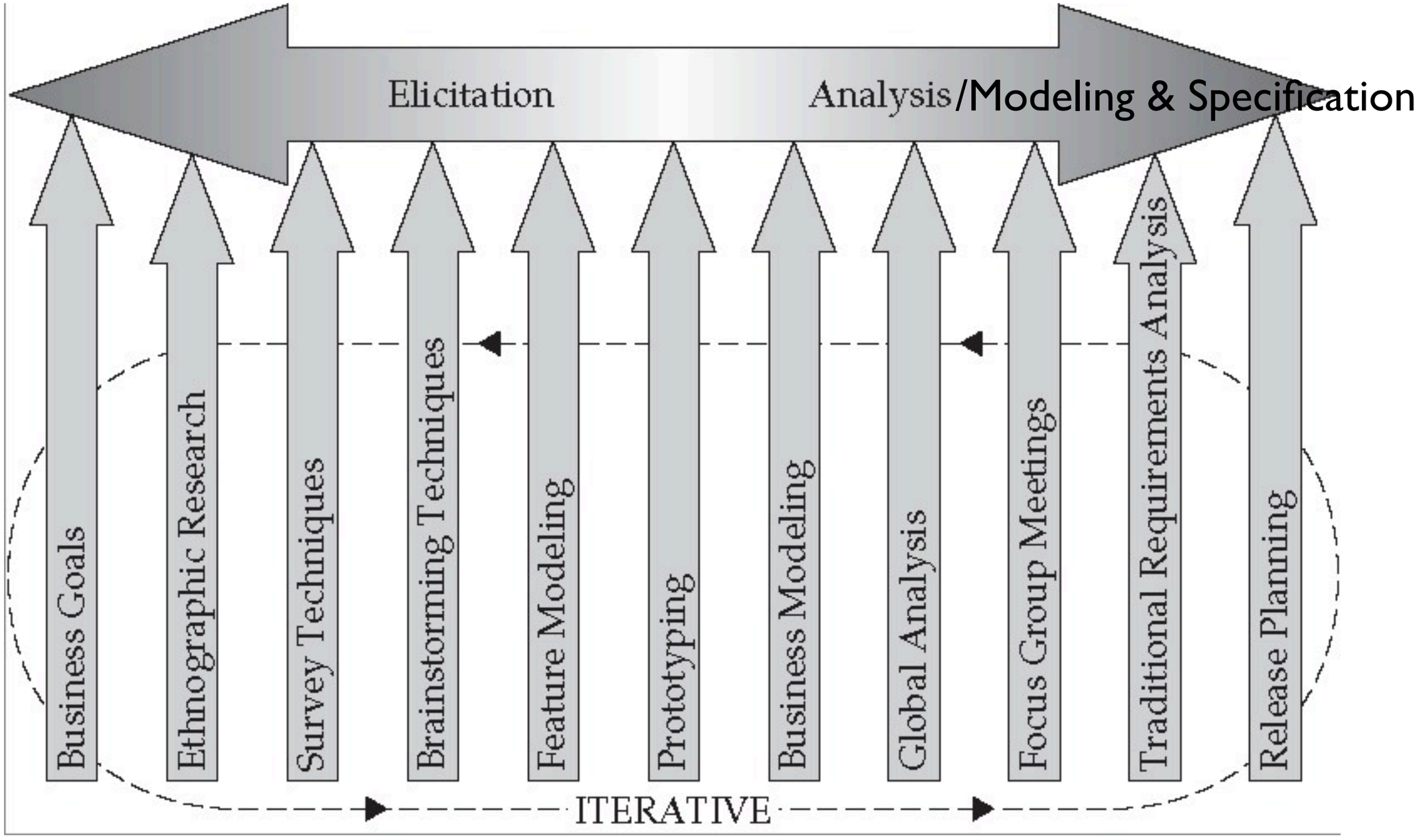
Requirements Specification with Models

Lectures 4, DAT230, Requirements Engineering
Robert Feldt, 2011-09-12

Recap

- Elicitation to find/gather/create/refine/specify reqs & understand stakeholder needs
- Many different elicitation techniques
  - Interviews, Group sessions, Observation are key
    - Always: care, be human, listen, focus on them, glossary
- Other sources: Docs, Strategies, Problem domain, History, Competitors, Environment
- Different abstraction levels
- Structured interview more powerful than open-ended

A continuum


Elicitation
Analysis/Modeling & Specification
Business Goals
Ethnographic Research
Survey Techniques
Brainstorming Techniques
Feature Modeling
Prototyping
Business Modeling
Global Analysis
Focus Group Meetings
Traditional Requirements Analysis
Release Planning
ITERATIVE

What is Req Specification?

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i.e. writing requirements down in a form so that we avoid later problems

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"The construction of
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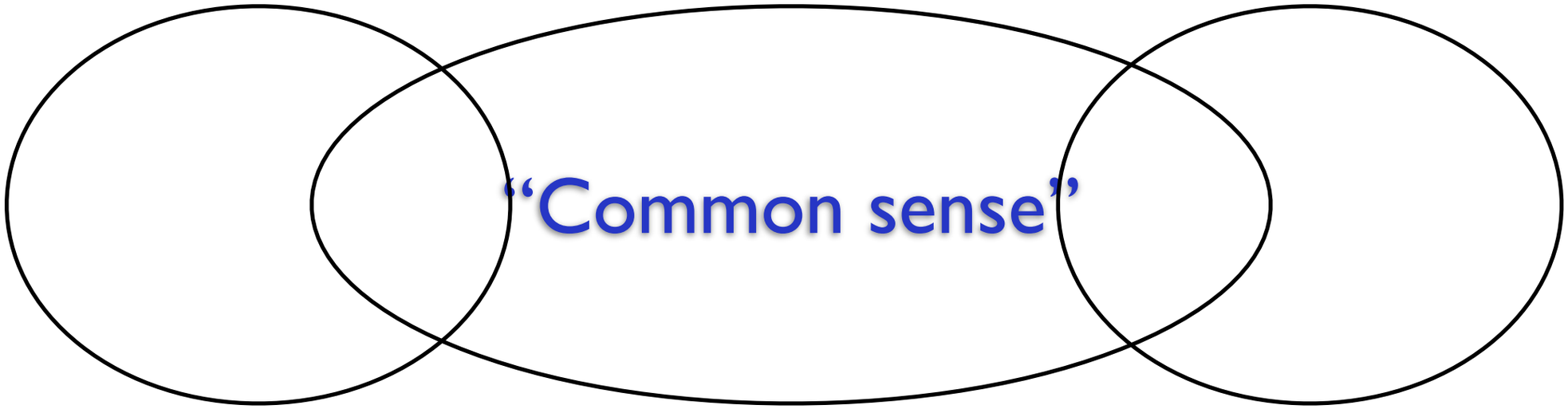
Used in several RE activities:
elicitation, analysis, specification

What are risks without doc?

- Reqs still ambiguous & open-ended after elicitation =>
- Developers make decisions/assumptions later =>
- User <-> Dev difference: User not satisfied
- Dev <-> Dev difference: Inconsistent system
- Overall: Costs high!
- BUT:
  - Goal is ideal PRODUCT not ideal Req Doc!
  - Thus: Just enough Req Spec to reduce Risks!

Cost-effectiveness

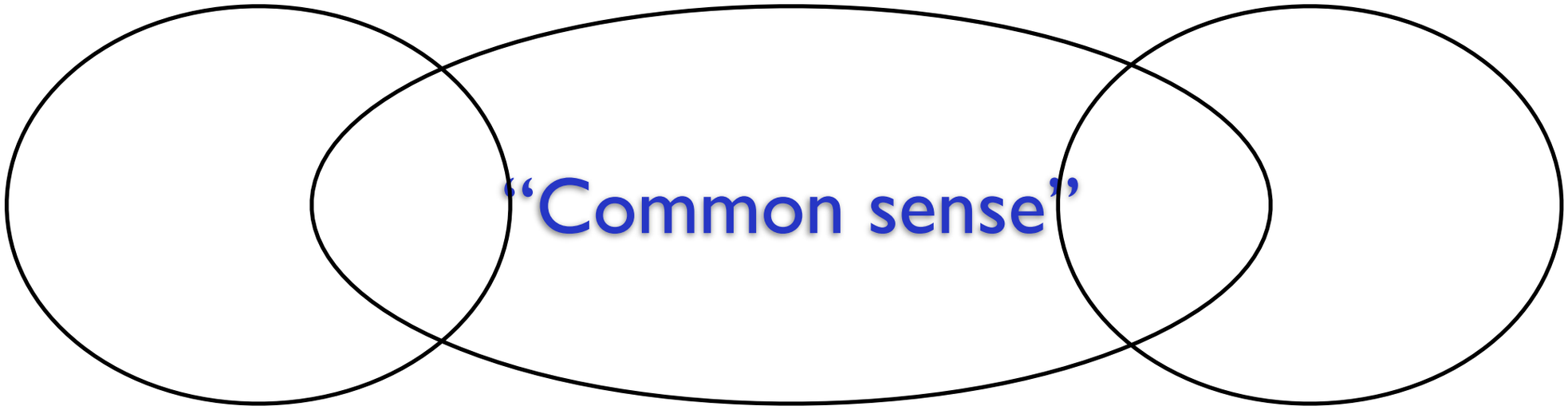


Customers/Users

SRS Doc

Developers

Cost-effectiveness



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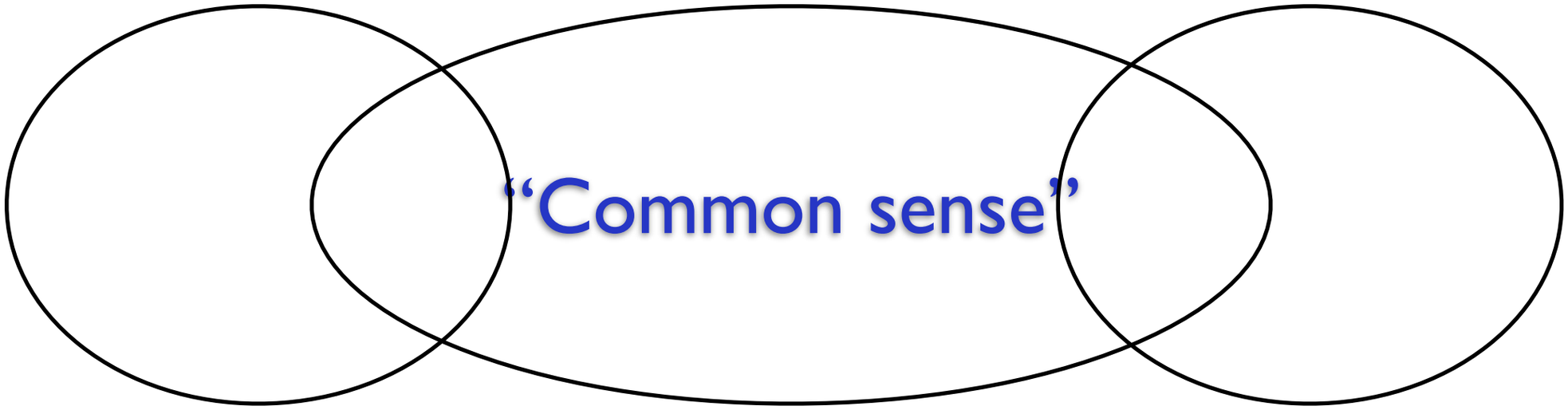
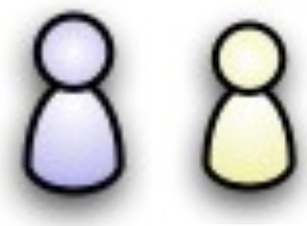


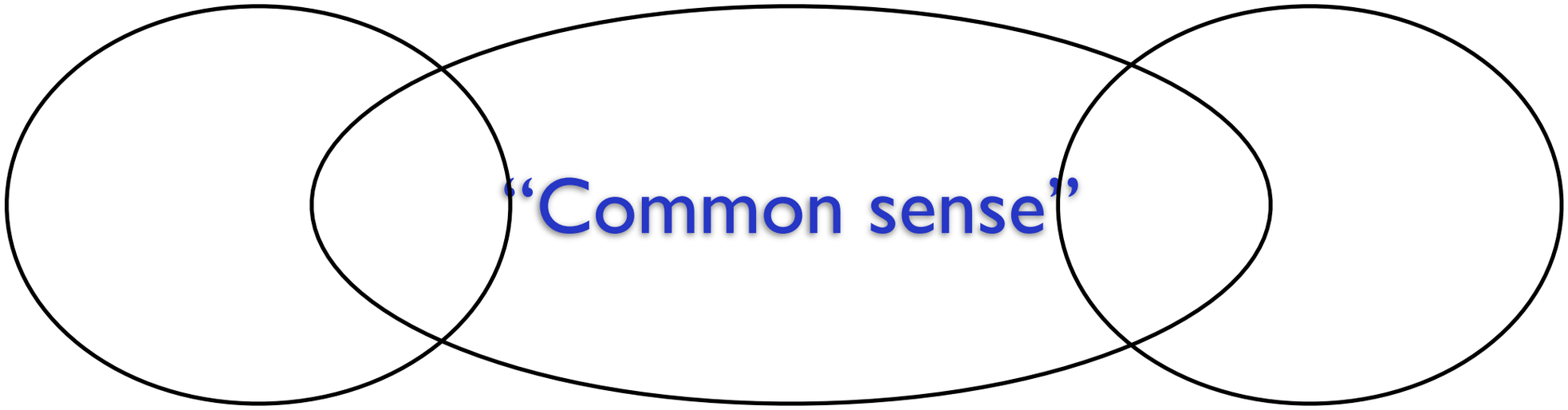
Customers/Users

SRS Doc



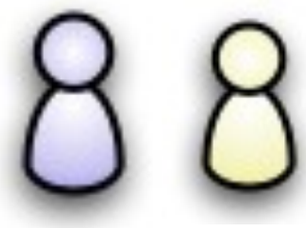
Developers

Cost-effectiveness



Customers/Users

SRS Doc

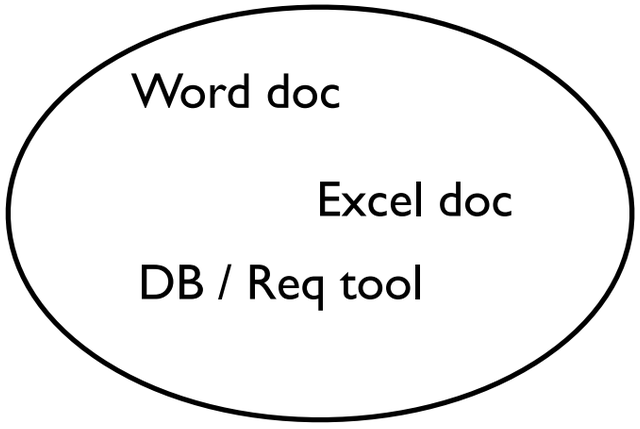


Developers

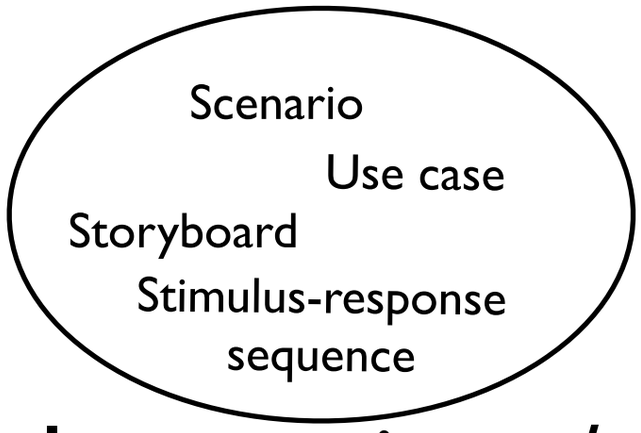
Roles of Req Doc

- Communication device between all parties
  - Customers, Marketing, Sales, Finance, Management, Devs, Testers
- Drives design and choices
- Drives testing
- Drives project management
- Basis for evolution / releases

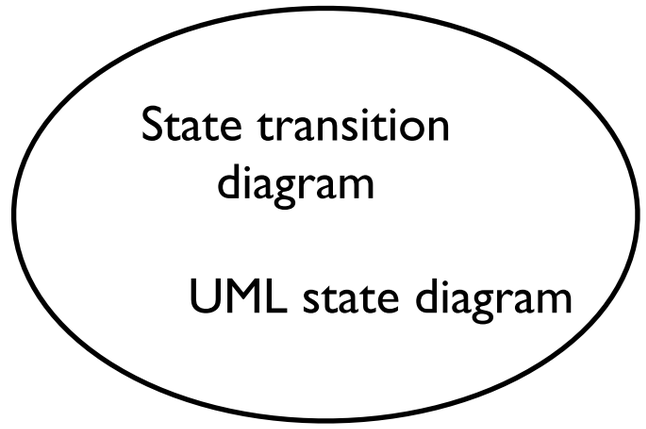
Specification Techniques



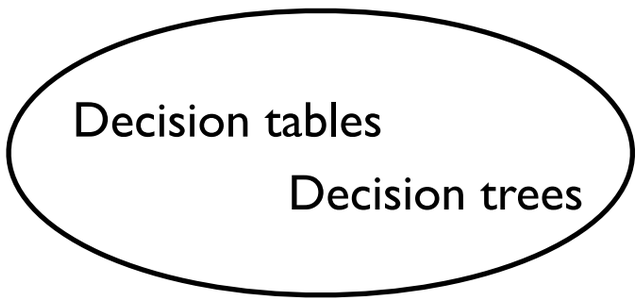
Text



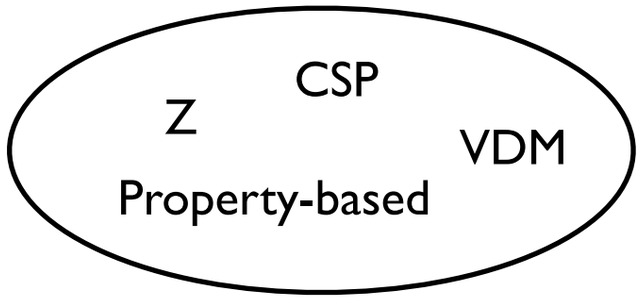
Interaction- / Sequence-based



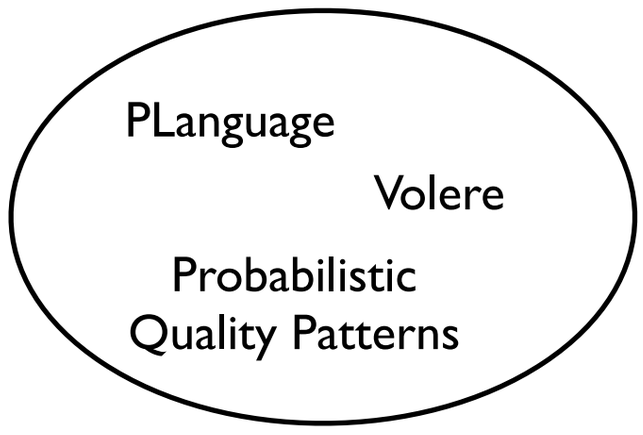
State-based



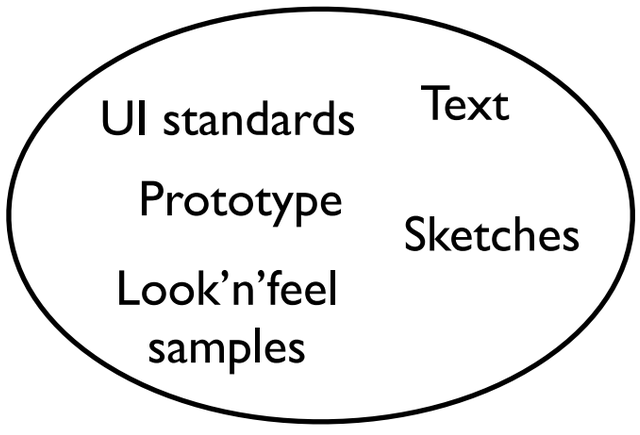
Decision-based



Formal



Quality Requirements



User Interfaces

Selecting techniques

- Stakeholders must understand => Natural Language
- Models where NatLang has risks:
  - Complex interactions/sequences/states/decisions
  - Interfaces
  - BUT not "One model to rule them all!"
- Quality requirements:
  - Quantify
  - Capture in structured english or PLanguage

Industrial survey: Methods for ReqEng?

Uses...	**"Yes"**
Reviews of requirements	63.8%
Model-based development	25.0%
Prototype-based development	24.3%
Prioritization of reqs	23.7%
Personas for req elicitation	20.4%
UML	17.8%
Modeling/formalisms for reqs	11.8%
Software Product Lines	5.9%

152 answers from Swedish industry, Spring 2009

Tool for Req Eng work?

Svarade	**Andel**
Office (Word, Excel, Visio)	23.8%
None	15.3%
Requisite Pro	10.2%
Quality Center	9.6%
Don't know	5.1%
Focal Point / DOORS	4.0%
Caliber	3.4%
Customer-specific	3.4%
RSA	3.4%
Clear Case	3.4%
Req Test	3.4%
Rest / Other (max 2 mentions per tool)	18.6%

177 tools mentioned in total

Goal-driven Req Specification

Table 1: The role of goal-analysis in relation to RE activi ties

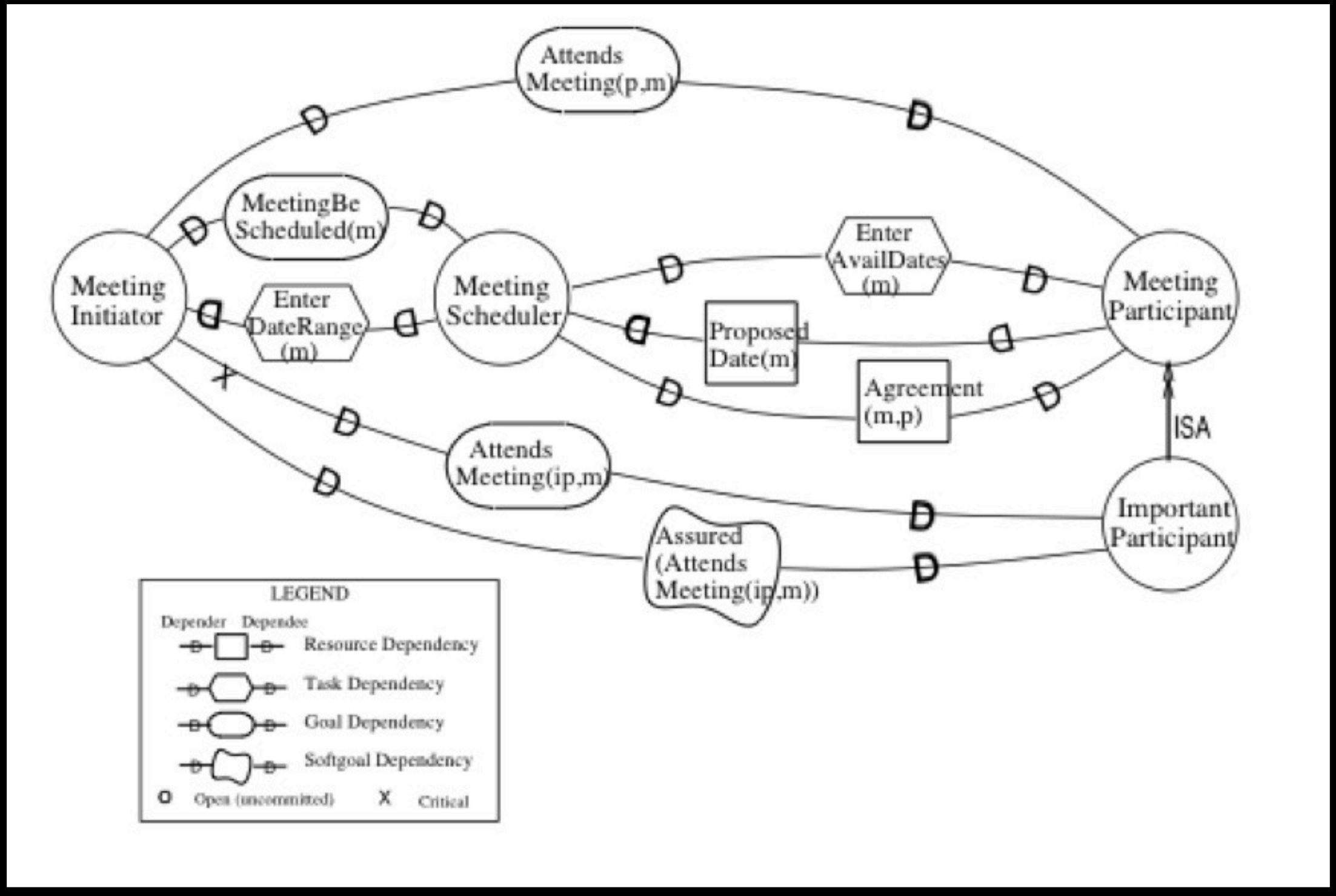
RE Activity	*Goal Analysis Contribution*	*Goal-Oriented Approach*
• requirements elicitation	1. understanding the current organisational situation, 2. understanding the need for change	GOMS, Goal-based Workflow, *i**, EKD ISAC, F^3
• requirements negotiation	3. providing the deliberation context of the RE process	SIBYL, REMAP, The reasoning loop model
• requirements specification	4. relating business goals to functional and non-functional system components	KAOS, GBRAM , the NFR framework, the Goal-scenario coupling frame work
• requirements validation	5. validating system specifications against stakeholders' goals	GSN, GQM

[Kavakli2003]

i*

- http://www.cs.toronto.edu/km/istar/
- Models Agents and their Intentions
- Early Req Specification together with Customers
- 1. Strategic Dependency Model
  - Actors and Dependencies
  - Certain Actions performed by certain Actors
  - Ex: User depends on system to open door to meet goal to enter building
- 2. Strategic Rationale Model
  - Looks inside actors, what drives them

I* example


Attends Meeting(p,m)
MeetingBe Scheduled(m)
Meeting Initiator
Enter DateRange (m)
Meeting Scheduler
Enter AvailDates (m)
Proposed Date(m)
Agreement (m,p)
Meeting Participant
ISA
Attends Meeting(ip,m)
Important Participant
Assured (Attends Meeting(ip,m))
LEGEND
Depender Dependee
Resource Dependency
Task Dependency
Goal Dependency
Softgoal Dependency
Open (uncommitted)
Critical

KAOS Goal modeling and refinement [Betrand1998]

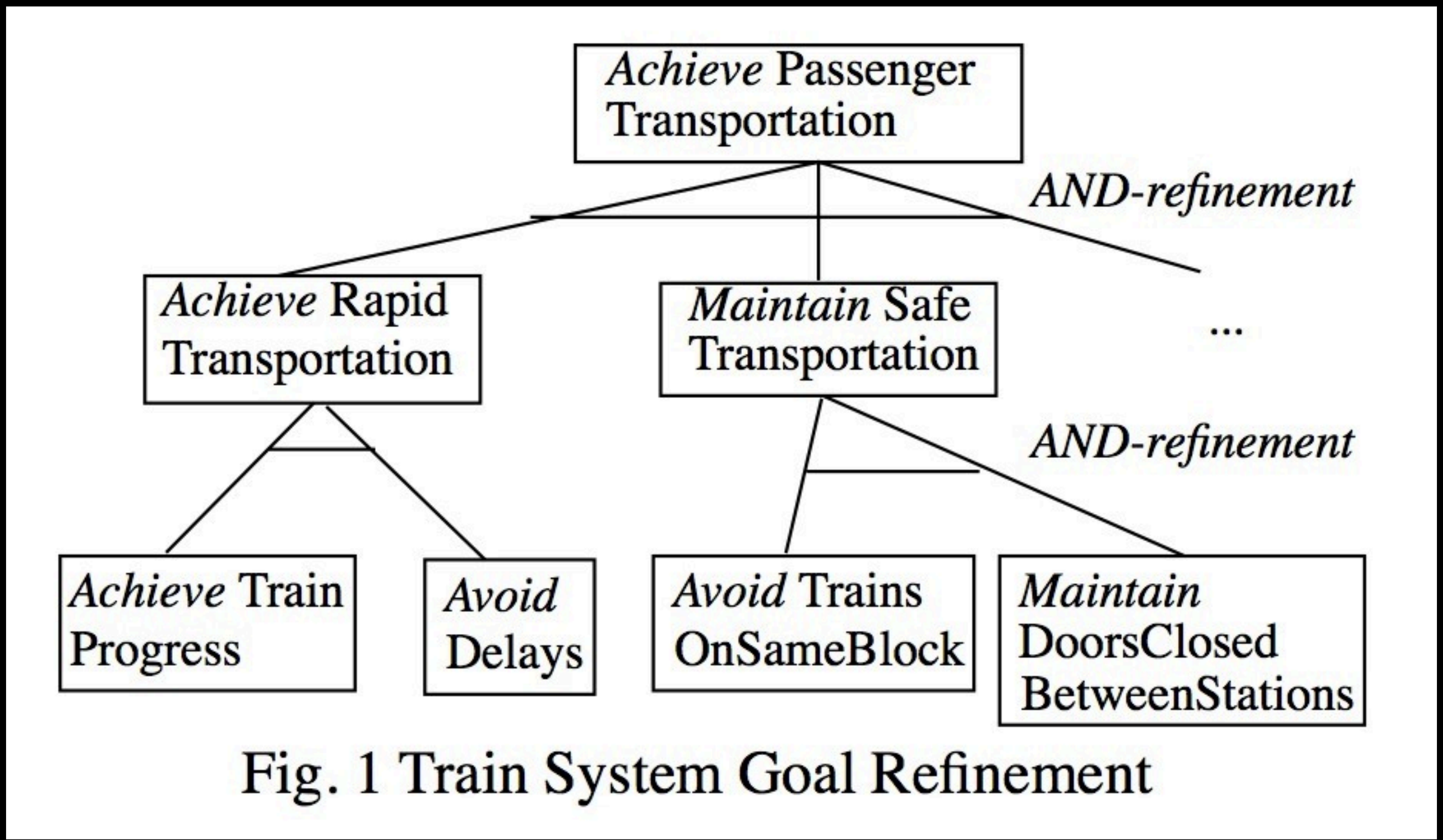


Fig. 1 Train System Goal Refinement

KAOS Goal modeling and refinement

Goal Maintain [DoorsClosedBetweenStations]

InstanceOf SafetyGoal

Informal Definition The train doors must remain closed while the train is moving between two stations.

FormalDef ($\forall$ tr:Train, s: Station)

$\Box$ At (tr, s) $\wedge \neg$ At (tr, s)

$\Rightarrow$ tr.doorState="closed" W At(tr,Next(s))

[Betrand1998]

KAOS Goal modeling and refinement

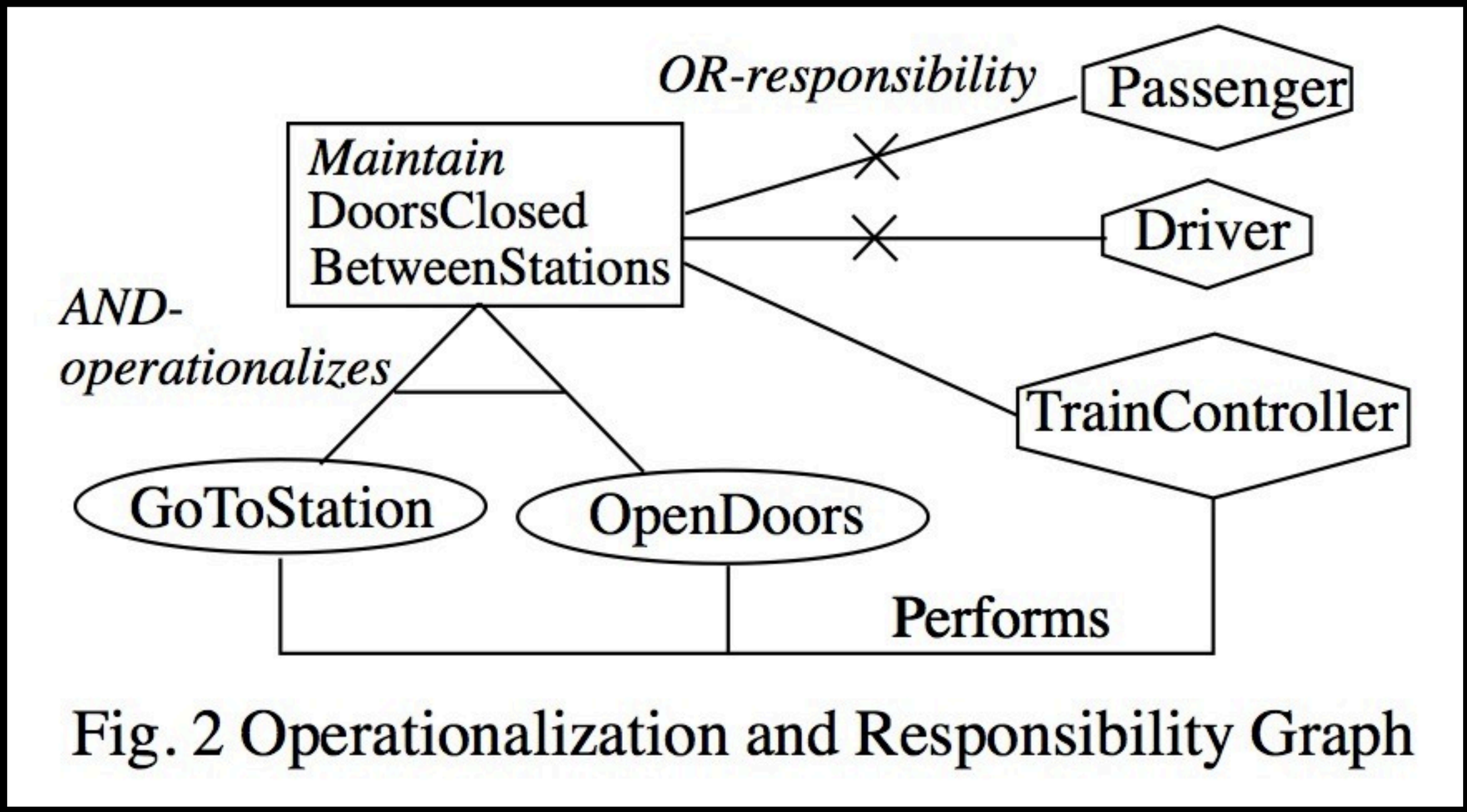
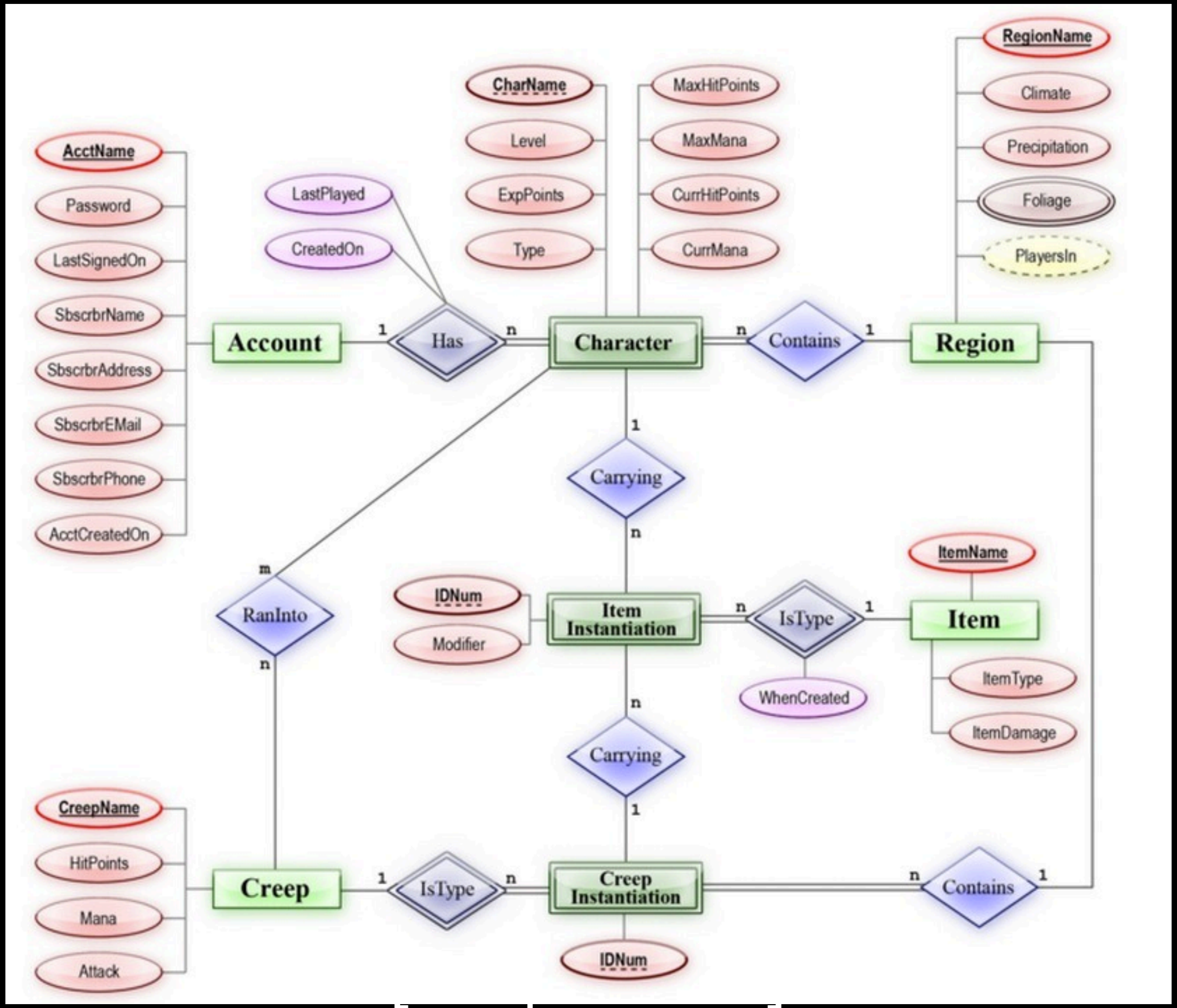


Fig. 2 Operationalization and Responsibility Graph

[Betrand1998]

Data modeling: E-R Diagrams

[Wikipedia2012]


RegionName
Climate
Precipitation
Foliage
PlayersIn
CharName
MaxHitPoints
Level
MaxMana
ExpPoints
CurrHitPoints
Type
CurrMana
AcctName
Password
LastSignedOn
SbscrbrName
SbscrbrAddress
SbscrbrEMail
SbscrbrPhone
AcctCreatedOn
LastPlayed
CreatedOn
Account
1
Has
n
Character
n
Contains
1
Region
1
Carrying
n
ItemName
IDNum
Modifier
Item Instantiation
n
IsType
1
Item
ItemType
ItemDamage
WhenCreated
m
RanInto
n
n
Carrying
1
CreepName
HitPoints
Mana
Attack
Creep
1
IsType
n
Creep Instantiation
n
Contains
1
IDNum

Formal languages: Z

- Mathematical language for describing computing system
- Model-based, models abstract data type (ADT)
- ADT = system state and operations on it
  - State = state variables and their values
  - Operation = can change state
- Good match to imperative programming languages
- Also extension for OO languages; form of inheritance
- Very mature, used since 1970's

State Transition Diagram (Z example)

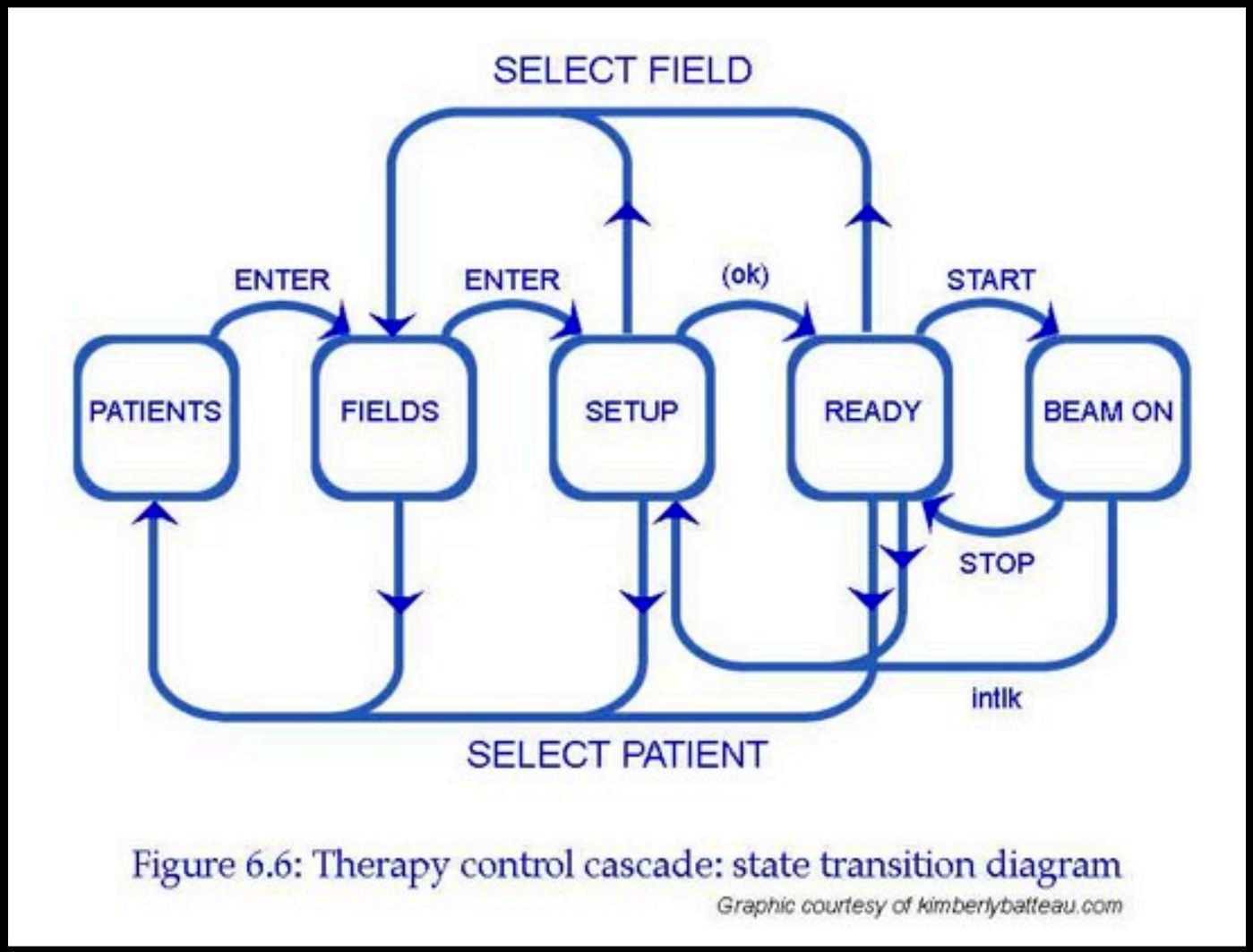


Figure 6.6: Therapy control cascade: state transition diagram

Graphic courtesy of kimberlybatteau.com

From J. Jacky, "The way of Z", chapter 6

State Transition Table (Z example)

	SELECT PATIENT	SELECT FIELD	ENTER	ok	START	STOP	intlk
PATIENTS	---	---	FIELDS	---	---	---	---
FIELDS	PATIENTS	---	SETUP	---	---	---	---
SETUP	PATIENTS	FIELDS	---	READY	---	---	---
READY	PATIENTS	FIELDS	---	---	BEAM ON	---	SETUP
BEAM ON	---	---	---	---	---	READY	SETUP

And now in Z

$STATE ::= patients \mid fields \mid setup \mid ready \mid beam\_on$

$EVENT ::= select\_patient \mid select\_field \mid enter \mid start \mid stop \mid ok \mid intlk$

$FSM == (STATE \times EVENT) \pfun STATE$

$no\_change, transitions, control : FSM$

$control = no\_change \oplus transitions$

$no\_change = \{ s : STATE; e : EVENT \bullet (s, e) \mapsto s \}$

$transitions = \{ (patients, enter) \mapsto fields,$

$(fields, select\_patient) \mapsto patients, (fields, enter) \mapsto setup,$

$(setup, select\_patient) \mapsto patients, (setup, select\_field) \mapsto fields, (setup, ok) \mapsto ready,$

$(ready, select\_patient) \mapsto patients, (ready, select\_field) \mapsto fields, (ready, start) \mapsto beam\_on, (ready, intlk) \mapsto setup,$

$(beam\_on, stop) \mapsto ready, (beam\_on, intlk) \mapsto setup \}$

References

[Kavakli2003] Kavakli, E. and Loucopoulos, P., "Goal driven requirements engineering: evaluation of current methods", Proceedings of the 8th CAiSE/ IFIP8, pp. 16-27, 2003.

[Bertrand1998] Darimont, R. and Delor, E. and Massonet, P. and Van Lamsweerde, A., "GRAIL/KAOS: an environment for goal-driven requirements engineering", ICSE conference, pp. 612-620, 1997.