

REVERSE-ENGINEERING OF PERSONAL AND INTER- PERSONAL WORK PRACTICES: A CONTEXT-BASED APPROACH

Marielba Zacarias, H. Sofia Pinto, José Tribolet

CEO / ALGOS (INESC-INOV) / IST, Lisboa
Universidade do Algarve, Faro - Portugal

SUMMARY

- Introduction and Motivation

- Related Work

 - ~ Enterprise Modeling

- Conceptual Framework

 - ~ (Enterprise + Agent + Context) Modeling

 - ~ Model of Organizational Agents

- Acquisition Approach

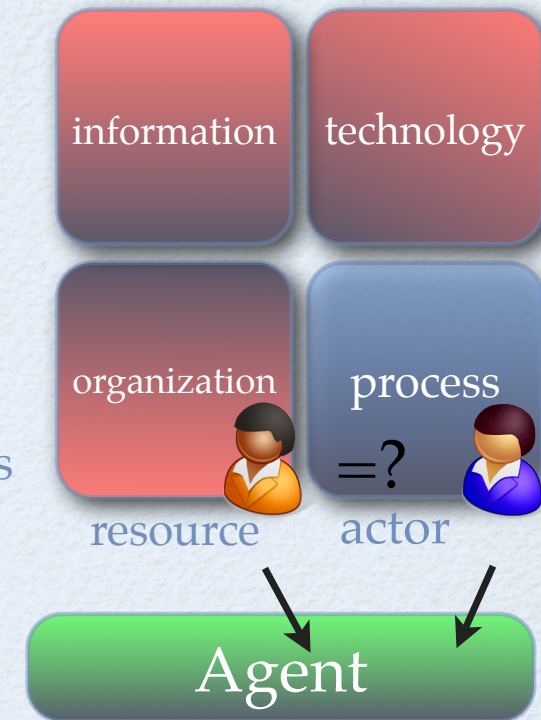
- Some results

INTRODUCTION

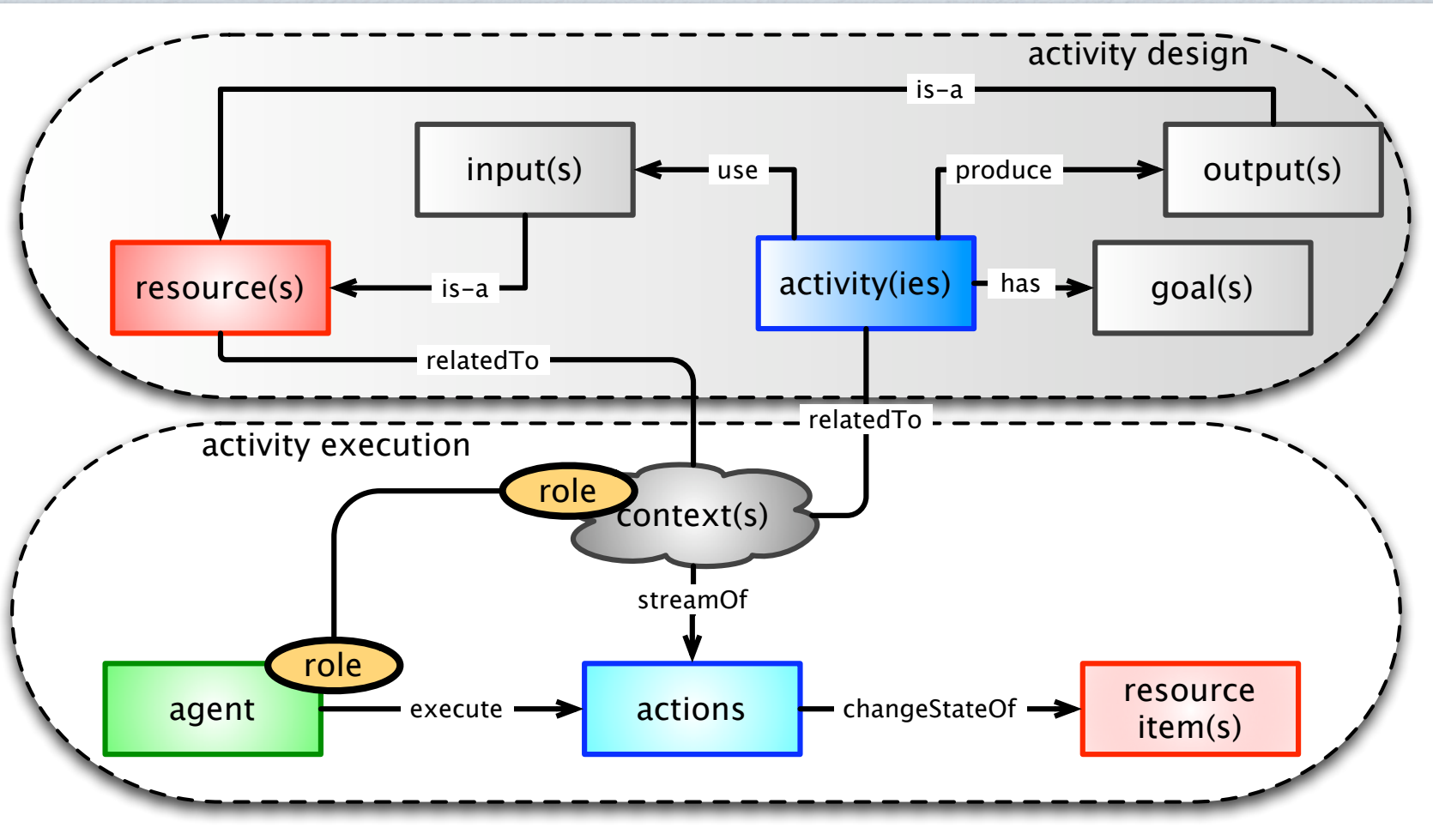
- Enterprise modeling: effective tool to *understand* and *communicate* the organization's *design* (structure and processes)
- GOAL: explore Enterprise Modeling to understand, analyze and discuss aspects of its *implementation*
- particularly, of individual and inter-personal work practices:
 - ~ who performs the work (people-activities-resources)
 - ~ *how / when / why* work is performed by individuals
 - ~ i.e. we aim at modeling the behavior of organizational agents
- *Motivation?*
 - ~ Better support to people at work
 - ~ Uncover problems not related to process / activity design
 - ~ Assessing the design-execution alignment
 - ~ Enhancing traceability of organizational agents

ENTERPRISE MODELING

- Enterprise Architectures/Ontologies (IS/IA)
 - ~ Support IS design, answering questions, process (re)design
 - ~ Different perspectives, a single enterprise
 - ~ Issues: Perspective mapping and alignment
- Agents in Enterprise Models:
 - ~ Part of organizational/process perspectives
 - ~ Regarded as simple actors/resources
 - ~ Fragmented representation of physical agents
 - ~ Only expected behaviors are captured
- Some models “decouple” agents from the other views
- However, some questions remain not answered..
 - ~ how/when/why agents do specific tasks?
 - ~ how/when/why agents use specific resources/tools?
 - ~ how do agents coordinate their work?

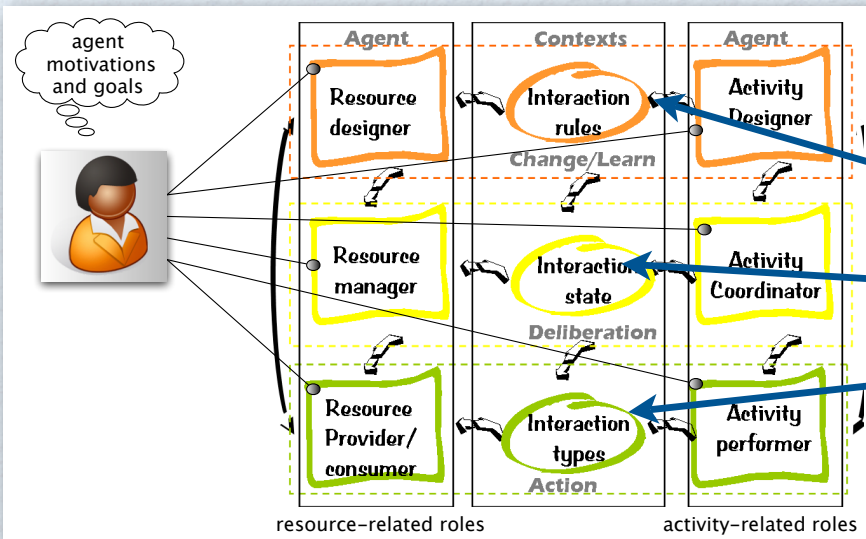


FUNDAMENTAL CONCEPTS



CONCEPTUAL FRAMEWORK

ARCHITECTURE OF ORGANIZATIONAL AGENTS

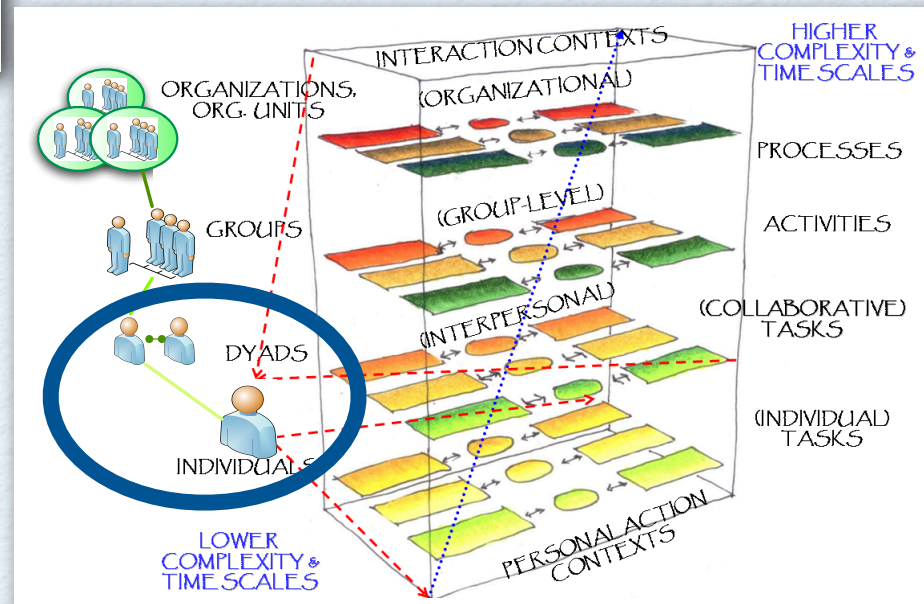


Context as unobservable rules

Context as a state of affairs

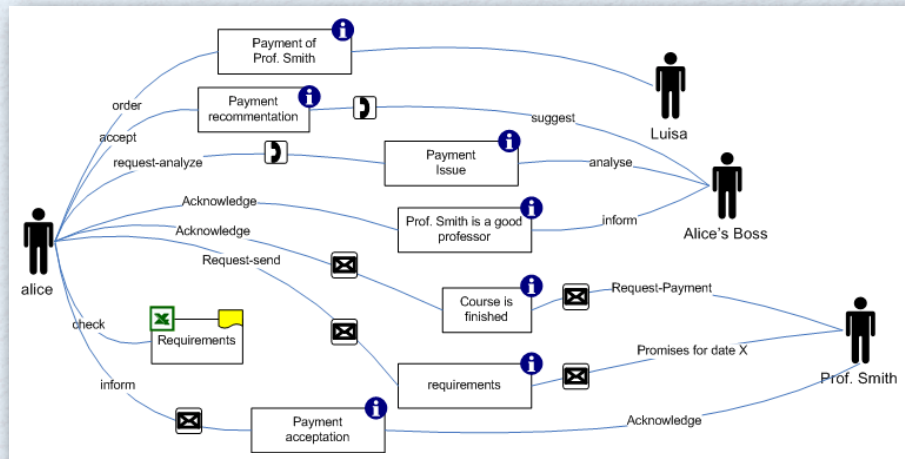
Context as a set of relevant items

Levels of detail addressed



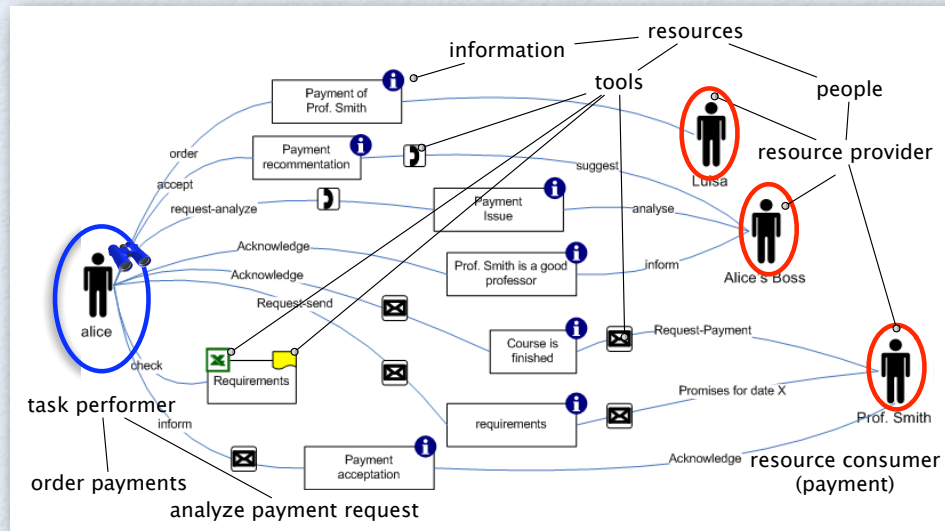
PERSONAL AND INTER-PERSONAL CONTEXTS

1. Prof. Smith request Alice payment of course
2. Alice check Prof. Smith's payment requirements
3. Alice request Prof. Smith to send payment requirements (course grades and report)
4. and inform payment will be ordered after sending payment requirements
5. Prof. Smith request payment without the requirements and justifies why (reason X)
6. Prof. Smith promises requirements for day D
7. Alice analyzes reason X given
8. Alice asks her boss if Prof. Smith request should be accepted and informs reason X
9. Alice's boss analyzes reason X and recommends payment because prof. Smith has a good record and reason X is strong
10. Alice accepts Prof. Smith request
11. Alice orders payment
12. Alice inform prof. Smith payment is ordered



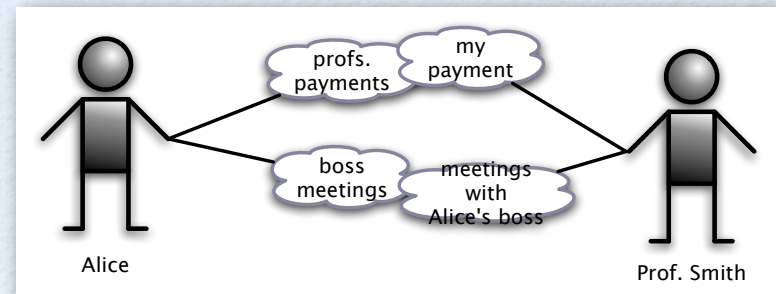
PERSONAL AND INTER-PERSONAL CONTEXTS

Personal contexts are *individual* views of given interaction contexts

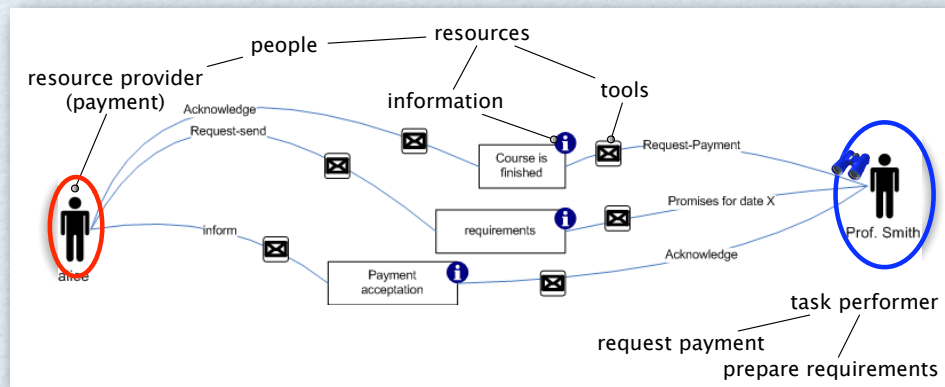


Payment Context: Alice's View

Resource provider



Resource consumer

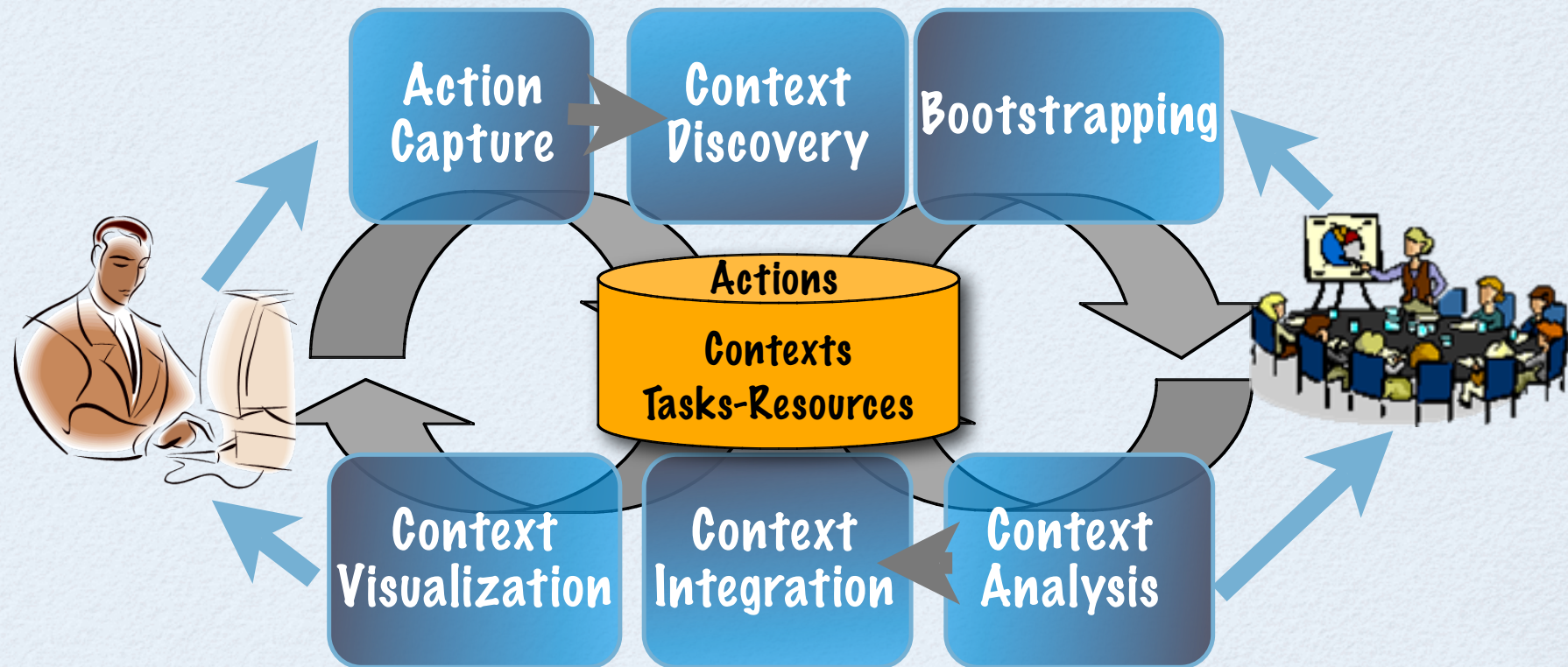


Payment Context: Prof. Smith View

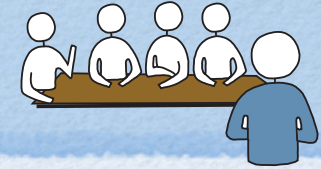
ACQUISITION APPROACH

- Premises:
 - Agent behavior of *action* and *deliberation* layers can be discovered from actions and interactions
 - Action and deliberation behavior is partially governed by *unobservable* rules.
 - These behaviors cannot be dissociated from their corresponding execution contexts
 - Agent behaviors change / evolve in time

APPROACH OVERVIEW

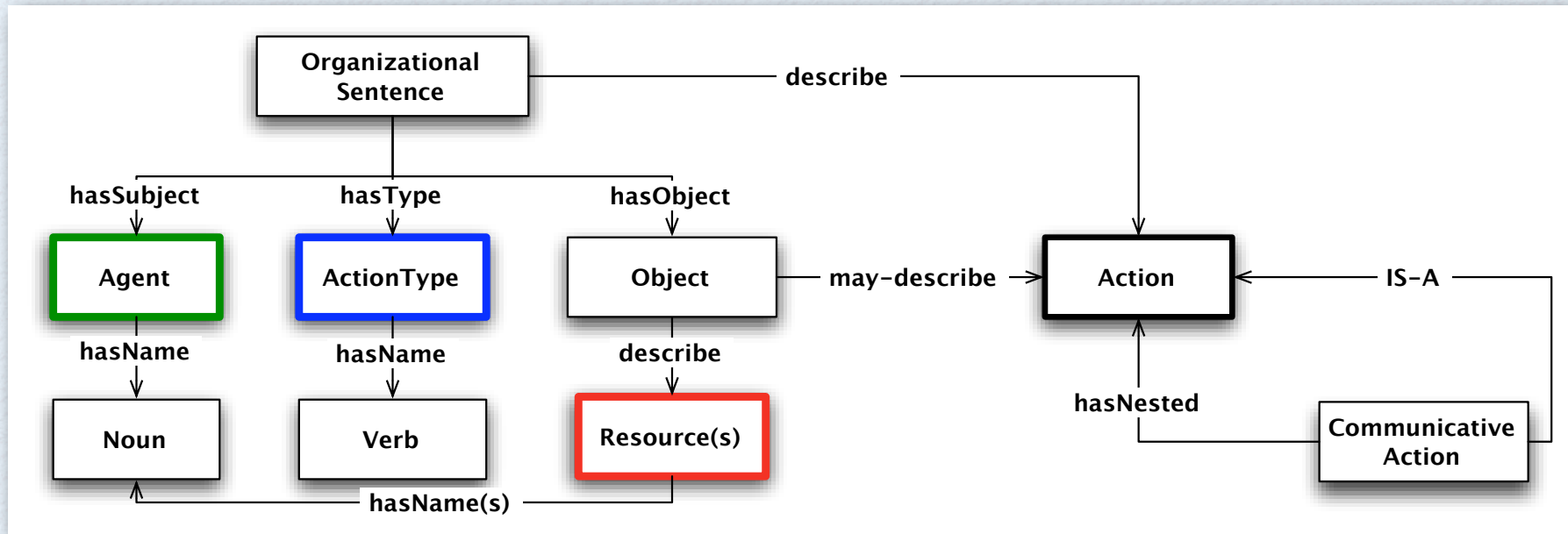


BOOTSTRAPPING



- Defining elementary semantic units (actions)
 - ~ request, inform, promise, ask, answer
- Resource-related items emerge from the action types defined
 - ~ Formal and informal information items:
 - ~ Payment requirements (course grades and report), Prof. Smith record
 - ~ Tools (MS-Excel)
 - ~ People or group names (Alice's boss)
- Initial set (may be extended)

ACTION STRUCTURE



action structure = <agent, action type, object>

example = <Alice, analyze, payment request>

structure of communicative actions = <agent, action type, <action>>

example = <Alice, request, <boss, analyze, payment request>>

ACTION CAPTURE



- Registered with their execution date
- Registered by the observed subjects, complemented with observer annotations
- Action sequences are identified

Example Action Log

n°	Date	foll.	Subject	Action Type	Receiver	Nested Action	Object Description Action	
							Main resource-related items	..supporting Resources (tools, people, information items)
...
20	1-Apr	0	Prof. Smith	request	Alice	pay	course X	e-mail
21	1-Apr	20	Alice	check			Prof. Smith's payment requirements	excel, payment requirement records
22	1-Apr	21	Alice	request	Prof. Smith	send	Prof. Smith's payment requirements	e-mail
23	1-Apr	22	Alice	inform		pay	will proceed when requirements are sent	e-mail
24	1-Apr	23	Prof. Smith	request	Alice	pay	without payment requirements	e-mail
25	1-Apr	24	Prof. Smith	inform	Alice		reason for not sending requirements	
26	1-Apr	25	Prof. Smith	inform	Alice	promise	requirements for date D	e-mail
27	2-Apr	26	Alice	analyze			payment request and reason given	
28	2-Apr	0	Alice	request	Boss	analyze	accept or reject Prof. Smith's request	telephone
29	2-Apr	28	Alice's boss	analyze			payment request and reason given	
30	2-Apr	29	Alice's boss	suggest	Alice	accept	payment request of Prof. Smith	telephone
31	2-Apr	30 28		inform	Alice		prof. Smith is a good professor	telephone
32	2-Apr	27	Alice	accept	Prof. Smith	pay	course X	e-mail
33	2-Apr	32	Alice	order	Luisa	pay	course X to Prof. Smith	
34	2-Apr	33	Alice	inform	Prof. Smith	pay	is ordered	e-mail

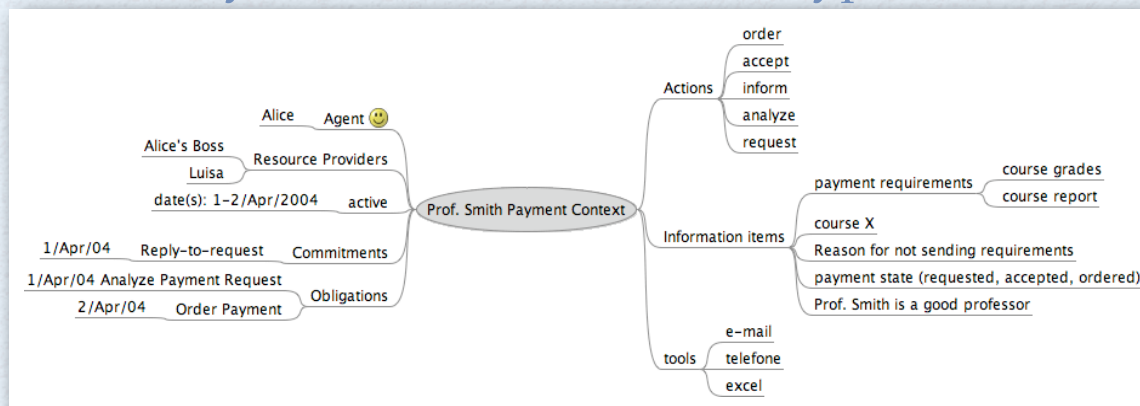
CONTEXT DISCOVERY



1. Personal contexts: Grouping action streams using similar resources

nº	Date	fol.	Subject	Action Type	Receiver	Nested Action	Main resource-related items	..supporting Resources (tools, people, information items)
21	1-Apr	20	Alice	check			Prof. Smith's payment requirements	excel, payment requirement records
22	1-Apr	21	Alice	request	Prof. Smith	send	Prof. Smith's payment requirements	e-mail
23	1-Apr	22	Alice	inform		pay	will proceed when requirements are sent	e-mail
27	2-Apr	26	Alice	analyze			payment request and reason given	
28	2-Apr	0	Alice	request	Boss	analyze	accept or reject Prof. Smith's request	telephone
32	2-Apr	27	Alice	accept	Prof. Smith	pay	course X	e-mail
33	2-Apr	32	Alice	order	Luisa	pay	course X to Prof. Smith	
34	2-Apr	33	Alice	inform	Prof. Smith	pay	is ordered	e-mail
9	1-Apr	8	Alice	inform	Miguel		last POSI meeting is OK	e-mail
17	1-Apr		Alice	order	Luisa	pay	March-April IT support	e-mail, March-April invoices
19	1-Apr	0	Alice	send	TR		software CDs for installation	snail mail, CDs
2	1-Apr	1	Alice	request	Luisa	search	travels folder	
4	1-Apr	3	Alice	request	Luisa	register	invoice data in travels file	
5	1-Apr	4	Alice	request	Luisa	compare	invoice value with budgeted value	excel, travels budget file
6	1-Apr	5	Alice	request	Luisa	register	invoice data in travels file	excel, travels folder, travels file
13	1-Apr	12	Alice	print			PM course proposal file	word, PM course proposal file
14	1-Apr	13	Alice	store			PM course proposal in short courses folde	word, course folder
11	1-Apr	1	Alice	schedule			when to provide information about POSI	outlook

2. Context keywords: Recurrent action types and resources



3. Labeling contexts: Prof.'s Smith payment

4. Tagging actions with their contexts

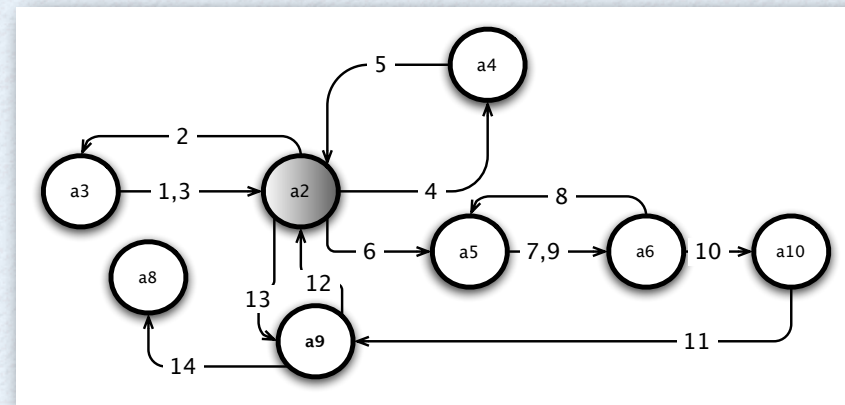
ACQUISITION APPROACH

CONTEXT-BASED ANALYSIS



CONTEXT ID	CONTEXT NAME
a1	Prof. Smith's Payment
a2	Contact information and calls for boss
a3	Post-Graduate Course (POSI) budget training and supervision
a4	Student scholarship issue
a5	Travel Arrangements
a6	POSI Candidate students
a7	Project Management (PM) Courses
a8	POSI Document handling
a9	POSI budget elaboration
a10	POSI meetings
a11	TR (POSI Sub-contractor)

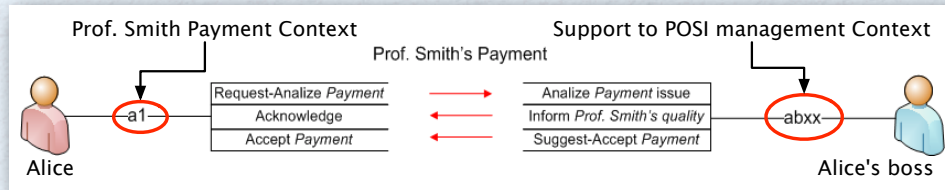
Alice: List of Personal Contexts



Context Switches

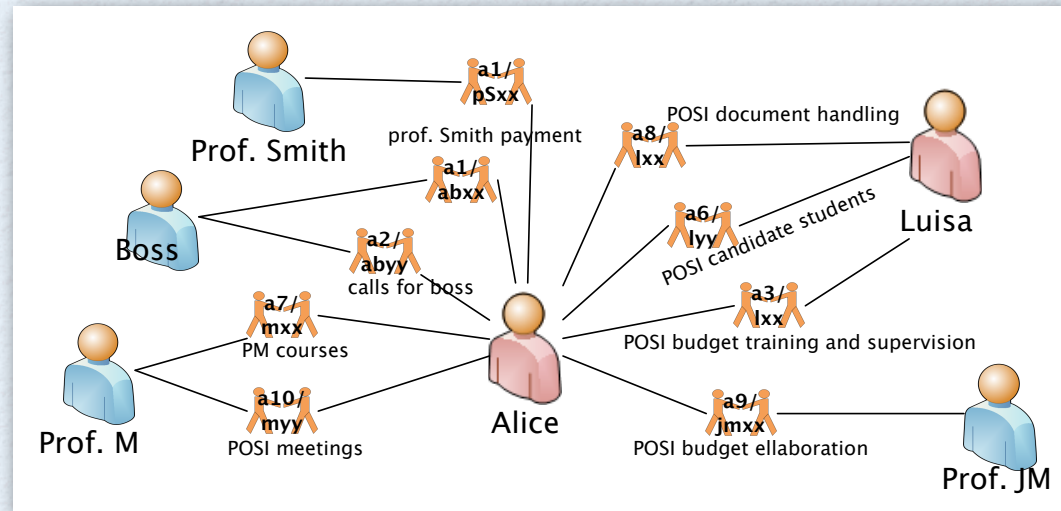
Application: Discovery and Analysis of multi-tasking behavior

CONTEXT-BASED ANALYSIS



Acquiring Inter-Personal Contexts

Acquiring Inter-Personal Interaction Networks



Applications:

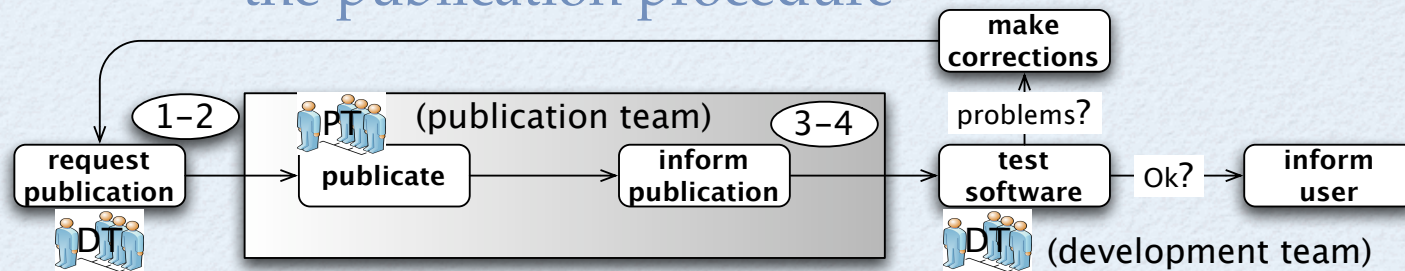
1. Discovering recurrent action sequences
2. Discovering recurrent resource flows

CONTEXT INTEGRATION



- Human process
- “de-contextualization” of representations i.e.
- representations are discussed and integrated in formal models

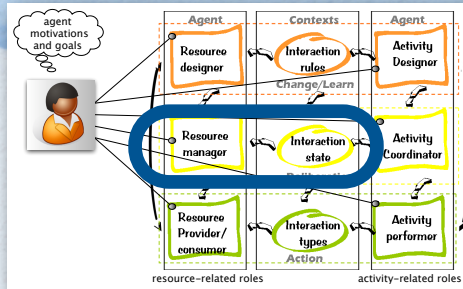
the publication procedure



CASE STUDIES

- Software development team of commercial bank
 - ~ 1 team leader, 4 programmers
 - ~ three-week period observation
 - ~ over 500 actions
 - ~ no bootstrapping, manual process
- Purchasing team
 - ~ 5 individuals
 - ~ three-week period observation
 - ~ over 700 actions
 - ~ bootstrapping, action capture supported by web application

MULTI-TASKING BEHAVIOR



1. Personal Contexts

Person Name	Context ID	Context Name
Alexandre	a1	Data Collection for Mail Application
	a3	Evictions Web Service Problem
	a5	Carla's Support (Web Serv & Mail App)
	c1	Common Services Application Programmin
Carla	c2	Programming support (Mail & Suppliers Ap
	c3	Team Meetings
	Mariana	m1
m011		Cards Information Collection
m6		Evictions Web Service Problem
m8		Suppliers Application Programming

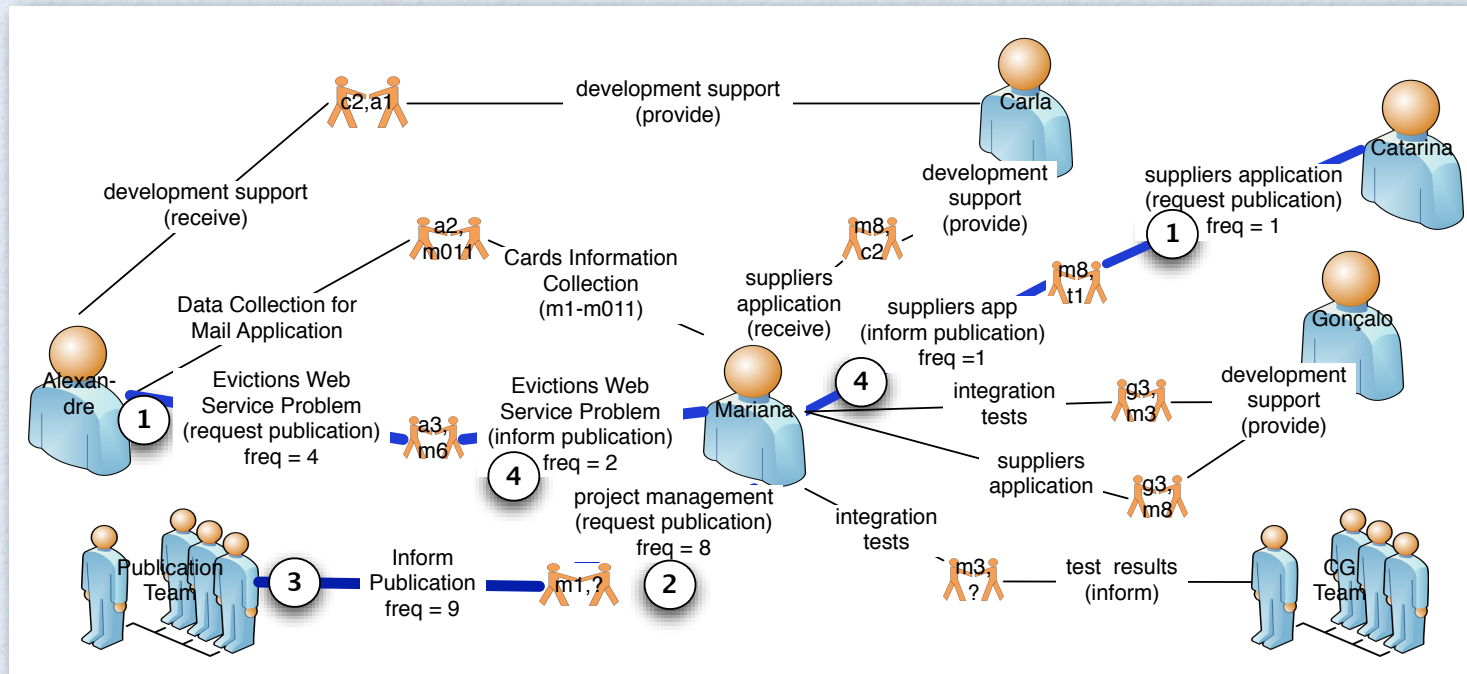
3. Switching Rules

Rule	Trigger (event)	Trigger (commitment)	Activate Context
1	meeting accepted	elaborate project list	m1 project reports and meetings
2	Dept. Head's request	elaborate project status report provide information of the	m1 project reports and meetings
3	Alexandre's request	cards application	m011 cards information collection
4	CG team informs test failure	resume tests	m3 Integration tests
5	Catarina's request	perform message maintenance	m9 message maintenance

switch order	6	7	9	10	14	15	16	17	20	21	22	23	27	28	29	30
19	m1															
18	m011															
17	m1															
16	m3															
15	m1											m8				
14	m3											m81	m81			
13	m1	m5				m5						m3	m9			
12	m4	m3				m51						m1	m81			
11	m1	m6				m5		m6				m81	m8			
10	m3	m5	m1	m5	m51	m1		m81				m3	m81			
9	m4	m3	m3	m1	m3	m81		m6				m8	m9		m8	m9
8	m1	m5	m5	m3	m51	m5		m81				m5	m81	m1	m5	m10
7	m011	m012	m6	m1	m8	m8		m8		m81		m81	m9	m8	m9	m8
6	m3	m4	m3	m3	m81	m2	m8	m81	m011	m3	m6	m10	m8	m1	m8	m5
5	m1	m5	m6	m1	m51	m81	m81	m3	m2	m011	m10	m81	m81	m81	m9	m8
4	m2	m4	m3	m3	m8	m3	m8	m81	m1	m8	m2	m8	m5	m8	m8	m81
3	m3	m5	m6	m1	m1	m81	m81	m3	m81	m3	m10	m81	m9	m1	m9	m8
2	m2	m1	m3	m3	m8	m1	m3	m8	m1	m8	m6	m1	m81	m10	m8	m81
1	m1	m3	m2	m1	m7	m3	m81	m81	m81	m81	m10	m10	m9	m9	m9	m9

2. Context Switches

RECURRENT ACTION SEQUENCES



1. Request-Publication (developer to PM)
2. Request-Publication (developer to PM)
3. Inform-Publication (PM to publication team)
4. Inform-Publication (publication team to PM)

AUTOMATIC CONTEXT DISCOVERY

- Data preparation:
 - Identify resource-related keywords (information, tools, people)
 - ~ described with noun phrases within objects
 - Text mining services of Sql Server (term extraction services)
 - ~ fuzzy grouping to eliminate errors and inconsistencies
 - ~ term extraction to identify resource-related keywords

keyword term	frequency	clean keyword term	similarity degree
automatic table updates	18	automatic table update	0.9
automatic table update	4	automatic table update	1
evictions web service	42	evictions web service	1
web service	2	evictions web service	0.8

1. Eliminating errors and inconsistencies

2. Keyword extraction

Keyword Term	frequency
suppliers application	192
claims application	105
Team meeting	58
quality env	49
evictions web service	42
integration test	42
Mail application	31
Web component	31
production env	27
marketing application	25
Data management class	25
User access	24
application class	24
common services application	23
automatic table update	22
document association function	20

AUTOMATIC CONTEXT DISCOVERY

Grouping action around:

- ~ date, action and resource keywords
- ~ (information items, tools, people)

Probabilistic clustering

- ~ Allows overlapping clustering
- ~ Appropriate for non-numerical attributes
- ~ Microsoft Expectation-Maximization Algorithm

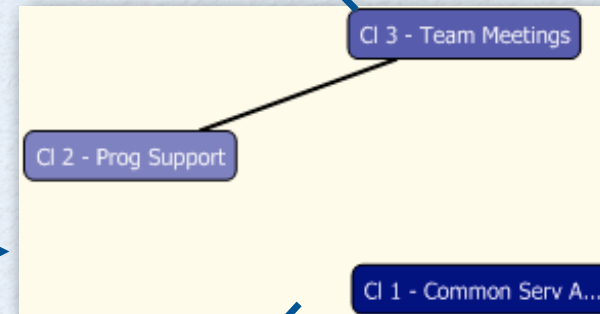
Person Name	Context ID	Context Name
Alexandre	a1	Data Collection for Mail Application
	a3	Evictions Web Service Problem
	a5	Carla's Support (Web Serv & Mail App)
Carla	c1	Common Services Application Programmin
	c2	Programming support (Mail & Suppliers Ap
	c3	Team Meetings
Mariana	m1	Project Management Reports and Meetings
	m011	Cards Information Collection
	m6	Evictions
	m8	Suppliers

Cluster Diagram Cluster Profiles Cluster Characteristics Cluster Discrimination

Cluster: CI 3 - Team Meeting

Characteristics for CI 3 - Team Meetings

Variables	Values	Probability
Action Human Resources(catarina)	Existing	[Bar]
Action Human Resources(goncalo)	Existing	[Bar]
Action Keywords(team meeting)	Existing	[Bar]
Action Human Resources(mariana)	Existing	[Bar]
Action Human Resources(alexandre)	Existing	[Bar]
Action Interaction	accept	[Bar]
Action Interaction	assist	[Bar]



Cluster Diagram Cluster Profiles Cluster Characteristics Cluster Discrimination

Cluster: CI 1 - Common Serv

Characteristics for CI 1 - Common Serv App

Variables	Values	Probability
Action Keywords(common services a...)	Existing	[Bar]
Action Interaction	program	[Bar]
Action Tools(visual studio dotnet)	Existing	[Bar]
Day	13,0 - 17,7	[Bar]

CLUSTERING EVALUATION

Person Name	Context Description	CI 1	CI 2	CI 3	CI 4	CI 5	CI 6	CI 7	CI 8	Total Clus	Success Rate
carla	Common Services Application Programming	20	1							21	0.95
	Development Support		8	2						10	0.80
	Team Meetings		1	11						12	0.75
	total Carla	20	10	13						43	0.91
goncalo	Suppliers Application Programming	26	2		2					30	0.87
	Development and User Support		13	5	6					24	0.79
	Discussions/Collaboration - Catarina		2	13	6					21	0.62
	Product License Management			1						1	1.00
	Team Meetings			1	1	9				11	0.82
total goncalo	26	17	20	15	9				87	0.77	
catarina	Automatic Table Update Problem	7		3	1					11	0.64
	Discussions/Collaboration - Goncalo	13		7		4				24	0.54
	Suppliers Application Classes Programming	2	22	2		6				32	0.69
	Message Maintenance			4						4	1.00
	Report Elaboration			3						3	1.00
	Team Meetings	2			7	1				10	0.70
total catarina	24	22	19	8	11				84	0.67	
alexandre	Data Collection for Mail Application	6		2	4					12	0.50
	Mail Application Programming	8	14							22	0.64
	Carla's Support (Web Serv & Mail App)			5						5	1.00
	Evictions Web Service Problem	3		3	4	7				17	0.41
	Team Meetings	2					7			9	0.78
total alexandre	19	14	10	8	7	7			65	0.60	
mariana	Campaings Application Adjustments	14					2			16	0.88
	Message Maintenance	15								15	1.00
	Suppliers Application Programming	24	9	7		1	1			42	0.57
	Suppliers Application Web Components Programming	4	28				1			33	0.85
	Automatic Table Update Problem	1		6					1	8	0.75
	Cards Information Collection			2		1	1		1	5	0.40
	Evictions Web Service Problem			9		3		1		13	0.69
	Script Execution Problem			1		1				2	0.50
	Claims Application User Support				5		1	1		7	0.71
	Claims Application Document Association Function	4	1		13	1		2		21	0.62
	Claims Application File Upload Component					9		1		10	0.90
	Courses for team members					1	3			4	0.75
	Project Management Reports	4	3	2		8	14			31	0.45
	Integration Tests	1		2	9	1	2	17		32	0.53
	Team Meetings								9	9	1.00
	total mariana	67	41	29	27	28	23	22	11	248	0.56
	Total actions of team members										527

CONCLUSIONS

- context-based approach to discover and represent individual and inter-personal work practices
- part of a model of organizational agents and their contexts
- key features:
 - ~ acquisition from action repositories
 - ~ context as a unit of analysis
 - ~ recurrence of verbs and noun phrases
- benefits:
 - ~ context provided a natural means of classifying actions
 - ~ shows private and shared views, foster discussions on discrepancies
 - ~ shows individual measures (e.g. work overload, fragmentation)
 - ~ using small semantic units (actions) eased consensus on their meaning
 - ~ acquisition fast and reliable, few corrections from observed subjects

FUTURE WORK

- further case studies
 - ~ usefulness of representations
 - ~ elicitation and representation of unobservable rules
- approach scalability: wider and longer case studies
- automated support for:
 - ~ action capture
 - ~ automatic capture of actions: implications for the design of business applications
 - ~ context discovery
 - ~ context analysis

questions?

REVERSE-ENGINEERING OF
PERSONAL AND INTER-
PERSONAL WORK PRACTICES:
A CONTEXT-BASED APPROACH

Marielba Zacarias, H. Sofia Pinto, José Tribolet

CEO / ALGOS (INESC-INOV) / IST, Lisboa
Universidade do Algarve, Faro - Portugal