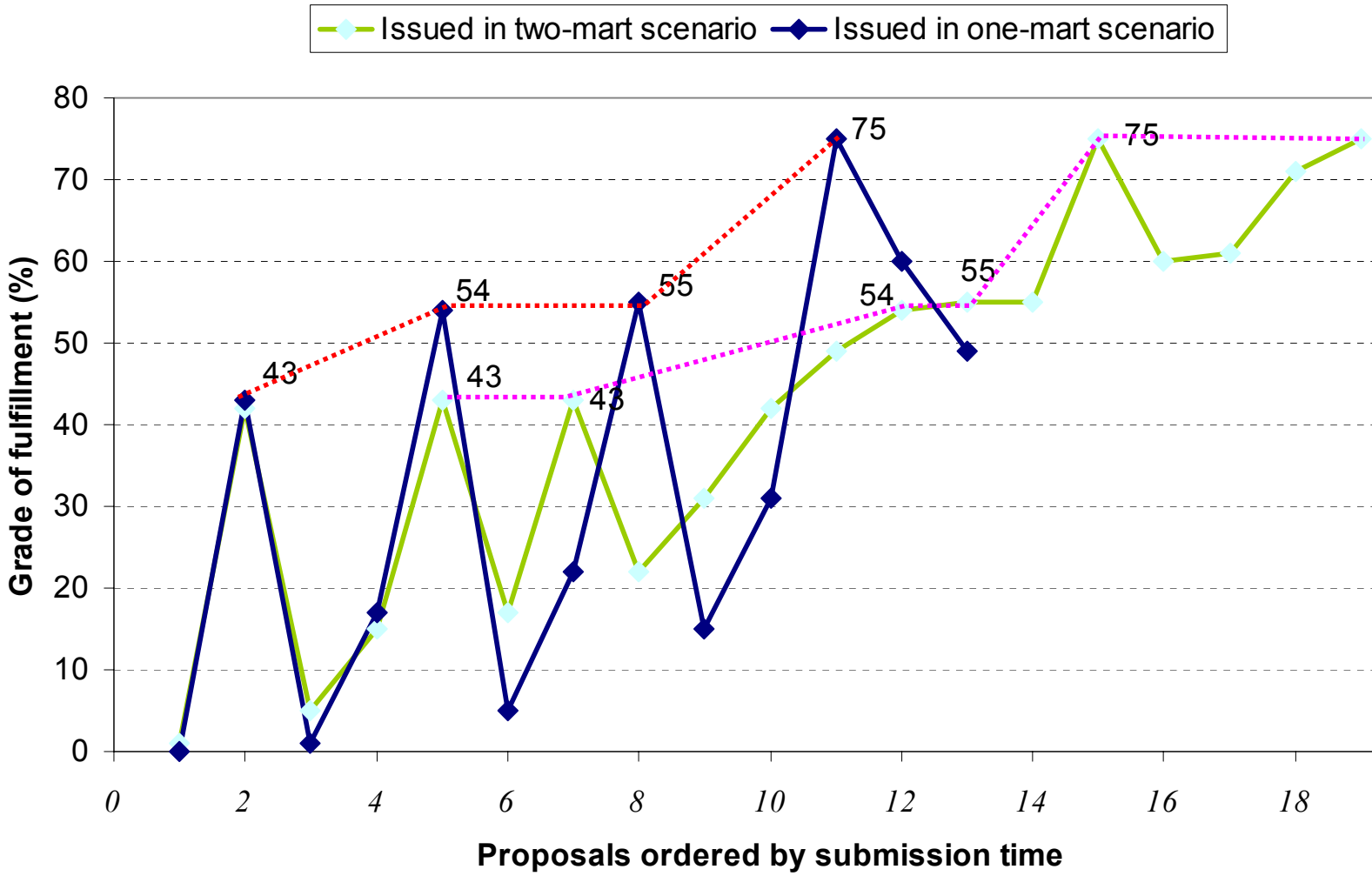
Consolidation after t_0 expiration

t_1 expires

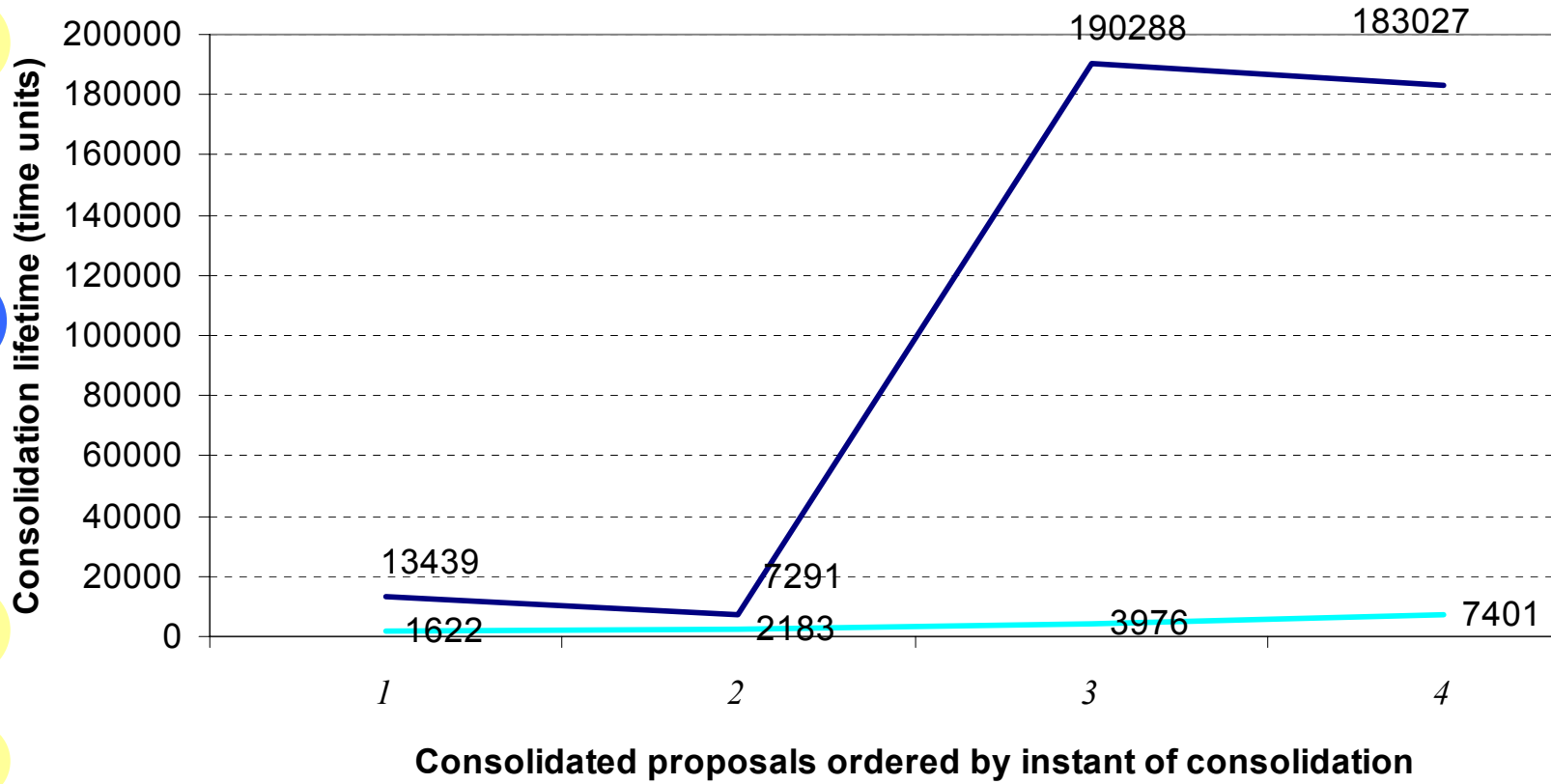


After t_1 expiration

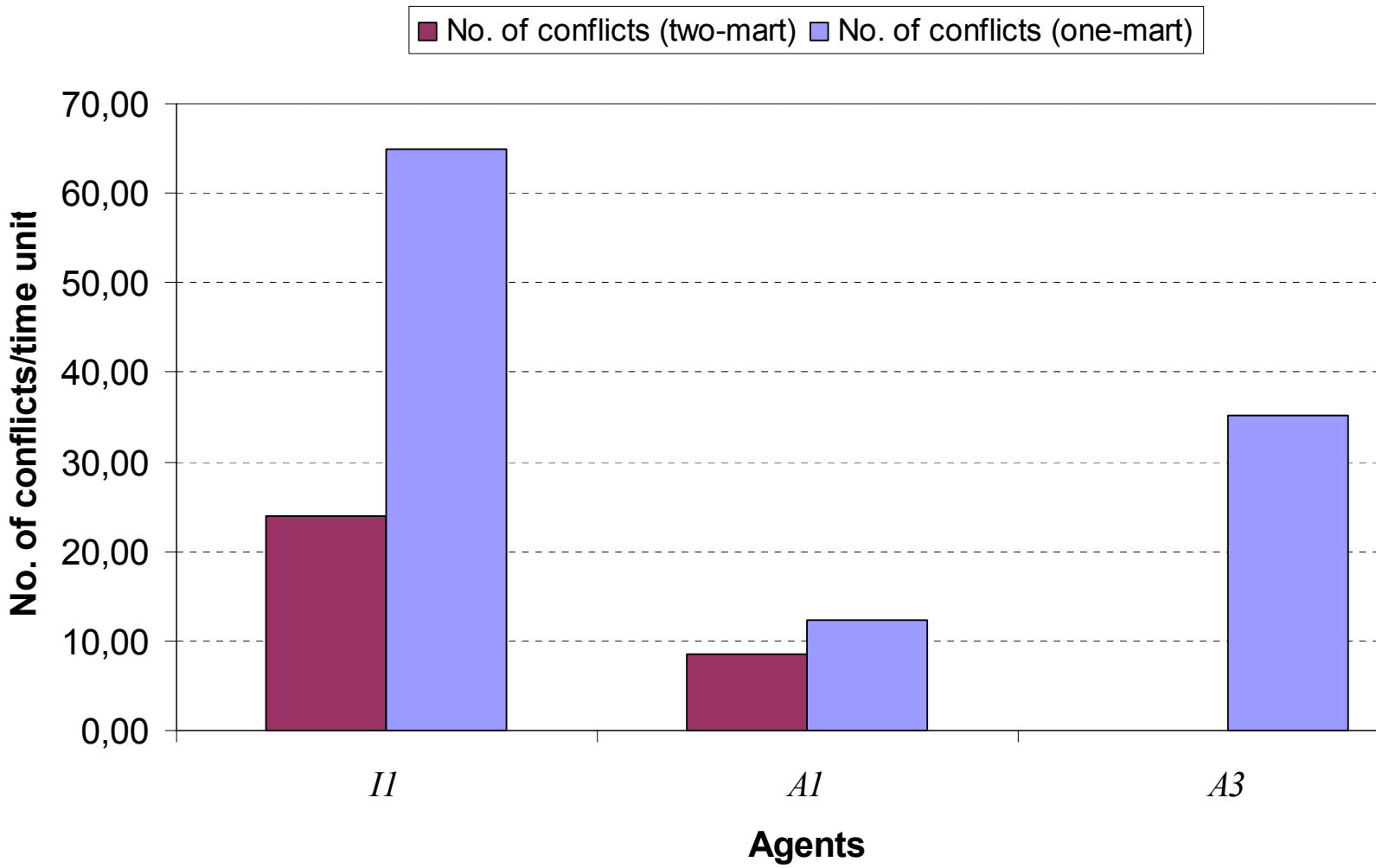
Results: quality (grade of fulfilment)



Results: consolidation lifetime



Results: number of conflicts

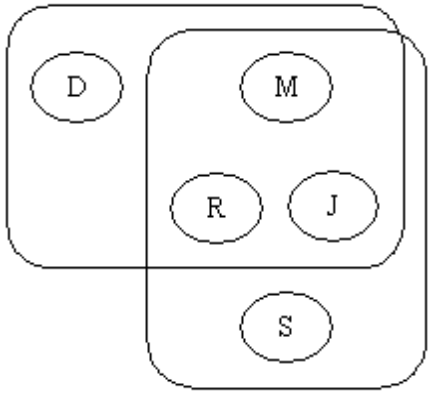


4. Dynamics of markets

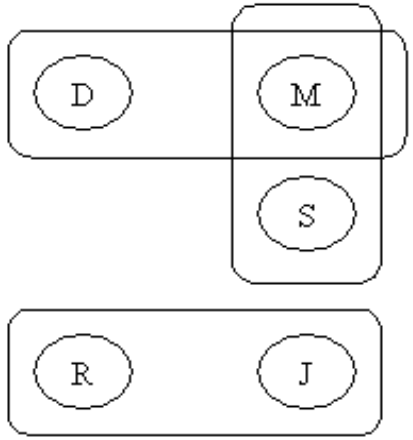
- Dynamics of collaborative groups
  - Agents affiliate to marts depending on the kind of knowledge that they produce
  - Marts evolve (merge or divide) depending on the kind of knowledge consolidated within them
- Agents arrangement
  - Cognitive distance d_k between agents and marts
  - Defined from dissimilarity between issued proposals' attributes
  - Agents operate in the *nearest* mart
  - Agents relocate based on Knowledge production
- Evolution of groups
  - Mart fusion/division
  - MajorClust algorithm

Dynamic of markets

- Information brokering services
  - Content-driven delivery
  - Filters to deliver contents of interest
  - Publish/subscribe pattern



- Communities of users
  - User agents subscribe to items of interest
  - User agents produce (publish) items
  - Brokers' routing tables are built
  - Routing tables contain (hide) users' layout into communities of interest



Goal

- Effective communications
  - Reduce amount of info shared by brokers
  - Reduce distance among agents and their interested marts
- Evaluate
  - Mart's optimal size
  - Cost of agent's relocation related to brokers communication efforts
  - Impact of mart's evolution in the service
- Find best clustering algorithm
  - *K*-means, COBWEB, MajorClust,... etc

5. Conclusions

❑ Features

- Bottom-up, multi-agent approach to collaborative knowledge production systems
- Dynamic building of user communities
- Applicable to other collaborative KM production tasks
  - e-Book & learning objects composition
  - Calendar organization
  - Software development (analysis & design)

❑ Improvements

- Further validation in multi-tiered scenarios
- Test of mixed interaction styles (retract, substitute, reject)
- Evaluation of dynamic evolution of marts