# Intellectual Foundations for *i**
# Past, Present, and Future

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*University of Toronto*

9th International iStar Workshop
at RE'16 12-13 September , 2016
Beijing, China

UNIVERSITY of TORONTO

# Agenda

1. Why intellectual foundations?
2. Past, Present, and Future Contexts for RE
3. Was there an intellectual foundation(s) for i* (1.0)?
4. Why bother?
5. Retracing intellectual sources
6. Rethinking intellectual foundations for i* 3.0
7. Conclusions

# 1.
# Why intellectual foundations?

# Why intellectual foundations?

- Where do the concepts (of a modeling framework) come from?
- Why actors and dependencies?
- Why means-ends? Why goal vs task?
- Why not some other concepts?
  - Power? Trust? …
- How do they come together as a coherent whole?

# Why revisit intellectual foundations (for *i**) ?

- Have not really been articulated, except indirectly in:
  - [WIj01] Yu, E. (2001). Agent orientation as a modelling paradigm. *Wirtschaftsinformatik*, *43*(2), 123-132.
  - [AOSE02] Yu, E. (2002). Agent-oriented modelling: software versus the world. *International Workshop on Agent-Oriented Software Engineering.* Springer Berlin Heidelberg. 206-225.

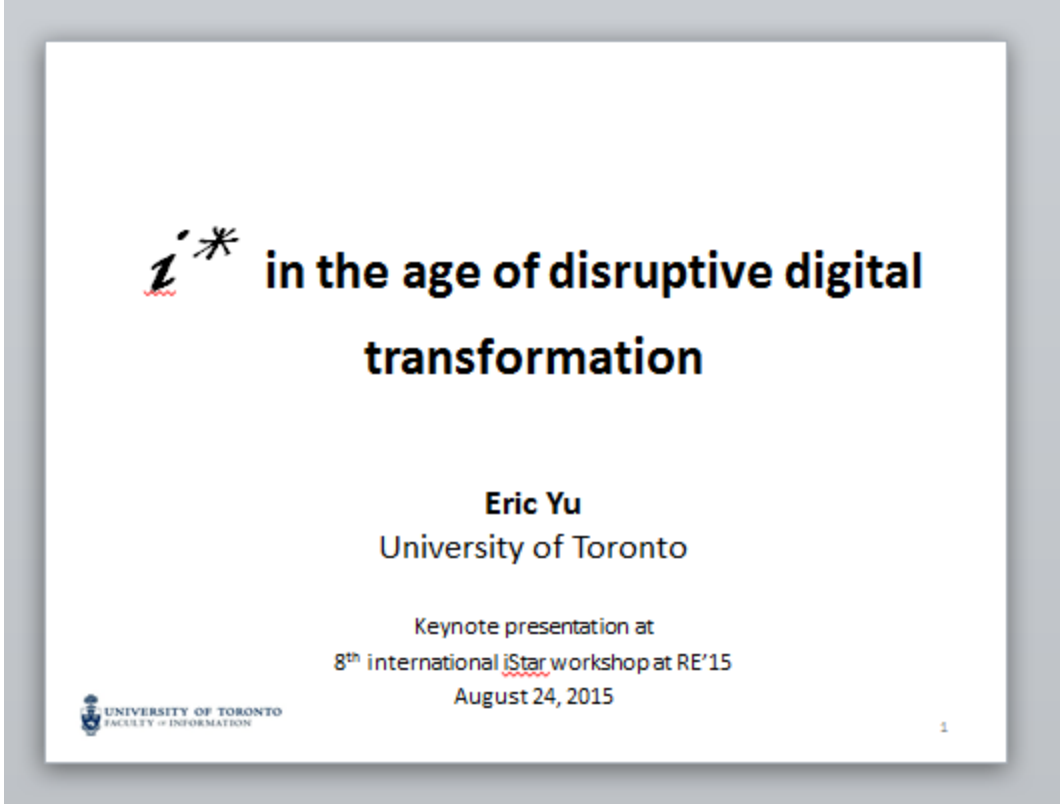
- Can help improve the design of ***i**** (or any kind of social modeling) if intellectual foundations were studied in more depth and more systematically.
- More importantly, the world has changed, and will change some more.
  - Modeling frameworks need to keep up with the changes – for iStar 2.0, 3.0 …

# 2.
# The Changing Contexts of RE - past, present, and future

# The world circa 1980's 1990's

- Mainframes
- Office automation
- Personal computers
- CSCW
- Internet – what's that? (Netscape browser 1996)

# My current work…
## (overviewed last year at iStar'15)



# “A confluence of emerging technologies …”

McKinsey Global Institute

May 2013

**Disruptive technologies: Advances that will transform life, business, and the global economy**

**Ten IT-enabled business trends for the decade ahead**

McKinsey Global Institute

May 2013

**Don't Get SMACked:**

**How Social, Mobile, Analytics and Cloud Technologies are Reshaping the Enterprise**

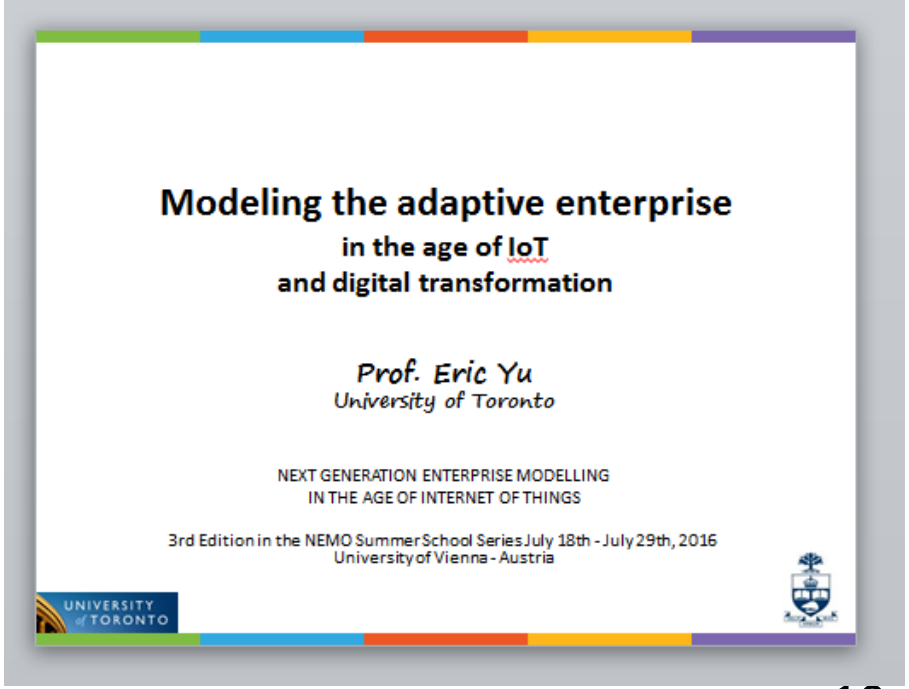
By Malcolm Frank

Cognizant Executive Vice President, Strategy & Marketing

# This year at NEMO'16

***I asked:***

**How will enterprises be different in the digital age?**



# Fashion


## Digital Marketing – Fast Fashion

**FAST FASHION RETAILING and BRAND MANAGEMENT**

The fastest growing sales Channels for both **Fast Fashion and Luxury Goods** are **Smart Apps on Mobile Phones**. Innovative new Retail Business Operating Models such as "Retail 2.0" and "Perfect Store" are driving the development of these new Channels. For example, when a Customer enters a store, the Retailer of the Future can detect and identify him from his Smart Phone Number, as the Customer accesses the In-store WiFi or WiMAX Network Connection. Based on vast amounts of data describing their previous consumer behaviour – we can alert the consumer to relevant In-store offers and promotions – based on Propensity Modelling –similar in content and style to those offers and promotions the customer has responded to positively in the past When a Customer Tweets that she is going to buy a "little black cocktail dress" – we can initiate a Social Media Conversation .

| Fast Fashion | Sports Apparel and Footwear | Designer Labels | Luxury Brands | Luxury Brand Aggregators |
|---|---|---|---|---|
| • *ASOS* • | • *Nike* • | • *Armani* • | • *Channel* • | • *PPR* • |
| • *Next* • | • *Adidas* • | • *Burberry* • | • *Dior* • | • *LVMH* • |
| • *New Look* • | • *Columbia* • | • *D&G* • *DKNY* • | • *Hermes* • | • *Richemont*• |
| • *Primark* • | • *North Face* • | • *Ralph Lauren* • | • *Gucci* • | |
| • *Top Shop* • | | • *Versace* • | • *Prada* • | |


[Nigel Tebbutt 2015]

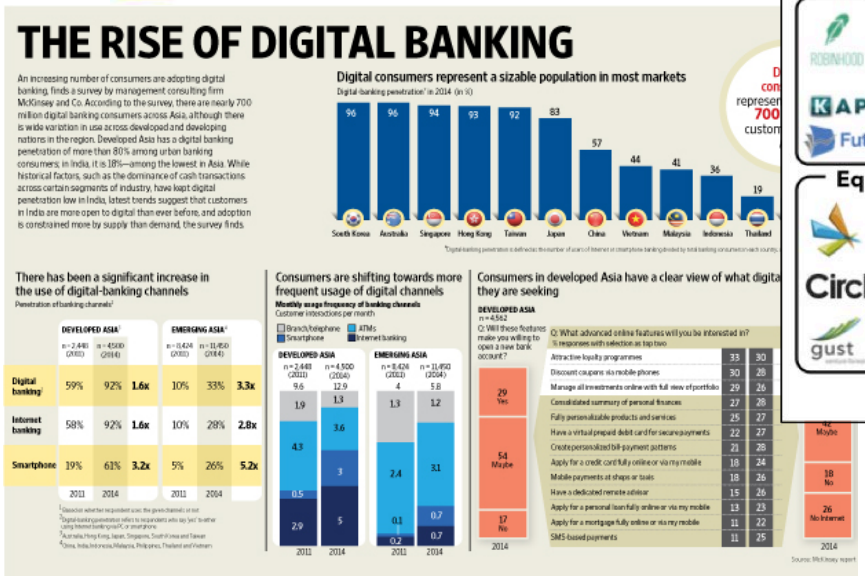
# Travel

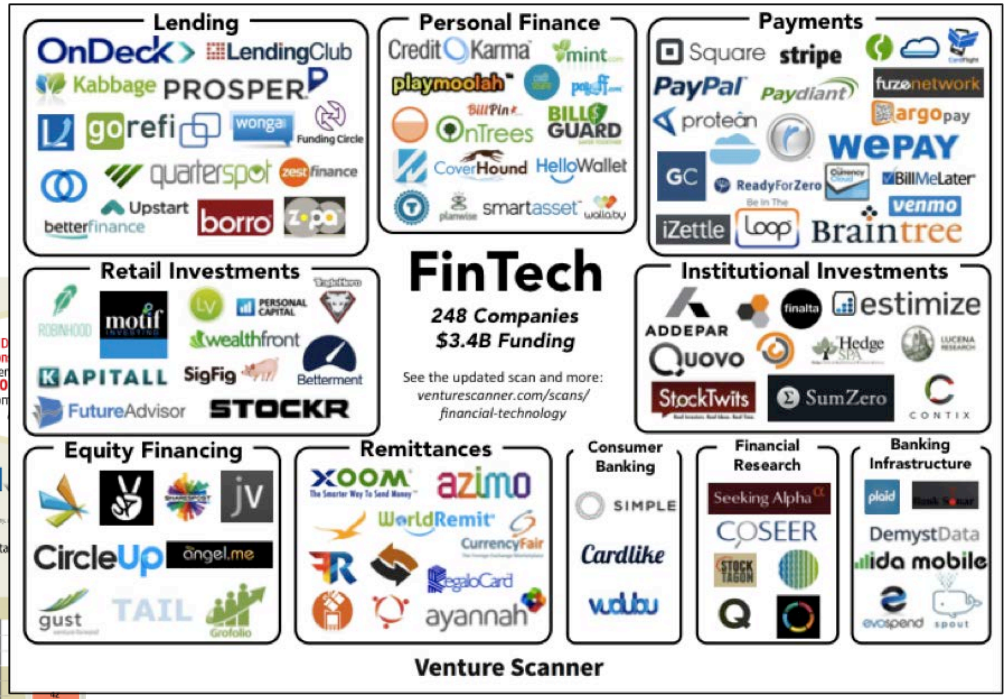


- Disruptors
  - Uber, …
  - Airbnb, …
  - Self-driving vehicles

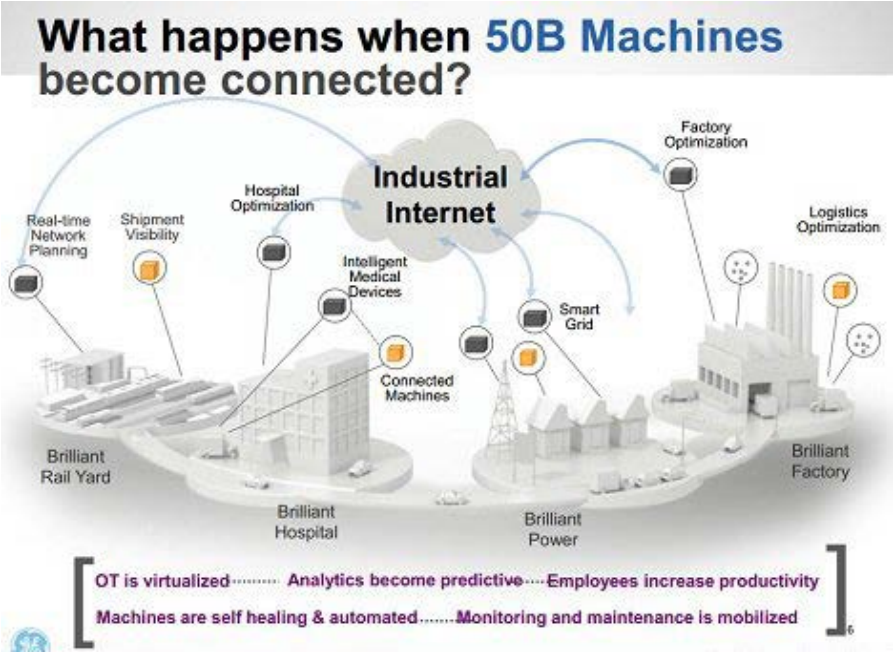
# Banking


RBC
Digital Done Right
Join Our Team
MENU
RBC IS DIGITAL
Join our team →
Our customers are savvy citizens of the digital world. They're quick to adopt what works for them. They're just as quick to throw away what doesn't. So we spend our days dreaming of new ways to engage our customers with thoughtful experiences that are useful and intuitive, simple and secure.
We work hard to make their lives easier, to build digital solutions that slip as effortlessly into people's lives as their phones do into their pockets.


THE RISE OF DIGITAL BANKING
An increasing number of consumers are adopting digital banking, finds a survey by management consulting firm McKinsey and Co. According to the survey, there are nearly 700 million digital banking consumers across Asia, although there is wide variation in use across developed and developing nations in the region. Developed Asia has a digital banking penetration of more than 80% among urban banking consumers; in India, it is 18%—among the lowest in Asia. While historical factors, such as the dominance of cash transactions across certain segments of industry, have kept digital penetration low in India, latest trends suggest that customers in India are more open to digital than ever before, and adoption is constrained more by supply than demand, the survey finds.
Digital consumers represent a sizable population in most markets
Digital-banking penetration[1] in 2014 (in %)
96 96 94 93 92 83 57 44 41 36 19
South Korea Australia Singapore Hong Kong Taiwan Japan China Vietnam Malaysia Indonesia Thailand
There has been a significant increase in the use of digital-banking channels
Penetration of banking channels[1]
DEVELOPED ASIA[2] n = 2,448 (2011) n = 4,500 (2014)
EMERGING ASIA[3] n = 8,424 (2011) n = 11,450 (2014)
Digital banking[4] 59% 92% 1.6x 10% 33% 3.3x
Internet banking 58% 92% 1.6x 10% 28% 2.8x
Smartphone 19% 61% 3.2x 5% 26% 5.2x
2011 2014 2011 2014
Consumers are shifting towards more frequent usage of digital channels
Monthly usage frequency of banking channels
Customer interactions per month
Branch/telephone
Smartphone
ATMs
Internet banking
DEVELOPED ASIA n = 2,448 (2011) n = 4,500 (2014)
9.6 12.9
1.9 1.3 4.3 3.6 0.5 3 2.9 5
EMERGING ASIA n = 8,424 (2011) n = 11,450 (2014)
4 5.8
1.3 1.2 2.4 3.1 0.1 0.7 0.2 0.7
2011 2014 2011 2014
Consumers in developed Asia have a clear view of what digita they are seeking
DEVELOPED ASIA n = 4,592
Q: Will these features make you willing to open a new bank account?
29 Yes
54 Maybe
17 No
2014
Q: What advanced online features will you be interested in? % responses with selection as top two
Attractive loyalty programmes 33 30
Discount coupons via mobile phones 30 28
Manage all investments online with full view of portfolio 29 26
Consolidated summary of personal finances 27 28
Fully personalizable products and services 25 27
Have a virtual prepaid debit card for secure payments 22 27
Create personalized bill-payment patterns 21 28
Apply for a credit card fully online or via my mobile 18 24
Mobile payments at shops or taxis 18 26
Have a dedicated remote advisor 15 26
Apply for a personal loan fully online or via my mobile 13 23
Apply for a mortgage fully online or via my mobile 11 22
SMS-based payments 11 25
Maybe
18 No
26 No Internet
2014
Source: McKinsey report

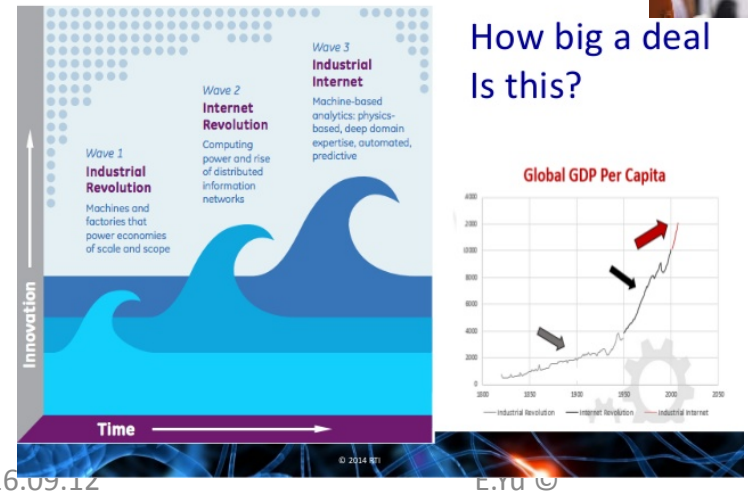

Lending
OnDeck
LendingClub
Kabbage
PROSPER
gorefi
wonga
Funding Circle
quarterspot
zest finance
Upstart
betterfinance
borro
Personal Finance
CreditKarma
mint
playmoolah
BillPin
OnTrees
BILL GUARD
CoverHound
HelloWallet
smartasset
wallaby
Payments
Square
stripe
PayPal
Paydiant
fuzenetwork
proteán
argopay
WePAY
GC
ReadyForZero
BillMeLater
venmo
iZettle
Loop
Braintree
Retail Investments
ROBINHOOD
motif
LV
PERSONAL CAPITAL
wealthfront
KAPITALL
SigFig
Betterment
FutureAdvisor
STOCKR
FinTech
248 Companies
$3.4B Funding
See the updated scan and more:
venturescanner.com/scans/financial-technology
Institutional Investments
ADDEPAR
finalta
estimize
Hedge
Quovo
StockTwits
SumZero
CONTIX
Equity Financing
jv
CircleUp
angel.me
gust
TAIL
Grofolio
Remittances
XOOM
azimo
WorldRemit
CurrencyFair
RegalaCard
ayannah
Consumer Banking
SIMPLE
Cardlike
wudubu
Financial Research
Seeking Alpha
COSEER
Banking Infrastructure
plaid
DemystData
ilda mobile
evospend
spout
Venture Scanner

# Manufacturing






GE: The next revolution




How big a deal
Is this?

# Grocery Retail


[McKinsey 2013]

Dynamic pricing

Dashboards, shop floor customer services

Self-checkout, digital wallet

Personalization, CRM

Digital marketing, social media, location-based services

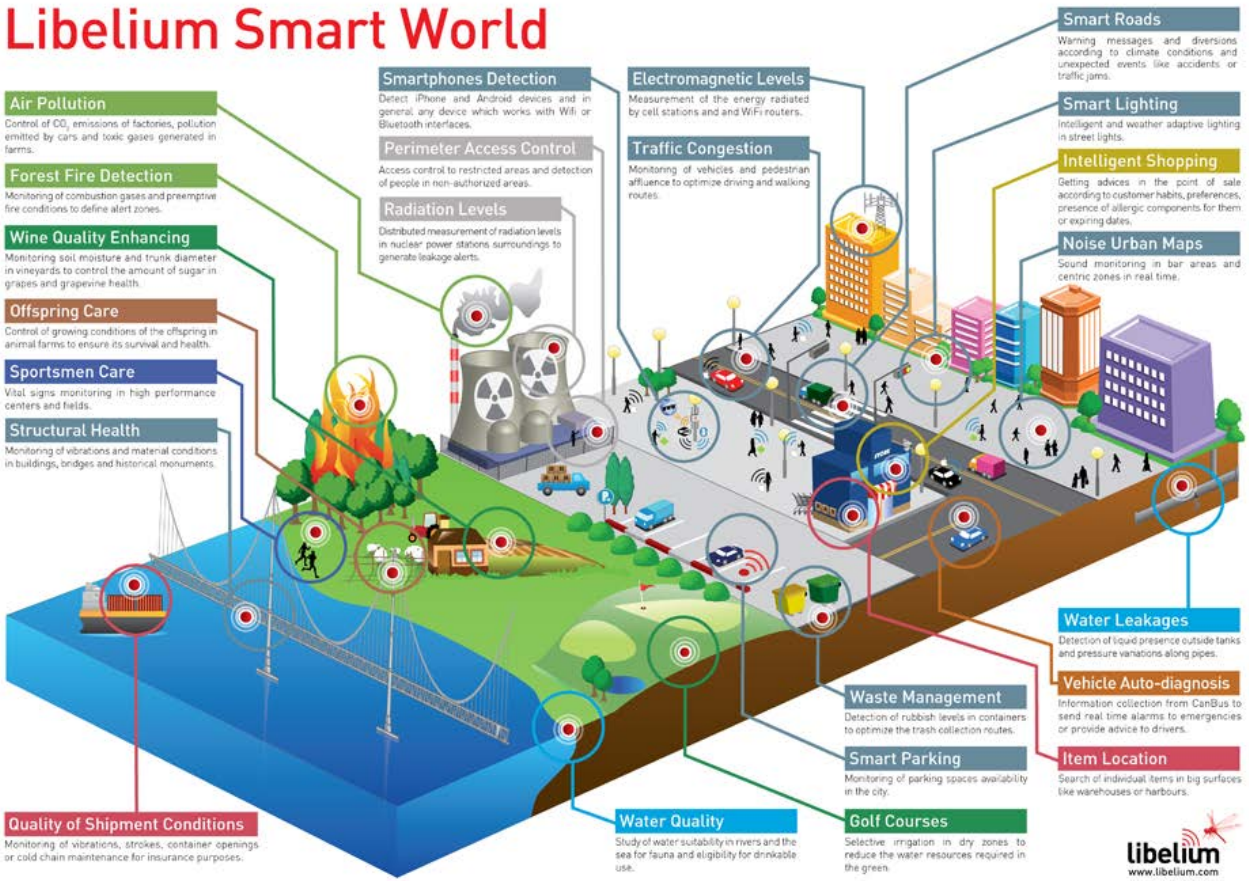
Blending the physical and virtual stores, online & offline

# Government

Australian Government

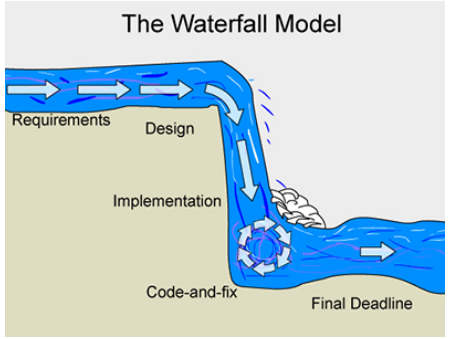
Digital Transformation Office


# Smart city

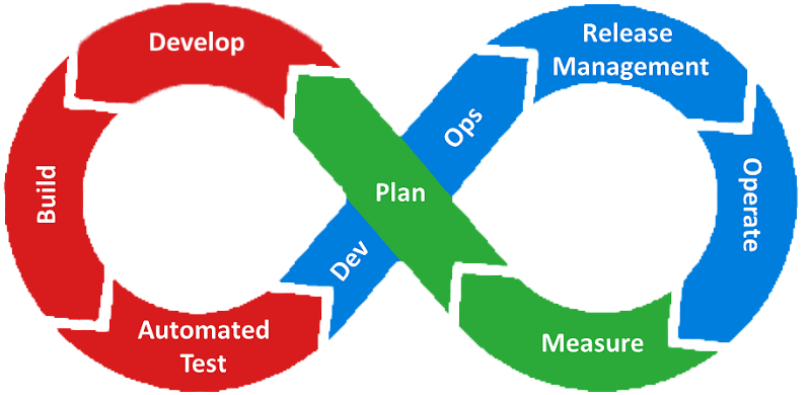

Libelium Smart World
Air Pollution
Control of $CO_2$ emissions of factories, pollution emitted by cars and toxic gases generated in farms.
Forest Fire Detection
Monitoring of combustion gases and preemptive fire conditions to define alert zones.
Wine Quality Enhancing
Monitoring soil moisture and trunk diameter in vineyards to control the amount of sugar in grapes and grapevine health.
Offspring Care
Control of growing conditions of the offspring in animal farms to ensure its survival and health.
Sportsmen Care
Vital signs monitoring in high performance centers and fields.
Structural Health
Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.
Quality of Shipment Conditions
Monitoring of vibrations, strokes, container openings or cold chain maintenance for insurance purposes.
Smartphones Detection
Detect iPhone and Android devices and in general, any device which works with Wifi or Bluetooth interfaces.
Perimeter Access Control
Access control to restricted areas and detection of people in non-authorized areas.
Radiation Levels
Distributed measurement of radiation levels in nuclear power stations surroundings to generate leakage alerts.
Electromagnetic Levels
Measurement of the energy radiated by cell stations and and WiFi routers.
Traffic Congestion
Monitoring of vehicles and pedestrian affluence to optimize driving and walking routes.
Smart Roads
Warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.
Smart Lighting
Intelligent and weather adaptive lighting in street lights.
Intelligent Shopping
Getting advices in the point of sale according to customer habits, preferences, presence of allergic components for them or expiring dates.
Noise Urban Maps
Sound monitoring in bar areas and centric zones in real time.
Water Leakages
Detection of liquid presence outside tanks and pressure variations along pipes.
Vehicle Auto-diagnosis
Information collection from CanBus to send real time alarms to emergencies or provide advice to drivers.
Item Location
Search of individual items in big surfaces like warehouses or harbours.
Waste Management
Detection of rubbish levels in containers to optimize the trash collection routes.
Smart Parking
Monitoring of parking spaces availability in the city.
Golf Courses
Selective irrigation in dry zones to reduce the water resources required in the green.
Water Quality
Study of water suitability in rivers and the sea for fauna and eligibility for drinkable use.
libelium
www.libelium.com


MITSloan Management Review
CASE STUDY
Data-Driven City Management
A Close Look at Amsterdam's Smart City Initiative
By Michael Fitzgerald
May 2016

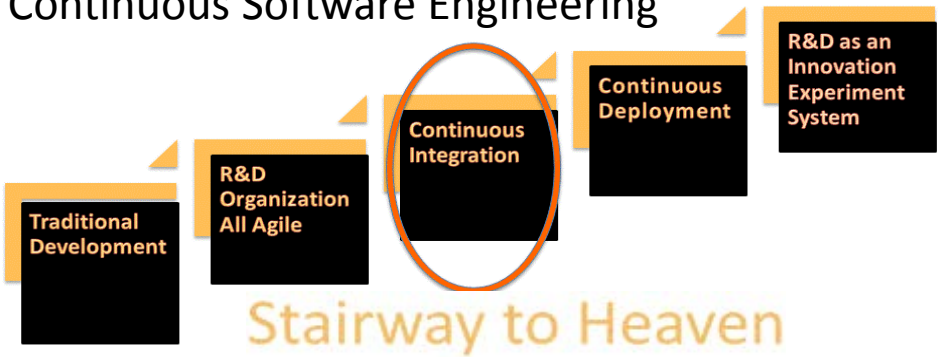
# Software Engineering




DevOps




Continuous Software Engineering




[Jan Bosch 2015]

# Will RE need to be different?

Is *i** a good enough RE framework for…

- Social
- Mobile
- Cloud
- Analytics
- IoT
- …

***RE for "Business"***

- Agile
- DevOps
- OSS communities
- Software ecosystems
- Gamification
- VR, AR
- …

***RE for SE (tools, processes, organizations)***

# From iStar'15 keynote

Fundamental Question:

**What RE techniques do we need in the age of digital transformation?**

- The new reality
  - Fast-moving, fluid, dynamic, turbulent
  - Highly distributed, but hyper-connected and networked
  - Disruptors and disruptees
  - Data-rich
- What are the suitable abstractions?
  - Process models - ~BPMN?
  - Intentional strategic actors, network of relationships ~ i*?
  - Dynamics?? Higher-order?
    - adaptive systems theory?

9

**Question in this talk:**

- **How do we get to the "suitable" abstractions?**

# Work in Progress

## Overviewed in iStar'15 keynote

### Work in Progress

1. **The vision - From emerging technologies to adaptive enterprise**
   - [CASCON ACET13] [ETT14] [TEAR12, 15]
2. **How to model adaptive loops in the enterprise?**
   - An initial attempt, BDBI as example [RCIS13] [IJISMD14]
3. **What dimensions for re-designing enterprise process architecture?**
   - [RCIS15][ER15]
4. **How to position data analytics in adaptive enterprise architecture?**
   - [PoEM13, 14]
5. **How to determine where inflexibilities exist in enterprise?**
   - Dynamic capabilities [ASDENCA14, 15] [ER15]
6. **How are organizations and communities reconfiguring their boundaries and relationships?**
   - Software ecosystems [RCIS14] [DIFENSE15] [EMMSAD15]
     Business model innovation , disruption [ISEBM08]
7. **How to help disruptors and disruptees understand impact of emerging technological advances?**
   - Knowhow mapping [iStar13, 14] [CAiSEforum14]

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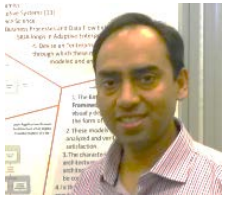
# Team







Eric Yu | Soroosh Nalchigar | Zia Babar | Mohammad Danesh | Mahsa Sadi | Vik Pant | Alexei Lapouchnian

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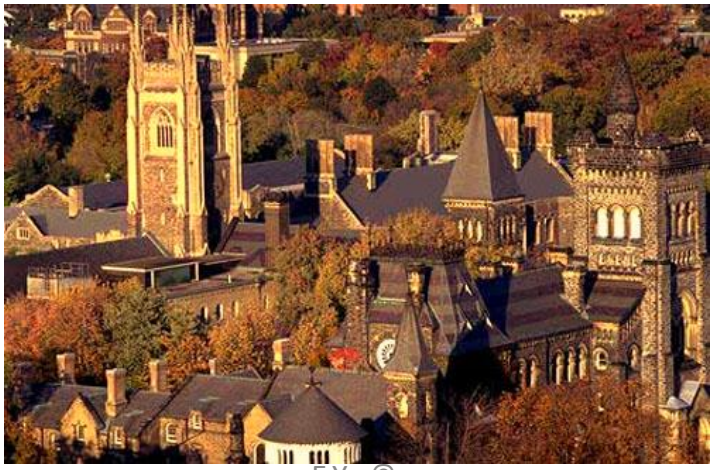

Computer Science
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# 3.
# Was there an intellectual foundation(s) for $i^*$ 1.0?

# Was there an intellectual foundation for *i** 1.0?

- Not explicitly.
  - Not considered a research contribution in CS?
  - What's the research methodology?
- Closest attempts:
  - [WIj01] Yu, E. (2001). Agent orientation as a modelling paradigm. *Wirtschaftsinformatik*, *43*(2), 123-132.
  - [AOSE02] Yu, E. (2001, May). Agent-oriented modelling: software versus the world. *International Workshop on Agent-Oriented Software Engineering*. Springer Berlin Heidelberg. 206-225.

# From "Agent orientation as a modelling paradigm" [WIj01]

- The changing needs of Requirements Engineering
  1. Technology as enabler
  2. Networked systems and organizations
  3. Increased interdependency and vulnerability
  4. Limited knowledge and control
  5. Openness and uncertainty
  6. Cooperation
  7. Boundaries, locality, identity

# From "Agent orientation as a modelling paradigm" [WIj01]

- "Based on the factors identified in Section 2, … we propose that the agent as a modeling construct should have the following properties:
  - Intentionality
  - Autonomy
  - Sociality
  - Agent identity and boundaries
  - Strategic reflectivity
  - Rational self-interest"

  - Vs [Jennings]? Cite [AOSE02]

# From "Agent orientation as a modelling paradigm" [WIj01]

- **Intentionality**
  - Agents are intentional
  - Agent intentionality is externally attributed by the modeller
  - Agency provides localization of intentionality
  - Agents can relate to each other at an intentional level
- **Autonomy**
  - An agent has its own initiative, can act independently. … not fully predictable, knowable, or controllable
  - The behaviour of an agent can be partially characterized, despite autonomy, using intentional concepts
- **Sociality**
  - An agent is characterized by its relationships with other agents, and not by its properties alone.
  - Relationships among agents are complex and generally not reducible.
  - Conflicts among relationships not easily resolvable
  - Multi-lateral relationships, not one-way
  - Agent relationships form an <u>unbounded</u> network
  - <u>Cooperation</u> among agents <u>cannot be taken for granted</u>
  - Autonomy is tempered by sociality

# From "Agent orientation as a modelling paradigm" [WIj01]

- **Identity and boundary**
  - There can be abstract agents, as well as physical agents.
  - The boundaries, and thus the identity, of an agent are contingent and changeable.
- **Strategic reflectivity**
  - Agents can reflect upon their own operations
  - Development world deliberations and decisions are usually strategic wrt the operational world.
- **Rational self-interest**
  - An agent strives to meet its goals
  - Self-interest is in a context of social relations
  - Rationality is bounded and partial

# How did I get there? what did I absorb/ leave out?

- Main objective: support reasoning about IT in social context
- Some (pragmatic) principles
  - Minimality - would rather tolerate some ontological overloading, or ambiguity, e.g., OR vs XOR.
  - Not prescriptive
  - "theory neutral" as much as possible –
    - want to be able to express as wide a range of theories of organization / agent characteristics as possible.
    - Abstracting from human vs machines - not assume humans are inherently diff from machines. Agents can be made up of mixture (composite systems). Don't know ahead of time what combination.
  - Generality wrt domains

# Compare BMM

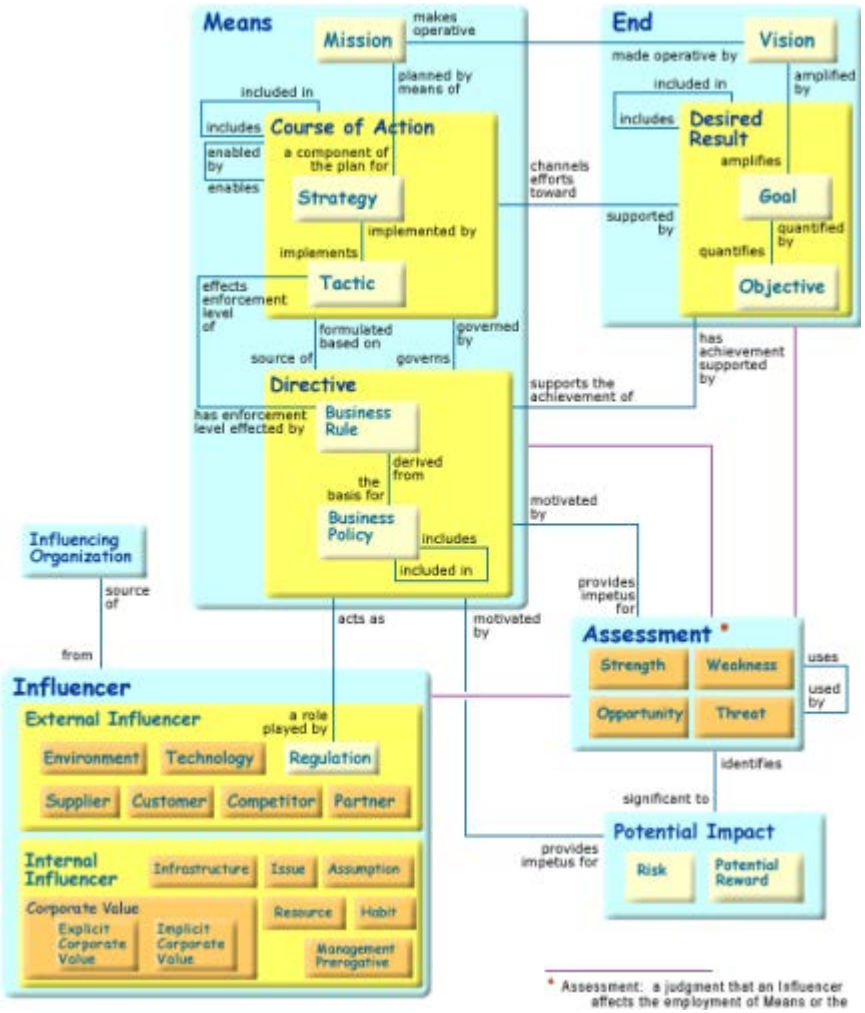



Figure A-1. Core Concepts of the Business Motivation Model

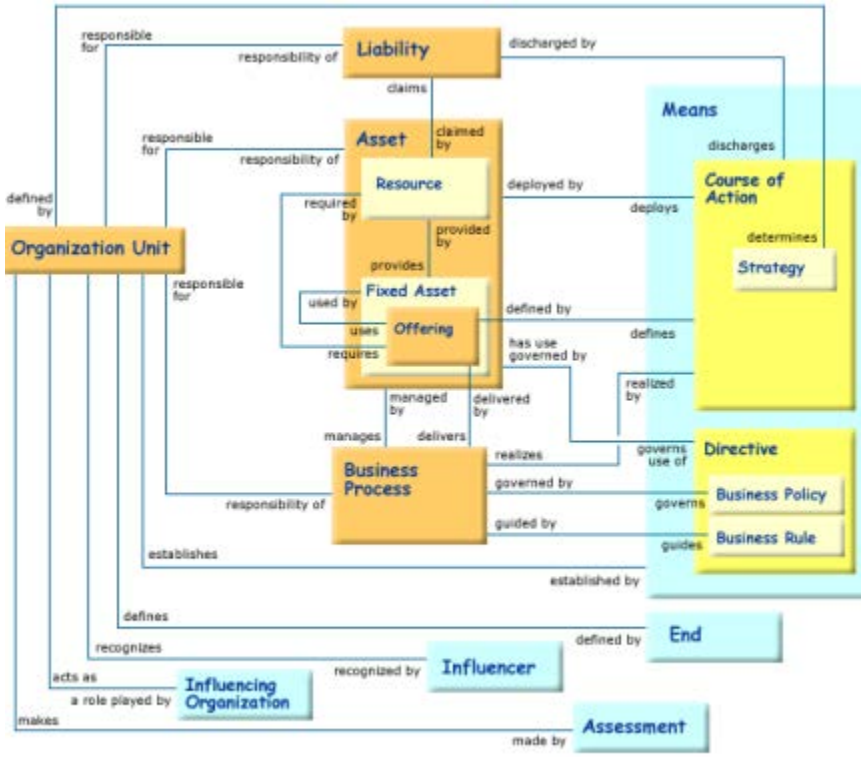



Figure A-2. Placeholders and Placeholder Conncetions in the Business Motivation Model

# 4.
# Why bother?

## It was personal

# My personal motivation

- Impact of technology – positive and negative
- Systems projects – successes and failures
- Many failures not due to technical reasons
  - Lyytinen, K. (1987). Different perspectives on information systems: problems and solutions. *ACM Computing Surveys (CSUR)*, *19*(1), 5-46.
  - Gasser, L. (1986). The integration of computing and routine work. *ACM Transactions on Information Systems (TOIS)*, *4*(3), 205-225.
  - Kling, R., & Scacchi, W. (1982). The web of computing: Computer technology as social organization. *Advances in computers*, *21*, 1-90.
-
-

# Solutions proposed during that time period – not entirely satisfactory (in my view)

- Hermeneutics
  - Winograd, T., & Flores, F. (1986). *Understanding computers and cognition: A new foundation for design*. Intellect Books.
- Participatory design
  - Eg: Ehn, P. (1990). Work-Oriented Design of Computer Artifacts.
- Goal-based approach
  - Eg: Croft, W. B., L. S. Lefkowitz (1988). A Goal-Based Representation of Office Work. *Office Knowledge: Representation, Management, and Utilization*, W. Lamersdorf (ed.), Elsevier, 99-124.
- Action-Workflow
  - Medina-Mora, R., Winograd, T., Flores, R., & Flores, F. (1992). The action workflow approach to workflow management technology. *ACM conference on Computer-supported cooperative work* (pp. 281-288).
  - Lyytinen, K. (2004). The Struggle with the Language in the IT–Why is LAP not in the Mainstream. In *International Working Conference on the Language-Action Perspective on Communication Modelling (LAP), New Brunswick, NJ*.
- Situated action
  - Suchman, L. A. (1987). *Plans and situated actions: The problem of human-machine communication*. Cambridge university press.

## Example – a promising approach

# Action Workflow modeling

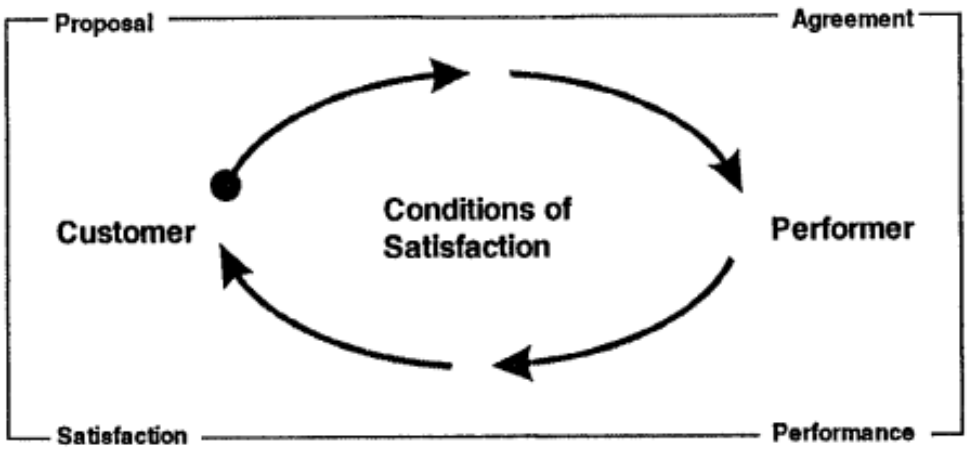



Figure 1. ActionWorkflow Loop

- Medina-Mora, R., Winograd, T., Flores, R., & Flores, F. (1992). The action workflow approach to workflow management technology. *ACM conference on Computer-supported cooperative work*. 281-288.

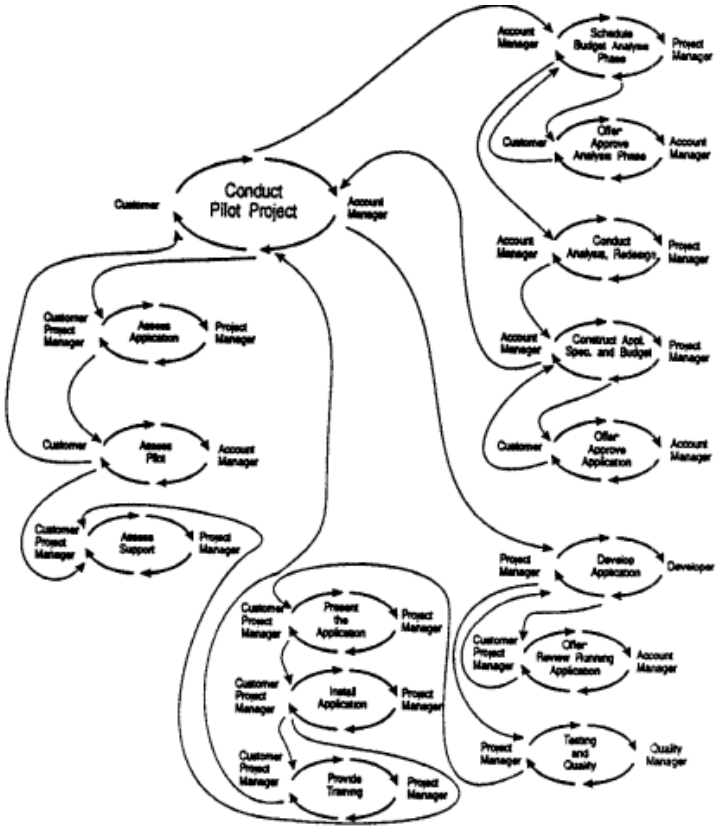
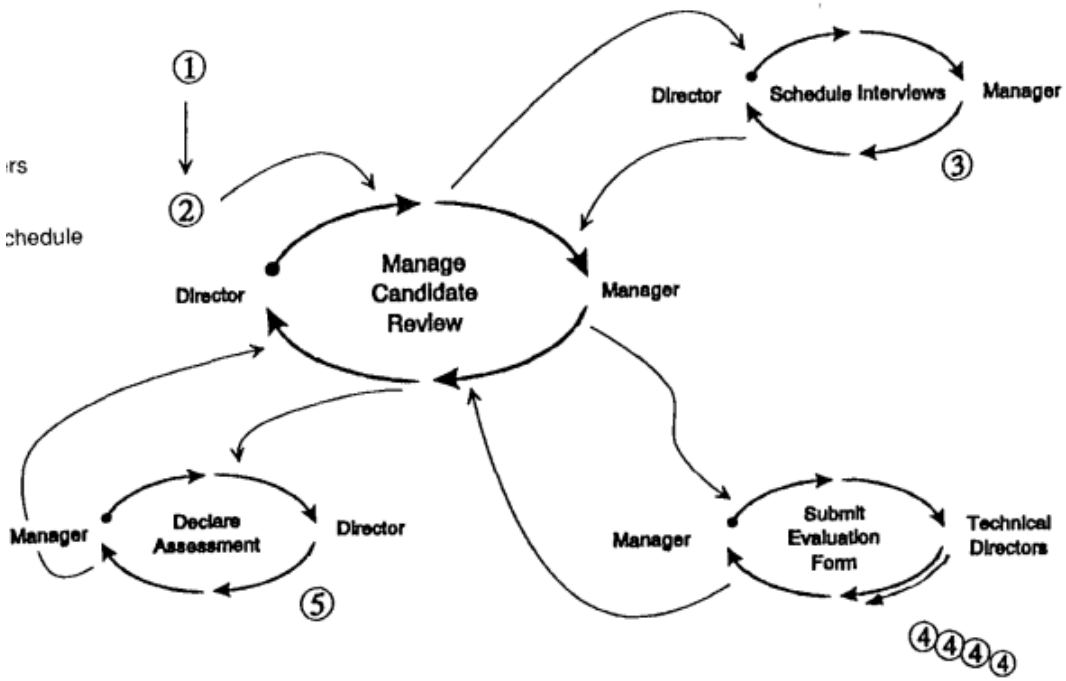



Figure 2. Business process map for pilot projects




Medina-Mora, R., et al. The action workflow approach to workflow management technology. CSCW 1992.

- Kethers, S. (2001). *Multi-Perspective Modeling and Analysis of Cooperation Processes* (Doctoral dissertation, Ph. D. thesis. Technical University of Aachen (RWTH), Germany).
- Lyytinen, K. (2004). The Struggle with the Language in the IT–Why is LAP not in the Mainstream. In *International Working Conference on the Language-Action Perspective on Communication Modelling (LAP), New Brunswick, NJ*.

# 5.
# Retracing intellectual sources

# Diverse fields and disciplines

**CS / SE / IS**

- IS engineering
  - ISD modeling, methodologies
- Office Systems
  - Hewitt, Croft, … [TOIS]
- SE, software processes
  - Curtis, … [ISPW]
- AI, DAI
  - Gasser
  - Cohen & Levesque
- CSCW, participatory design
  - Grudin, …

**"Social"**

- Organization theory
  - March Simon, …
- Sociology
  - Giddens, Crozier, …
- Social psychology
  - McGrath, …
- Workplace anthropology
  - Suchman, Blomberg, …
- Management theory
  - Pfeffer Salancik, …
- Sociotechnical analysis
  - Emery & Trist, …
- Quality movement
  - Deming, Duran, …
- BP innovation, reengineering
  - Keen, Davenport, Hammer, …

# What concepts to include/exclude?
# How to synthesize from diverse sources?

(A recollection of some selected challenges for i*)

- Actor, Agent?
  - DAI; social science
- Goal?
  - AI planning; OT
- Means-ends reasoning?
  - AND/OR tree; OT [March & Simon]
- Rationality?
  - Bounded rationality, satisficing [Simon]
  - Design rationale; argumentation

# Dependencies?

- Sources
  - Thompson, J. D. (1967). *Organizations in action: Social science bases of administrative theory*.
    - Pooled interdependence; Sequential interdependence; Reciprocal interdependence
  - Coordination theory
    - Malone, T. W. (1987). Modeling coordination in organizations and markets. *Management science*, *33*(10), 1317-1332.
    - Malone, T. W., & Crowston, K. (1994). The interdisciplinary study of coordination. *ACM Computing Surveys (CSUR)*, *26*(1), 87-119
  - Resource dependency theory
    - Pfeffer, J., & Salancik, G. R. (1978, 2003). *The external control of organizations: A resource dependence perspective*. Stanford University Press.
      - Dependency is strategic!
- i* 1.0
  - Strategic dependencies
  - Focus on strategic viability
    - analysis of failures at strategic level, not coordination!

# Communication? Language?

- Sources
  - Speech acts
    - Agent Communication Languages
  - Language action perspective
    - From speech acts theory
    - Commitment
      - cf. M. Singh et al

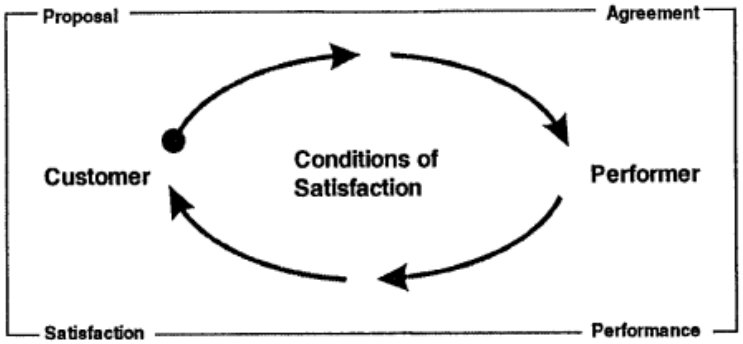


Figure 1. ActionWorkflow Loop

- i* 1.0
  - Focus on (viability of) strategic relationships instead!

# Process? Flow?

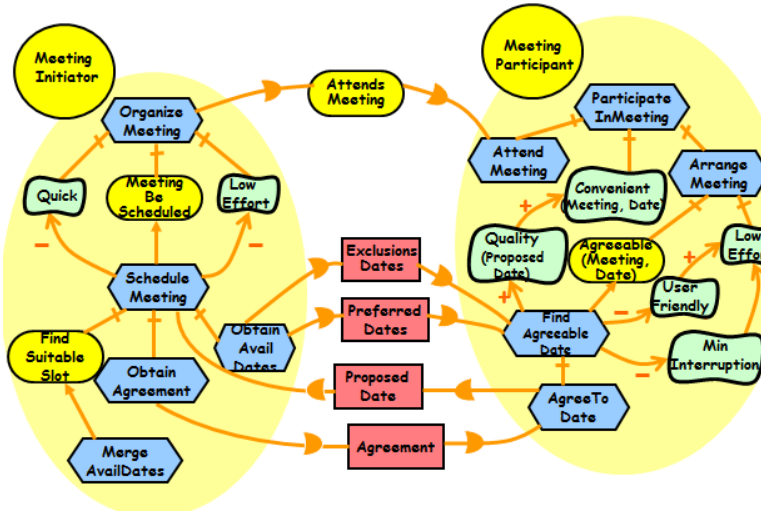
- Data flow? Sequence flow?
- Sources
  - Many

- i* 1.0
  - Intentional flow
  - Propagation of goal satisfaction status

# Negotiation?

- Sources
  - Robinson, W. N. (1990). Negotiation behavior during requirement specification. *ICSE.* 268-276. IEEE.
  - Fisher, R., & Ury, W. (1983). Getting to Yes: Negotiating Agreement Without Giving In.
    - "win-win"
  - Strauss, A. L. (1978). *Negotiations: Varieties, contexts, processes, and social order*. Jossey-Bass Inc Pub.
    - "negotiated order'

- i* 1.0
  - Iterate to satisfice all major stakeholder goals



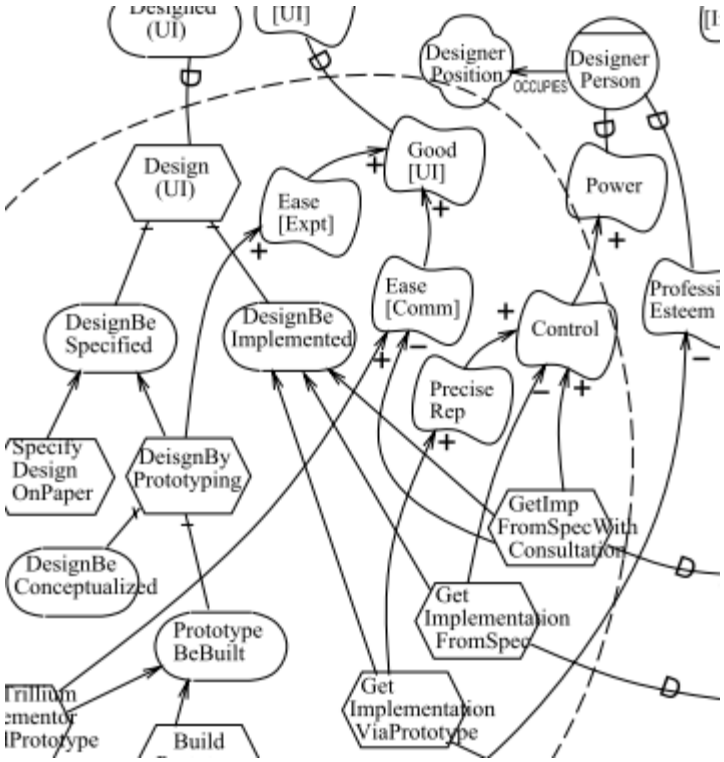
# Openness/closure?

- Sources
  - Freedom & constraint
    - Feather, M. S. (1987). Language support for the specification and development of composite systems. *ACM TOPLAS 9*(2), 198-234
  - Commitment
    - Cohen & Levesque (1990) Intention is Choice with Commitment

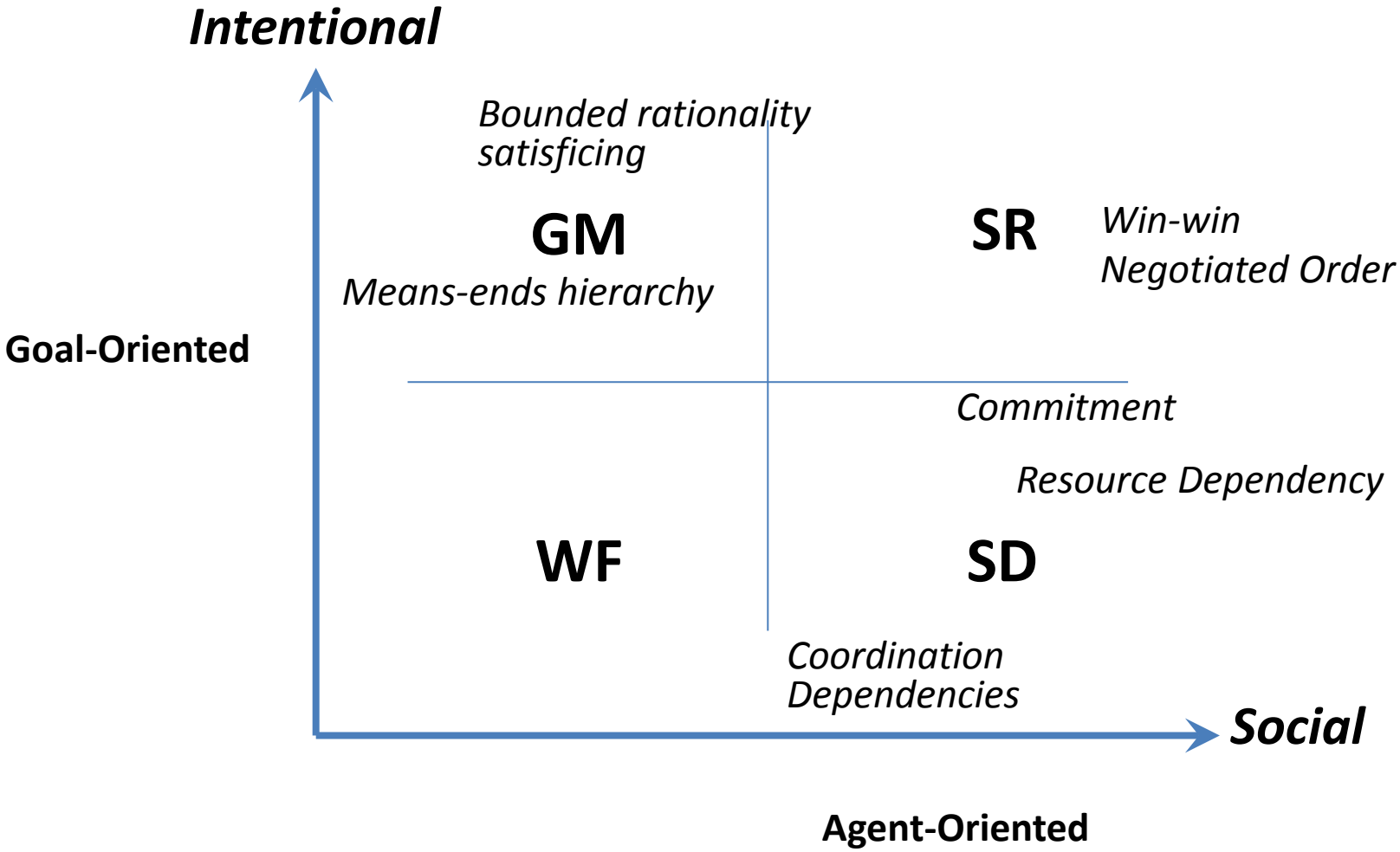
- i* 1.0
  - goal vs task;
  - (strategic) commitment between actors
  - design of actor boundaries

# Power? Trust?

- Sources
  - …
- i* 1.0
  - As softgoals!
  - Examples:
    - Yu (1995) Ch6
    - Yu & Liu (2001) Modeling trust …



# A rough map


Intentional
Bounded rationality
satisficing
GM
Means-ends hierarchy
SR
Win-win
Negotiated Order
Goal-Oriented
Commitment
Resource Dependency
WF
SD
Coordination
Dependencies
Social
Agent-Oriented

# 6.
# Intellectual Foundations for Future *i** / iStar ?

# Will RE need to be different?

Is *i** a good enough RE framework for…

- Social
- Mobile
- Cloud
- Analytics
- IoT
- …

***RE for "Business"***

- Agile
- DevOps
- OSS communities
- Software ecosystems
- Gamification
- VR, AR
- …

***RE for SE (tools, processes, organizations)***

# Ecosystems? Communities?

- Modeling software ecosystems
  - Jansen, S., Finkelstein, A., & Brinkkemper, S. (2009). A sense of community: A research agenda for software ecosystems. *ICSE-Companion 2009.* 187-190. IEEE.
  - Jansen, S., Cusumano, M. A., & Brinkkemper, S. (Eds.). (2013). *Software Ecosystems: Analyzing and Managing Business Networks in the Software Industry*. Edward Elgar Publishing.
  - Christensen, H. B., Hansen, K. M., Kyng, M., & Manikas, K. (2014). Analysis and design of software ecosystem architectures–Towards the 4S telemedicine ecosystem. *Information and Software Technology*, *56*(11), 1476-1492.

- Intellectual foundations?
  - Iansiti, M., & Levien, R. (2004). Strategy as ecology. *Harvard business review*, *82*(3), 68-81.
  - Boudreau, K. (2010). Open platform strategies and innovation: Granting access vs. devolving control. *Management Science*, *56*(10), 1849-1872.
  - West, J. (2003). How open is open enough?: Melding proprietary and open source platform strategies. *Research policy*, *32*(7), 1259-1285.
  - Gawer, A., & Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management*, *31*(3), 417-433.

- Is i* relevant? Useful? Need extension(s)?
  - Yu, E., & Deng, S. (2011). Understanding software ecosystems: A strategic modeling approach. *IWSECO*, 65-76.
  - Franch, X., Gutiérrez, J., Susi, A., Annosi, M. C., Ayala, C. P., Glott, R., Gross, D., ... & Ameller, D. (2013). Managing risk in open source software adoption. *ICSOFT 2013.* 258-264.
  - Sadi, M. H., & Yu, E. (2015). Designing Software Ecosystems: How Can Modeling Techniques Help?. EMMSAD'15. 360-375.

# Competition, Cooperation, Coopetition

- Topics for (IS, RE, EM) modeling?
  - Giannoulis, C., Zikra, I., Bergholtz, M., Zdravkovic, J., Stirna, J., & Johannesson, P. (2013). A comparative analysis of enterprise modeling approaches for modeling business strategy. *PoEM '13,* 193-204.
  - Carvallo, J. P., & Franch, X. (2012). Building strategic enterprise context models with i*: a pattern-based approach. In *Trends in Enterprise Architecture Research and Practice-Driven Research on Enterprise Transformation* (pp. 40-59). Springer Berlin Heidelberg.
  - Coopetition: ?
- Intellectual foundations?
  - Brandenburg , A. M., & Nalebuff, J. (1995). The Right Game: Use Game Theory to Shape Strategy. *Harvard Business Review, volume73*.
  - Gnyawali, D. R., & Park, B. J. R. (2011). Co-opetition between giants: Collaboration with competitors for technological innovation. *Research Policy*,*40*(5), 650-663.
  - Bengtsson, M., & Kock, S. (2014). Coopetition—Quo vadis? Past accomplishments and future challenges. *Industrial Marketing Management*,*43*(2), 180-188.
  - Gnyawali, D. R., Madhavan, R., He, J., & Bengtsson, M. (2016). The competition–cooperation paradox in inter-firm relationships: A conceptual framework. *Industrial Marketing Management*, *53*, 7-18.
- Is i* relevant? Useful? Need extension(s)?
  - V. Pant, E. Yu iStar'16.
  - V. Pant, E. Yu. PoEM'16

# Capability?

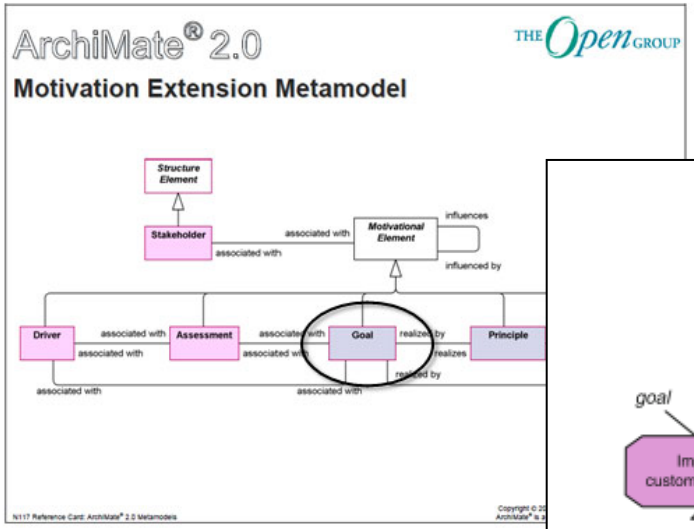
- An important topic in Enterprise Architecture
  - Industry standards: BIAN; ACORD, Open Group
  - Professional practice: Ulrich, W., & Rosen, M. (2011). The business capability map: the" rosetta stone" of business/it alignment. *Cutter Consortium, Enterprise Architecture*,*24*(4).
  - Azevedo, C. L., Iacob, M. E., Almeida, J. P. A., van Sinderen, M., Pires, L. F., & Guizzardi, G. (2015). Modeling resources and capabilities in enterprise architecture: A well-founded ontology-based proposal for ArchiMate. *Information Systems*, *54*, 235-262.
  - Stirna, J., Grabis, J., Henkel, M., & Zdravkovic, J. (2012, November). Capability driven development–an approach to support evolving organizations. PoEM'12 (pp. 117-131).

- Intellectual foundations?
  - Strategic management: Barney, Teece, Leonard-Barton, Helfat, …
  - IT capabilities: Wade & Hulland, …

- Is i* relevant? Useful? Need extension(s)?
  - Danesh, M. H., Loucopoulos, P., & Yu, E. (2015, October). Dynamic capabilities for sustainable enterprise IT–a modeling framework. ER'15 (pp. 358-366).
  - Danesh, M. H., & Yu, E. (2015, June). Analyzing IT flexibility to enable dynamic capabilities. ASDENCA workshop at CAiSE'15 (pp. 53-65).

# **Archimate** (Open Group specification)

- Archimate 2.0 “Motivation extension”
  - Now fully incorporated into Archimate 3.0 (June 2016)
- Archimate 3.0 includes “Capability” concept.



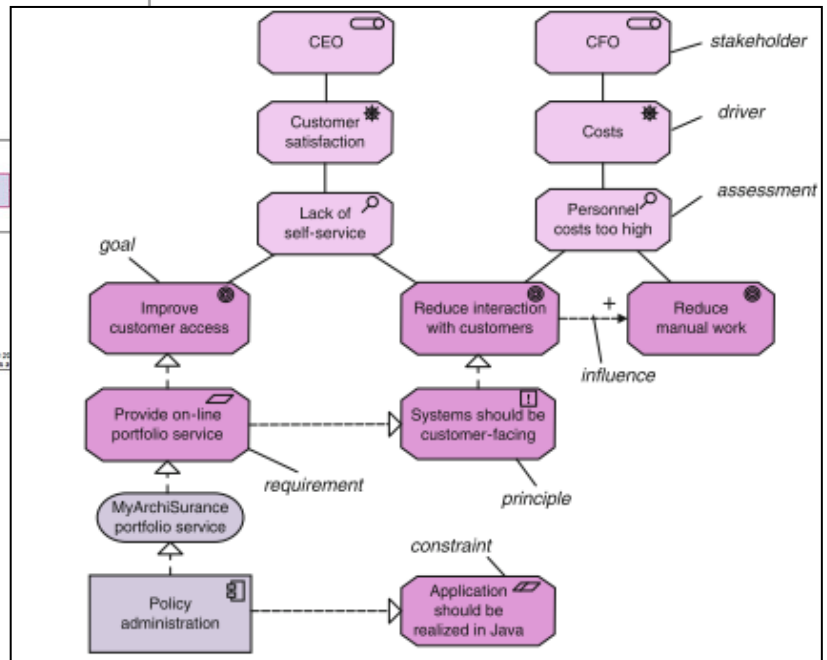
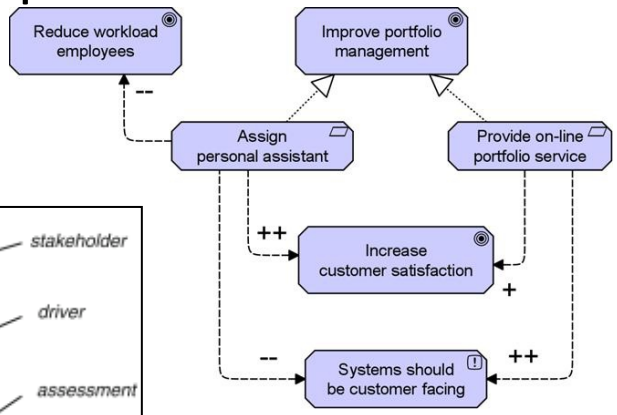




Fig. 5.18 Example of a motivation extension model




[Lankhorst 2013
Enterprise Architecture at Work]

Contributions of GORE are acknowledge (p. 100)

# Time? Speed? Scale?

- 2-speed organization; bi-modal IT; blitz scaling
  - Bossert, O., Ip, C., & Laartz, J. (2014). A two-speed IT architecture for the digital enterprise. *McKinsey on Business Technology*.
  - Kotter, J. (2012). Accelerate - how the most innovative companies capitalize on today's rapid-fire strategic challenges–and still make their numbers. *Harvard Business Review*, *90*(11), 43-58.
  - Sullivan, T. (2016). Blitzscaling – Reid Hoffman on high-growth, high-impact entrepreneurship. *Harvard business review*, *94*(4), 15.

- Intellectual foundations?
  - Gunderson, L. H. (2001). *Panarchy: understanding transformations in human and natural systems*. Island press.

- Is i* relevant? Useful? Need extension(s)?
  -
  -

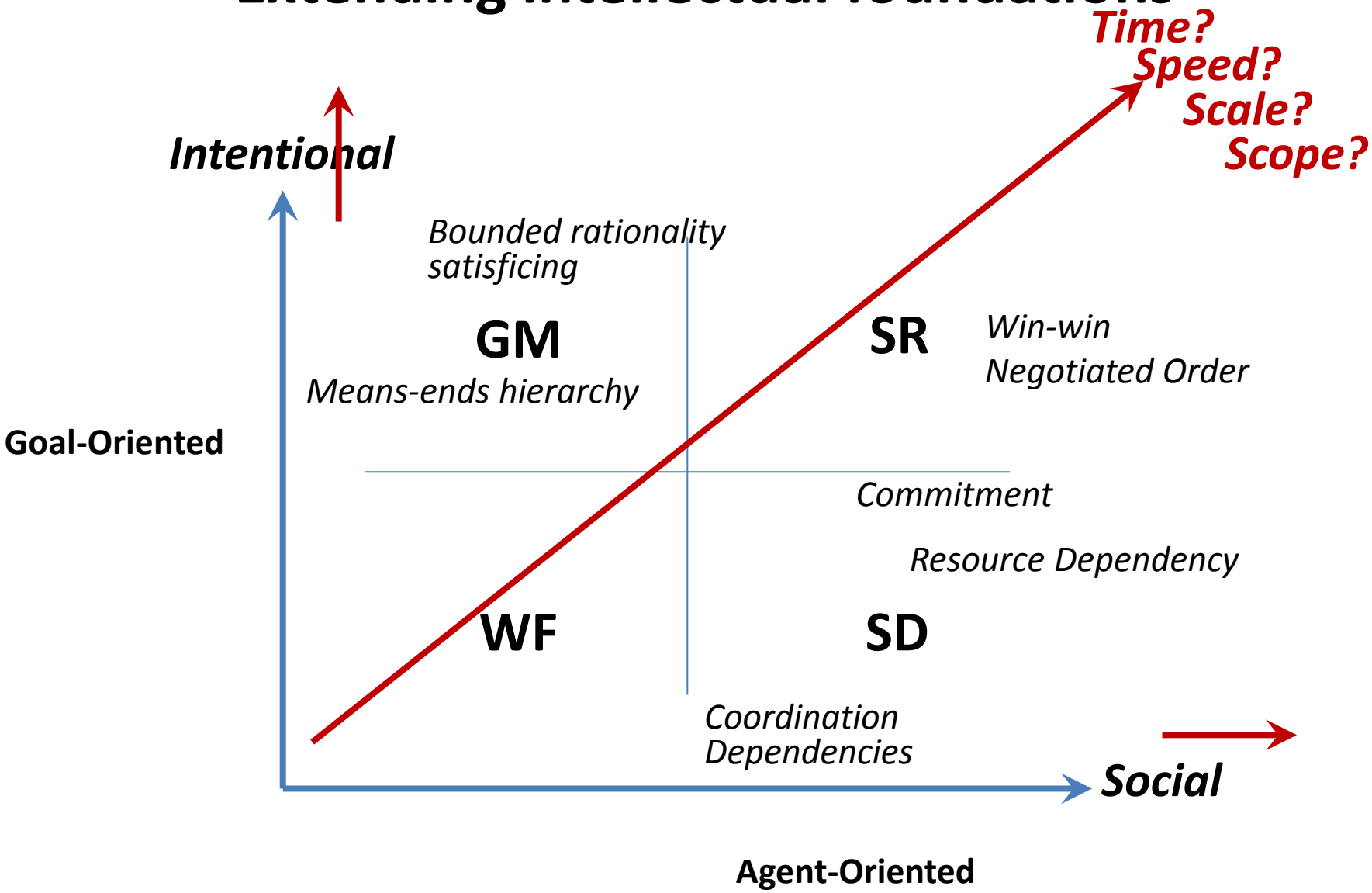
# Self-Adaptive, Multi-scale System Dynamics

- Control systems theory
- Socio-ecology
  - Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, *4*(5), 390-405.
  - Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and transformability in social--ecological systems. *Ecology and society*, *9*(2), 5.

# Culture?

- Culture in agile, devOps, …
- Intellectual foundations?
  –
- Is i* relevant? Useful? Need extension(s)?
  – Cf norms [Nomos]

# Extending intellectual foundations



# Exercise: Smart City (adapted from NEMO16)

## What intellectual foundations will undergird the modeling concepts for dealing with … ?

- **Ecosystem, Co-opetition**
  - Who to collaborate with? Who will you be competing with? Who can be your complementors?
  - How will you sustain a viable ecosystem?
- **Enterprise Analytics**
  - What are your business objectives and strategies?
  - How are you using data and analytics to achieve business objectives?
  - What do your measure? How do you generate insights from data?
- **Adaptive loops**
  - What, when, and how frequently do you sense and measure?
  - How do your insights lead to action?
  - How are Sense-Interpret-Decide-Act loops embedded in your Enterprise Process Architecture?
- **Process architecture**
  - What decisions and commitments are made at what points in which processes? By whom? Why?
  - Should a decision be moved closer to the customer, to run-time? (eg. personalization)
  - How much and what kinds of variability can/should be accommodated by defering commitments in action plans and in system designs and architectures?
  - What are the innovation cycles for your plans and artifacts/systems?
- **Capabilities & Dependencies**
  - What capabilities to develop to achieve sustained advantage & viability, given existing capabilities?
  - Is your architecture of technical and organizational capabilities agile and flexible enough to respond swiftly to threats and opportunities?

# 7.
# Conclusions

# Conclusions

- Computing is becoming more and more "social" – in applications as well as in the software process
  - SMACT …
  - Agile, devOps, ecosystems, …
- Social modeling should be of increasing significance, but only if it can addressing emerging & evolving needs.
- i* aimed to encompass some fundamental aspects of "social."
- We as a community should seek firmer intellectual foundations that underlie "social modeling".

# Thank you

## and Looking forward to Discussions