Getting Started

We now have dress shirts on sale for men with 16 necks
[at a department store]

Ice cream souveniers *[on a billboard on I-24, Nashville]*

Thou shall commit adultery *[The Wicked Bible, 1623, England]*

Slow children at play *[in residential areas]*

Please wait for hostess to be seated *[at restaurants]*

We will sell gasoline to anyone in a glass container
[Santa Fe gas station]

Don't kill your wife. *[In the window of a Kentucky appliance store]*
Let our washing machine do the dirty work.

Dinner Special - Turkey $2.35; Chicken or Beef $2.25;
Children $2.00

Will the last person to leave please see that the perpetual light is extinguished *[In the vestry of a New England church]*

When two trains approach each other at a crossing, both shall come to a full stop and neither shall start up again until the other is gone. *[Kansas legislature, early 1890's]*

Trespassers will be prosecuted to the full extent of the law
- Sisters of Mercy *[on the wall of a Baltimore estate]*

Man, honest. Will take anything *[an ad]*

Requirements Elicitation

- Critical Issues
- Desirable Properties of Requirements
- Some Elicitation Techniques
  - Ethnomethodology
  - Domain Analysis
  - Problem Frames
  - Data/Information Elicitation Techniques

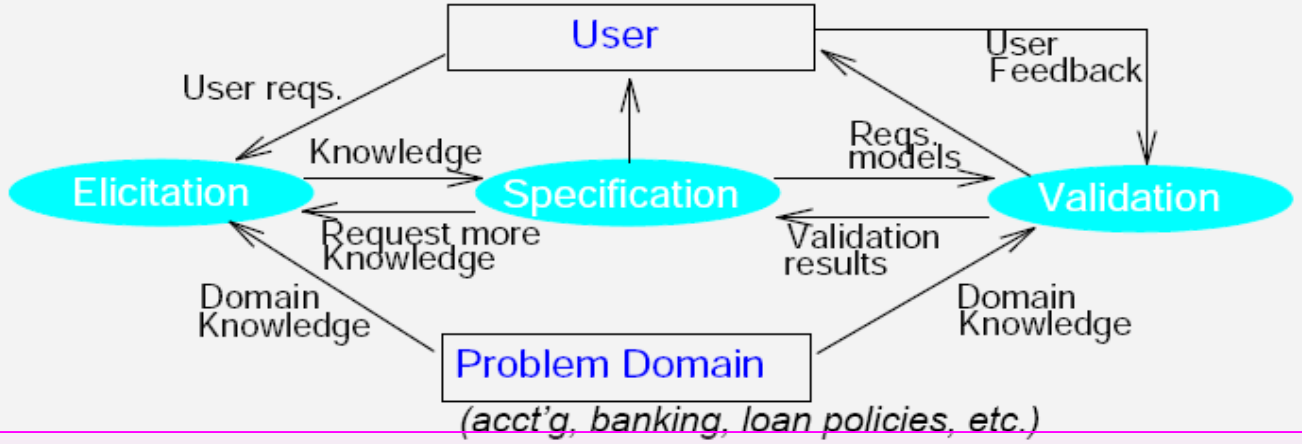
Refresher

What are RE Processes?

A Framework

for intial model construction & subsequent reengineering

3 fundamental concerns: *understand* *(formally) describe* *attain an agreement on* ***the problem***



- **Elicitation**
  determine what's really needed, why needed, whom to talk to
  acquire as much knowledge as possible

  } ***early RE***

- **Specification**
  produce a (formal) RS model: translate "vague" into "concrete", etc.
  make various decisions on what & how
- **Validation**
  assure that the RS model satisfies the users' needs

  } ***late RE***

Refresher

Why is it difficult?

A wicked problem

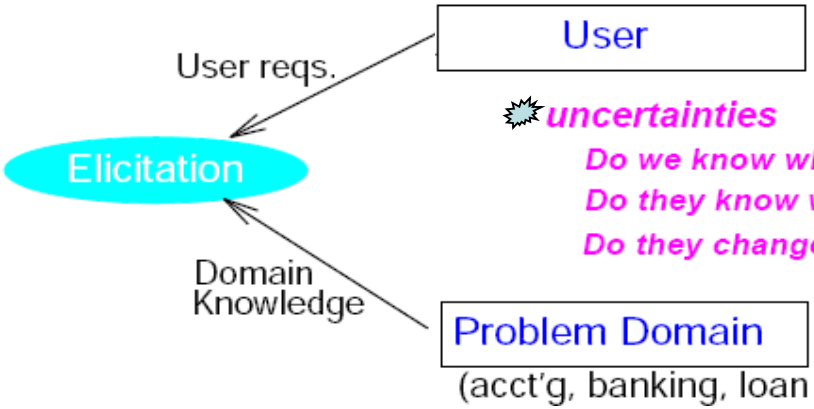
- *many sources*
  - *customers, tellers, other employees*
  - *databases, files, chapters, literature, standards, legal issues*
  - *surveys of similar applications*
    - *(what are they, who are they, how successful are they)*
- *different views on wants and needs*
- *different notations, mental models*

Relativism is everywhere:

Truth often depends on the observer

- The meanings of the words
- The assumptions about context
- The set of categories for understanding the world
- perceptual limitations
- cognitive ability
- personal values and experience

"In the land of the blind, the one-eyed man is king"



- *uncertainties*
  - *Do we know whom to talk to?*
  - *Do they know what they want/need?*
  - *Do they change their minds?*

- *many sources*
  - *domain experts (accountants, bankers, loan managers, etc.)*
  - *databases, files, chapters, literature, standards, legal issues*

Refresher

Why is it difficult?

A wicked problem

- identification process complex (repetitive interactions)
- communication, coordination process complex

- requirements volatility:

  Reqs. change because the problem being solved changes,
  because people's perception changes,
  because some involved persons were not contacted or
  were contacted but not in an appropriate manner.

Requirements creeping rate = percentage of change/time

Can you cope with 50%/month?

Requirements Elicitation

- Critical Issues
- Desirable Properties of Requirements
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  - Problem Frames
  - Data/Information Elicitation Techniques

How to do RE?

Major themes of the course

Types of Errors

- **Jet Propulsion Laboratory (JPL) [Kelly92]**

  nearly 2/3 requirements defects are due to omission of key information

  => *techniques of completeness*

  => *setting the scope*

  => *identifying system operations*

  => *identifying goals/objectives*

- **The Naval Research Laboratory**

  Navy A-7E aricraft's operational flight program [Boehm, DeMarco, et al.]

  ongoing research since the mid-70's

  77% of requirements errors were nonclerical

  49% incorrect facts
  31% omission
  13% inconsistency
  5% ambiguity
  2% misplacement

  33% of requirements errors were detected by manual review
  automated tools can detect a significant number of errors

- **Error detection and removal** — Using modeling and systematic decision making

  in defining

- **Why, What & How** — *& What else?*

How to do RE?

Major themes of the course

- **Error detection and removal**

Conceptuality ⟷ **Formality**

Natural language	Semi-formal notations	Formalisms
customer/users		modellers/ specifiers
defects ↑		defects ↓

- **A requirements engineer should:**

  understand the problem
  express/translate the needs *through interaction*

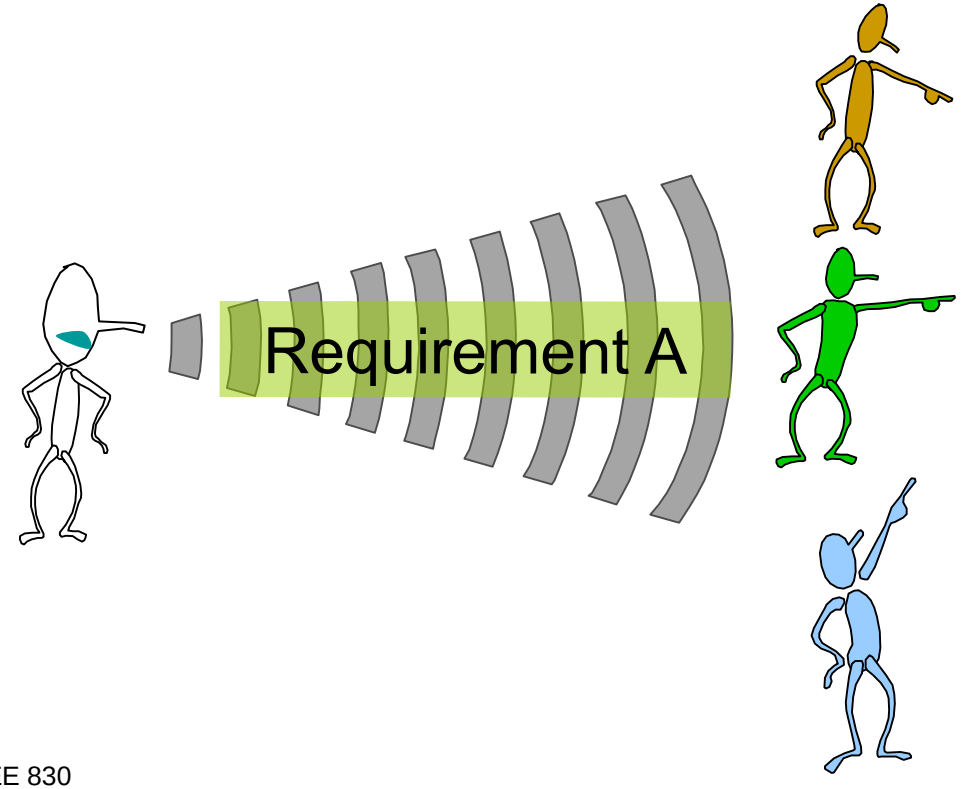
  be knowledgeable in relevant technologies toward possible solutions
  decide on a solution

  manage acquisition and evolution

A requirements engineer = SEeer, Customer Engineer, Req/Sys/Prog Analyst, Sys. Engineer, Sys. Engineer for Business, Req. Modeller, Assessor of Safety Control & Protection Systems, System Designer, RE Process Manager, Knowledge Engineer, Specifier, etc.

Qualities of a Requirement: Unambiguous

- A requirement is unambiguous if it has only one ***interpretation***.



"A shall do B to C"

"A shall do B to C"

"A shall do B to C"

ref - IEEE 830

Explore Ambiguity: Dictionary Definitions

Mary had a little lamb.

had - Past of have

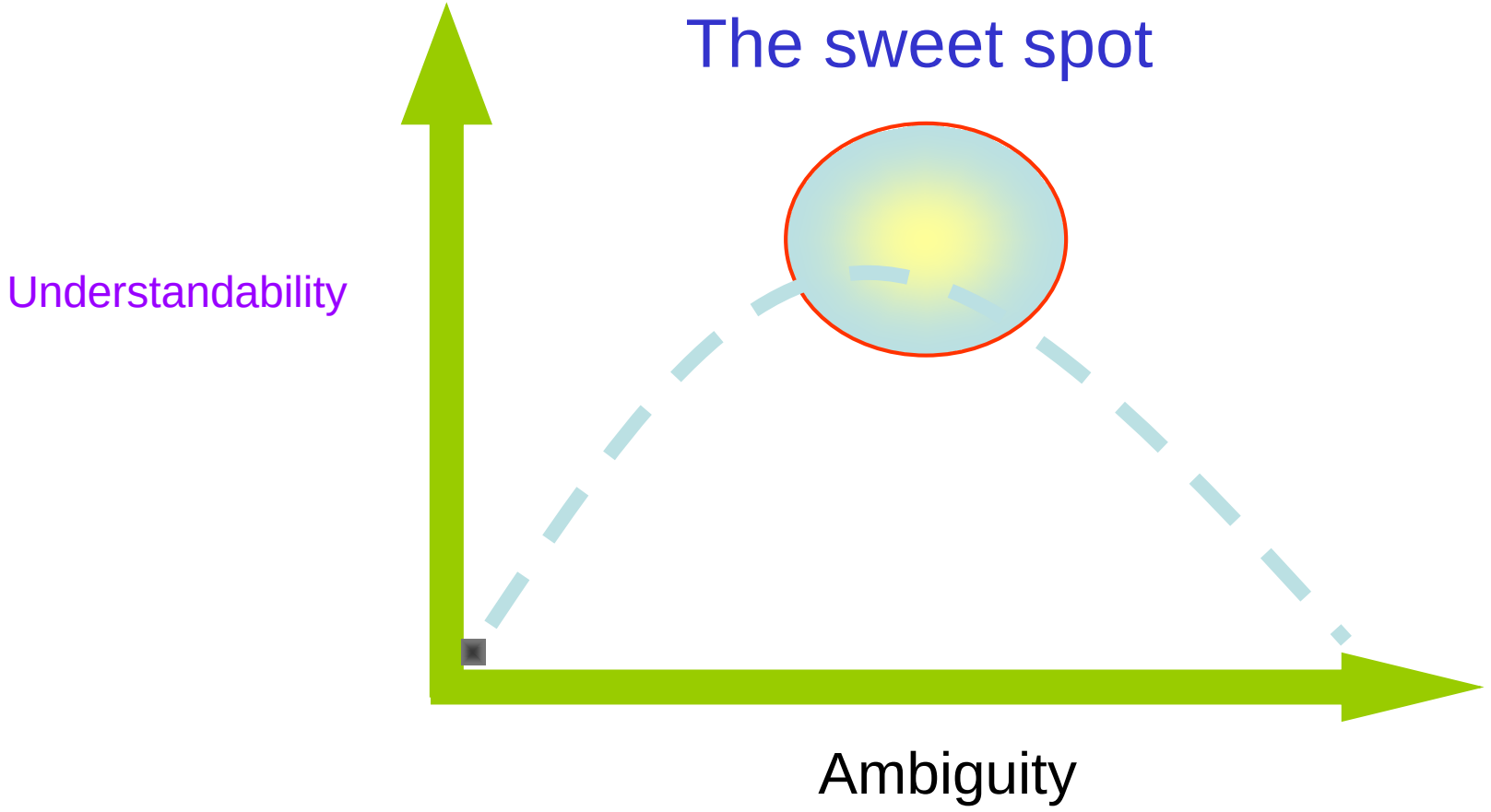
have - 1a: To hold in possession as property
4a: To acquire or get possession of: OBTAIN (best to be had)
4c: ACCEPT; to have in marriage
5a: To be marked or characterized by (have red hair)
10a: To hold in a position of disadvantage or certain defeat
10b: TRICK, FOOL (been had by a partner)
12: BEGET, BEAR (have a baby)
13: To partake of (have dinner)
14: BRIBE, SUBORN (can be had for a price)

lamb - 1a: A young sheep esp. less than one year old or without permanent teeth
1b: The young of various other animals (as smaller antelopes)
2a: A person as gentle or weak as a lamb
2b: DEAR, PET
2c: A person easily cheated or deceived especially in trading securities
3a: The flesh of lamb used as food

Explore Ambiguity: Analysis

Have	Lamb	Interpretation
1a	1a	Mary owned a little sheep under one year of age or without permanent teeth.
4a	1a	Mary acquired a little sheep under one year of age or without permanent teeth.
5a	1a	Mary is the person who owned a little sheep under one year of age or without permanent teeth.
10a	1a	Mary held a little sheep under one year of age or without permanent teeth in a position of disadvantage.
10b	1a	Mary tricked a little sheep under one year of age or without permanent teeth.
12	1b	Mary gave birth to a young antelope.
12	2a	Mary is (or was) the mother of a particular small, gentle person.
13	3a	Mary ate a little of the flesh of lamb.
14	2c	Mary bribed a small person trading in securities who was easily cheated.

Explore Ambiguity: An Observation



Qualities of Software Requirements

[Leffingwell & Widrig (1999). IEEE 830-1993, § 4.3.2, 1994]

- **Correct**
  - Is a true statement of something the system must do.
- **Complete**
  - Describes all significant requirements of concern to the user.
- **Consistent**
  - Does not conflict with other requirements.
- **Unambiguous**
  - Is subject to one and only one interpretation.
- Verifiable
  - Can be tested cost effectively.
- Ranked for importance and stability
  - Can be sorted based on customer importance and stability of the requirement itself.
- Modifiable
  - Changes do not affect the structure and style of the set.
- Traceable
  - The origin of each requirement can be found.
- Understandable
  - Comprehended by users and developers.

Qualities of a Requirement: Verifiable

IEEE 830-1993, § 4.3.2, 1994

- A requirement is verifiable if:
  - There exists some finite, cost-effective process with which a person or machine can check that the product meets the requirement.

- The system supports up to 1,000 simultaneous users.
- The system shall respond to an arbitrary query in 500 msec.
- The color shall be a pleasing shade of green.
- The system shall be available 24 x 7.
- The system shall export view data in comma-separated format, according to the IEEE specification.

Are these requirements verifiable? If not, what is a better way to state them?

How to elicit?

Recall

How to do RE?

Major themes of the course

Error detection and removal

Conceptuality		Formality
Natural language customer/users	Semi-formal notations	Formalisms modellers/ specifiers
defects ↑		defects ↓

Clarity

shall, will, must, should, etc. => formailty (criticality)

A or B => formality (inclusive-or/exclusive-or)

mostly A => formality (A in cases C1, C2, ..., Cn)

perhaps/could/may/might A => formality (A in cases C1, C2, ..., Cn)
by and large, often, frequently A => formality (A in cases C1, C2, ..., Cn)

A or ~A => formally ignore as tautology, but may mean something

How to elicit?

Recall

How to do RE?

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defects ↑		defects ↓

Consistency

A set of formulas Φ in first-order logic is **consistent** if and only if there is no formula φ such that $\Phi \vdash \phi$ and $\Phi \vdash \neg\phi$.

A and ~A => formally false, ignorable, but could be typo

A implies B A ~B

modus ponens

A or B ~A ~B

Slow children at play => semantic issue

How to elicit?

Recall

How to do RE?

Major themes of the course

Error detection and removal

Conceptuality		Formality
Natural language customer/users	Semi-formal notations	Formalisms modellers/ specifiers
defects ↑		defects ↓

Correctness (external Consistency)

When two trains approach each other at a crossing, both shall come to a full stop and neither shall start up again until the other is gone. [Kansas legislature, early 1890's]

=> scenario analysis and/or
=> formalism

Call forwarding: (B -> C); (A -> C); (D -> A)
(B -> C); (C -> B)

How would you detect these potential problems?
How should you deal with "feature interaction problems"?

How to elicit?

Recall

How to do RE?

Major themes of the course

Error detection and removal

Conceptuality ← → Formality

Natural language	Semi-formal notations	Formalisms
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defects ↑		defects ↓

Completeness *sometimes, "the" key issue*

hard => elicitation techniques

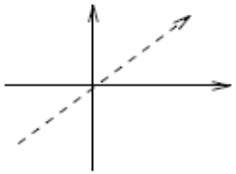
(logical formalism is modern philosophy)

=> use of "ontological" primitives

goals, agents, decisions, rationale ***goal-orientation, agent-orientation***

entities, activities, constraints ***object-orientation***

=> use of organizational primitives



classes/metaclasses,
associations/aggregations,
superclasses/subclasses
views

In philosophy, ontology is the study of being or existence. It seeks to describe or posit the basic categories and relationships of being or existence to define entities and types of entities within its framework. Ontology can be said to study conceptions of reality. http://en.wikipedia.org/wiki/Ontology

Ontology

for more complete and more sound modelling

Meta-level

Class-level

token/ground-level

How to elicit?

Recall

How to do RE?

Major themes of the course

Error detection and removal

Conceptuality ← → Formality

Natural language
customer/users

Semi-formal notations

Formalisms
modellers/
specifiers

defects ↑ defects ↓

Overspecification

algorithms (sorting, searching, routing, serialization, normalization, etc.)
data structures (stack, queue, tree, graph, heap, etc.)

Technically unsolvable problems

scheduling, pattern recognition, etc.

Also, do not worry at this time about acquiring the resources to build the house. Your first priority is to develop detailed plans and specifications. Once I approve these plans, however, I would expect the house to be under roof within 48 hours.

While you are designing this house specifically for me, keep in mind that sooner or later I will have to sell it to someone else. It therefore should have appeal to a wide variety of potential buyers. Please make sure before you finalize the plans that there is a consensus of the population in my area that they like the features this house has.

I advise you to run up and look at my neighbor's house he constructed last year. We like it a great deal. It has many features that we would also like in our new home, particularily the 75-foot swimming pool. With careful engineering, I believe that you can design this into our new house without impacting the final cost.

Lawrence Chung

Requirements Elicitation

- Critical Issues
- Desirable Properties of Requirements
- Some Elicitation Techniques
  - Ethnomethodology
  - Domain Analysis
  - Problem Frames
  - Data/Information Elicitation Techniques

Ethnomethodology

Why is it difficult?

A wicked problem

the "say-do" problem: people know how to do things they normally don't describe (tacit knowledge); descriptions of such things may be highly inaccurate

So, what should be done then?

List three examples

How to elicit?

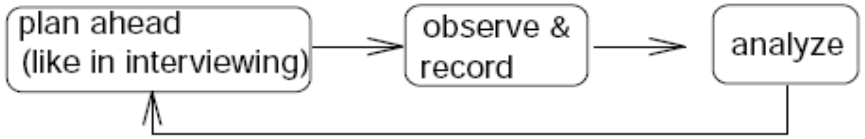
Data/Information Elicitation Techniques

g the "say-do" problem: people know how to do things they normally don't describe (tacit knowledge); descriptions of such things may be highly inaccurate

l experts may not want to tell ---> *"say-do" problem*

Ethnomethodology (People's methods)

- Sometimes, observation is the best way to understand how things are done
- (esp. where) social order is accomplished on a moment-to-moment basis
- So, OBSERVE in a NATURAL setting



- e.g., stock brokerage (multiple phone calls, computer), HCI
- ethical, legal implications, if video-taping without notification
- observation not in a natural setting, if people are aware of being observed
  needs maximal natural setting, minimal interruption
- can be too time-consuming to analyze the recording
  gradual identification of critical tasks and focusing

How to elicit?

Knowledge Acquisition: A Relative of Requirements Elicitation

- From AI, largely intended for acquiring expertise (e.g., of doctors, lawyers)
  - **practised by "knowledge engineer"**
  - Recall: requirements elicitation -> capturing "knowledge" of domain
- Use of mediating representations:
  - **help bridge the gap between the structure of expert' knowledge and formal, computer-based representations (e.g., Text, Note, Diagram, Chart, Table, Frame, Rule, Semantic-Net)**
- Automatic KA techniques
  - infer new knowledge from past experience

    worksFor(bill, john)
    worksFor(maria, john)
    worksFor(george, john)
    ---
    forall x worksFor(x, john) For whom does Susan work ?
  - suggest refinement

    forall x, y (x <> y) -> worksFor(x, y)
  - detect inconsistencies

    forall x worksFor(x, john)
    worksFor(eve, maria)
- Issues recognized for KA
  - **novice K <> expert K** *---> diff. types of customers*
  - **experts may not want to tell** *---> "say-do" problem*
  - **expertise (experience) doesn't always translate into "rules"**

    ---> reqs. analyst: informal -> formal (ethnomethodology)

How to elicit?

Data/Information Elicitation Techniques

- Sampling
- Questionnaires
- Interviewing
- Group Meetings
- Ethnomethodology
- Scenarios => 4

evolution

Requirements should contain *nothing but* information about the environment.

How to elicit?

Data/Information Elicitation Techniques

Sampling

- the process of systematically selecting representative elements of a population, often applied to documents ("hard" data, e.g., transaction log)
- useful as it can minimize costs/overhead during data gathering (only a portion, no direct involvement of customer)
- sampling tasks:
  - **data determination**

    E.g., in building/improving an ATM system
    - how much time/transaction (-> #machines, response time improvement)
    - how many errors before completion (-> UI design, robustness, help fns)
    - correlation between amount and time spent (-> max amt, accuracy assurance)
    - peak period, interval between transactions (-> performance improvement)
    - success/failure ratios (-> bad transaction types, time of day/week)
  - **population**

    E.g., transactions
    - transactions in 4 local branches for 1 week
  - **type determination**
    - **purposive sampling** choose population elements the analyst considers important with no regard to statistical issues (e.g., only high amount/frequent transactions)
    - **random sampling** every kth element
  - **sample size**

    E.g., consider 1/10th of all transactions (in 4 local branches for 1 week)

    the bigger the size, the higher the cost of sample collection, but higher confidence level

How to elicit?

Data/Information Elicitation Techniques

Questionnaires

- kinds of information sought: attitudes, beliefs, behavior
  - not normally found through sampling (hard data) or interviews

  But if not anonymous, customers may be reluctant to answer questions

  Have you used any meeting scheduler system before? Y N

  If yes, are you satisfied with it? 1 2 3 4 5

  If no, would you try a meeting scheduler system when available? Y N

  Would you encourage other people to use one? Y N

  How much time are you willing to spend in each session?

  5minutes< 5minutes< & <10 minutes 10 minutes< & <20 minutes

- avoid open questions
  (because answers to such questions are hard to correlate and interpret)

  Do you think a new meeting scheduler will succeed?

  Do you believe a mtg scheduler system should drastically change our daily lives?

- questionnaires should be short
  (otherwise, people may be reluctant to participate with busy schedule)

- administer the questionnaire using simple rules
  - scoring scheme: e.g., a range of from 1 to 5
  - group inter-related questions

    E.g., Q 1 2 3 represent customer satisfaction with current systems

    Q 4 5 6 7 represent customer willingness to try a new one

How to elicit?

Data/Information Elicitation Techniques

Interviewing

- kinds of information sought:
  tacit knowledge as well as hard facts, opinions, feelings, goals

- dos: planning ahead of time
  See how experienced journalists do it!

public library

magazines, films

read background material
(mtgs, scheduling mtgs, mtg scheduler systems)

↓

establish interviewing objectives
(what are you trying to get out of the interview?)

↓

decide whom to interview
(people are busy; likely or important customers)

↓

prepare for interview
call people ahead of time to prepare;
tell the purpose, duration, possibly question types

↓

decide on interview structure & question types
(write down questions & answer them ahead of time)

↓

hold the interview

↓

review on-line notes -> disseminate -> difference recording & resolution

- don'ts:
  needs mastery of skills
  buzzwords/acronyms to impress
  unusual body language
  (unusual tone of voice, facial/body expressions, dress, etc.)

often people can't articulate their perception or their needs;
often people are reluctant to reveal their thoughts

How to elicit?

Data/Information Elicitation Techniques

- Group Meetings
  - focus groups:
    kind of group interview, often conducted in terms of "stimulus material" (videos, stories, .
    Success depends on the kinds of participants and moderator
  - E.g., Joint Application Development (JAD)
    - Joint Requirements Planning (JRP)
      usually for high-level managers;
      identify and examine business goals, problems, critical success factors, strategic opportunities
    - Joint Application Design (JAD)
      identify and examine the end users' needs
    - 4 tenets of JAD:
      - group dynamics
        participants (developers, users/customers)
        leader/moderator/facilitator
        recorder/scribe
      - visual aids
        E.g., calendars, participants, equipments, locations
      - organized, rational process
        periodic, democratic, conflict accommodating
      - WYSIWIG documentation approach

How to elicit?

- Domain Analysis

  "support reuse of generic domain modelling patterns"
  => significant reduction in elicitation, specification & validation

  - Identify commonalities between similar applications
  - store requirements in a repository
  - select one or more similar requirements and tailor
  - E.g., "resource-allocation" meta-domain model
    - resource-allocation has as instances:
      airline reservation system, hotel reservation system, car rental, class registration, etc.

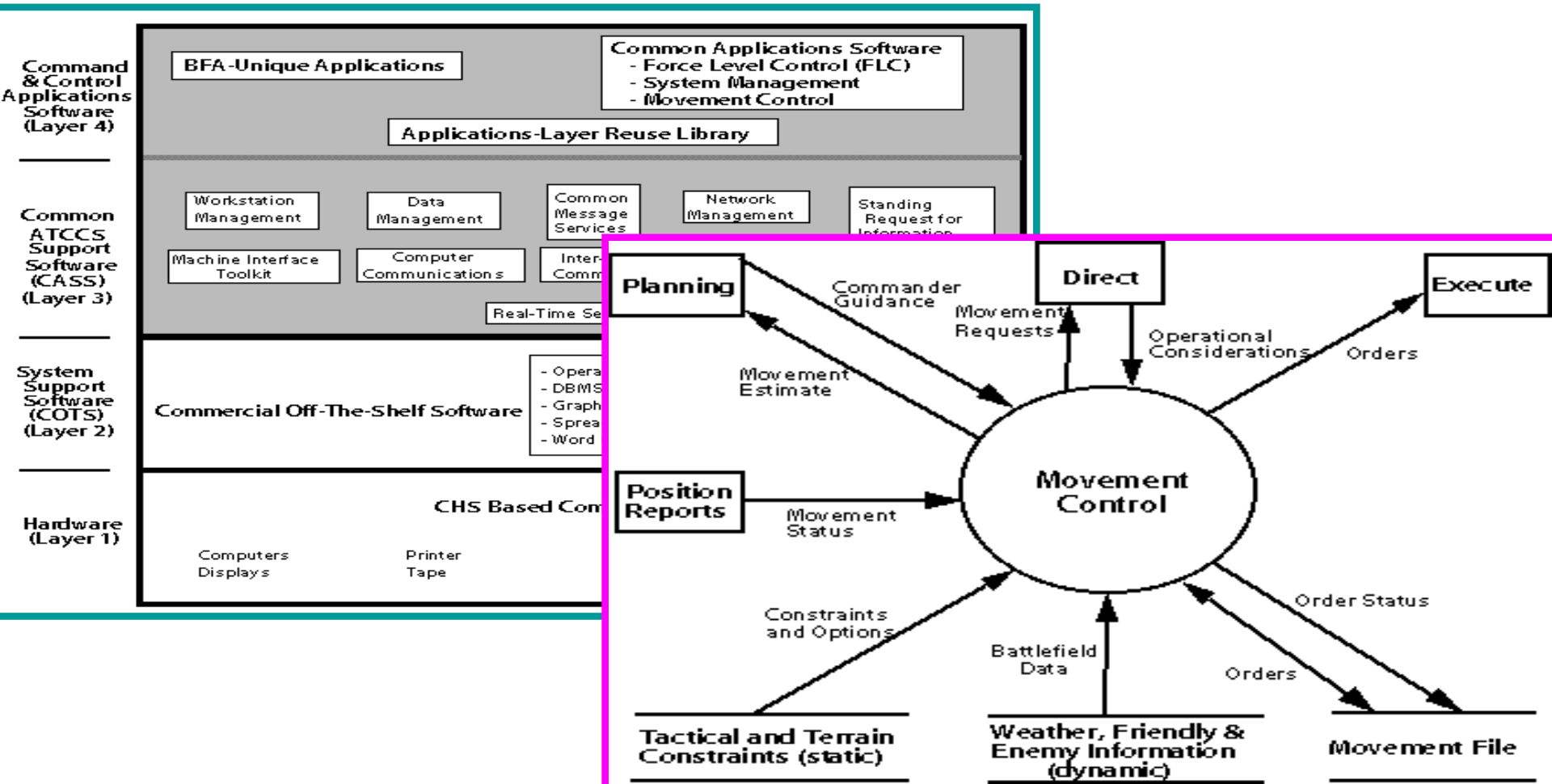
- Feature Oriented Domain Analysis (FODA): a process for domain analysis and establishes specific product for later use. Three basic phases:
  - **Context Analysis:** defining the extent (or bounds) of a domain for analysis
  - **Domain Modeling:** providing a description of the problem space in the domain that is addressed by software (See ***Enterprise Modeling***)
  - **Architecture Modeling:** creating the software architecture(s) that implement solutions to the problems in the domain
    - Note: The architectural modeling phase was initially defined as part of the FODA methodology. However, the process of integrating FODA products with architectural modeling has become part of the domain design activity in the overall concept of Domain Engineering.

[CMU/SEI-90-TR-21].

How to Elicit?: FODA

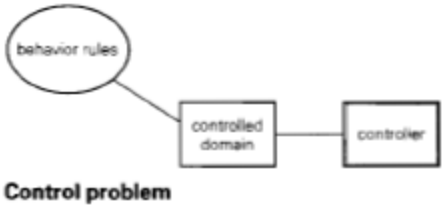
[adapted from CMU/SEI-90-TR-21].

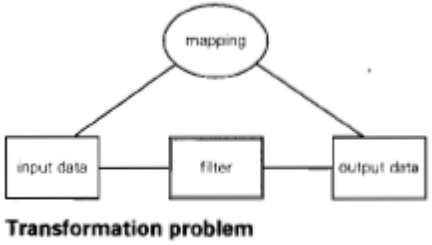
- **Context Analysis:**
  - **Structure Diagram -** an informal block diagram in which the domain is placed relative to higher-, lower-, and peer-level domains.
  - **Context Diagram -** a data flow diagram showing data flows between a generalized application within the domain and the other entities and abstractions with which it communicates.

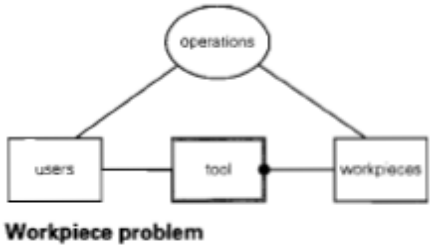


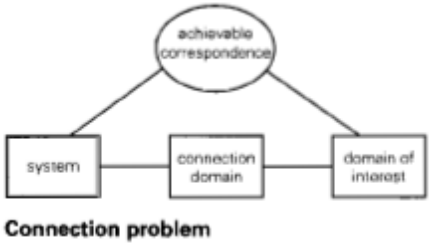
Problem Frames

[B. L. Kovitz, “Practical Software Requirements: A Manual of Content & Style”, pp.74-75]









Anti-requirements, abuse frame, security requirements

Introducing Abuse Frames for Analysing Security Requirements,
Luncheng Lin, Bashar Nuseibeh, Darrel Ince, Michael Jackson, Jonathan Moffett
RE 2003.

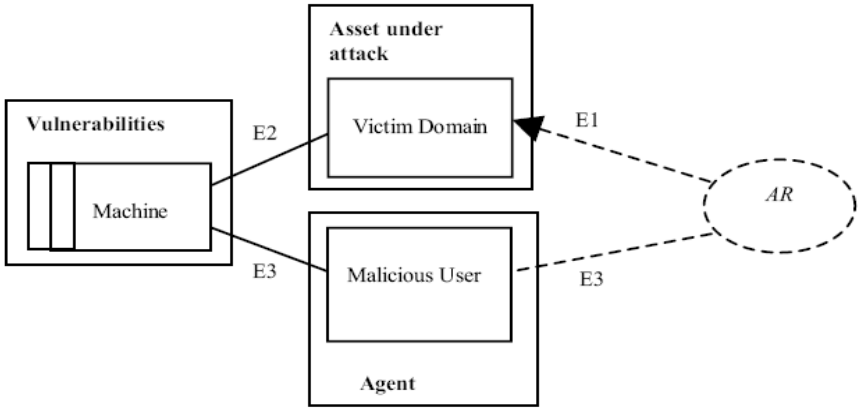


Figure 1: A threat described by a generic abuse frame diagram.

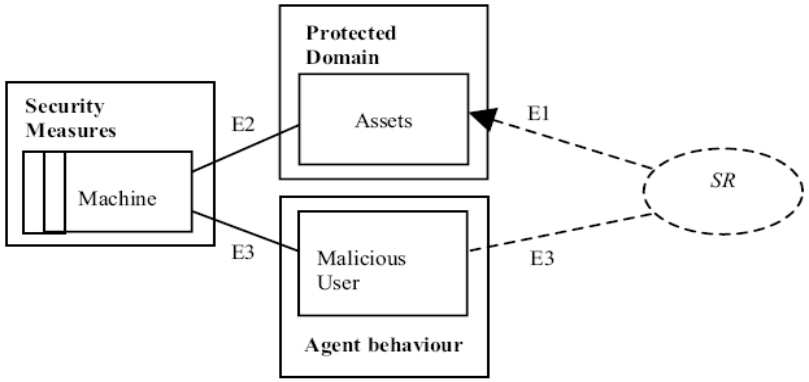


Figure 2: A security requirement expressed in Problem Frames.

Problem Frames

Source: Lecture note by Jim Herbsleb, http://conway.isri.cmu.edu/%7ejdh/MethodsF06/lec/probframes/prob-fr-1.pdf

The key idea in problem frames is *recurring problem types*

- Different problems share characteristics.
- If you stand back from the details of your current problem, you may recognize it as a known problem.
- Many known types of problems are already solved.
- A *problem frame* represents a "well-known" type of software problem.

Problem frames are a way of representing certain software-related expertise.

- *The nature of expertise*
  - Experts have about 50,000 chunks of knowledge
  - It takes them about 10 years to become experts
  - This is true across many domains
  - Experts recognize these chunks instead of deriving them
  - What passes for insight or intuition is often recognition
- *The idea in problem frames*
  - Frames represent chunks of knowledge
  - Knowing more variations will allow you to recognize more pre-solved problems and apply prior art
  - This is easier and less risky than analyzing from scratch

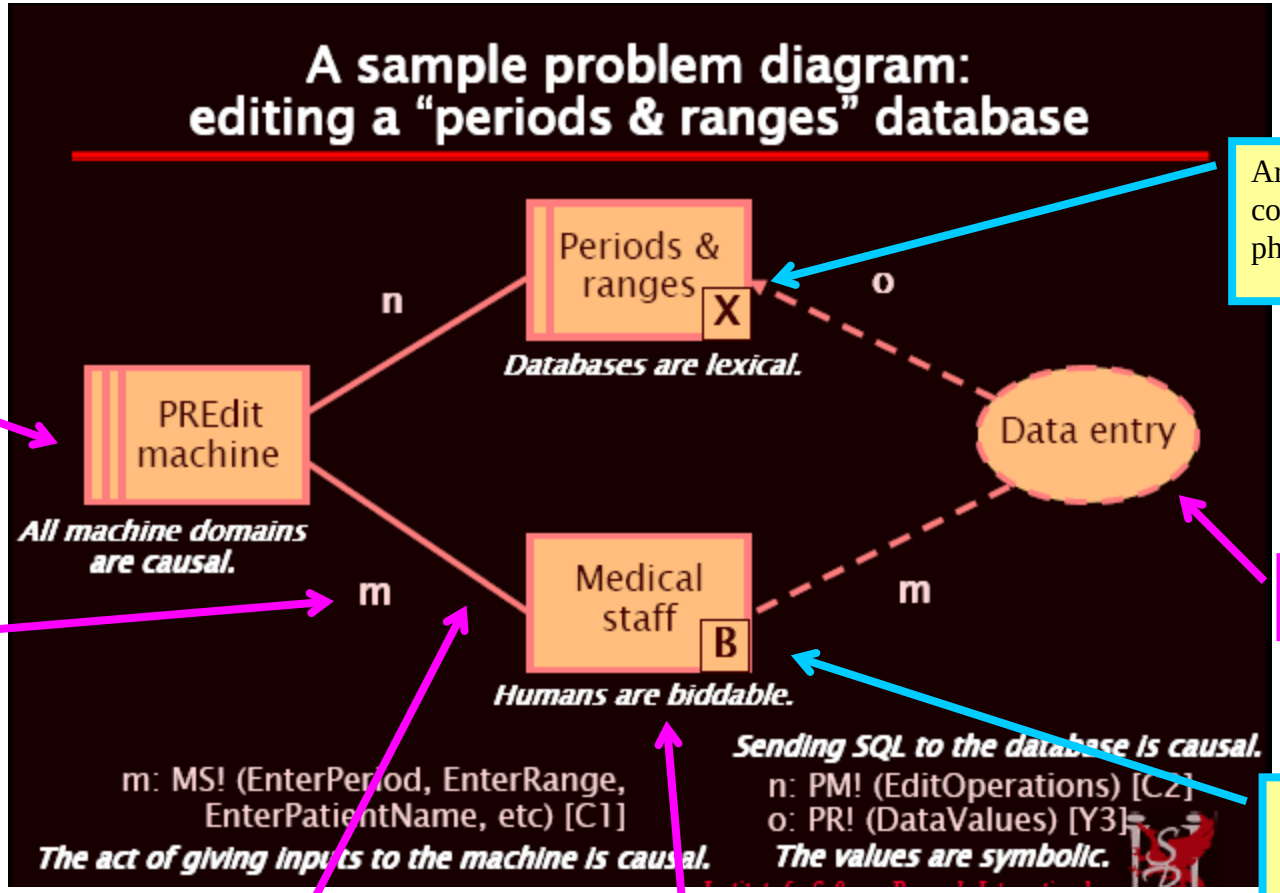
Problem Frames

Basic steps in applying problem frames

1. Break the context into pieces (called *domains*).
2. Identify the shared phenomena (called *interfaces*) among the domains.
3. Represent the domains and their interfaces in a *context diagram*
4. Add the conditions (called *requirements*) that the software must bring about.

- A context diagram that has been augmented with requirements is called a *problem diagram*.
- A problem diagram that recurs a lot is called a *problem frame*.

Problem Frames



Arrowed dashed line = constraining domain's phenomena

system

requirements

Shared phenomena

Dashed line = referencing domain's phenomena

interface

domain

Problem Frames

The different types of domains

- Causal (C) – has predictable relationships among physical phenomena
  - The machine domain, which has a double stripe, is always a causal domain.
- Biddable (B) - physical but unpredictable
  - Humans are the most common biddable domain.
- Lexical (X) – physical representation of data and symbolic phenomena
  - Designed domains, which have a single stripe, are usually lexical domains.

The different types of phenomena

- Causal (C or E) – the events that one domain initiates in order to influence or control another domain
  - Causal phenomena deal with what *happens*.
- Symbolic (Y) – values, truths, and states
  - Symbolic phenomena are *encodings* of other phenomena.

Examples of each type of phenomenon

- Causal (C or E)
  - DrawLine(x1,y1,x2,y2), supported by LCD screens
  - MakeElectricalPulse(voltage), supported by pacemakers
  - FireThruster(duration), supported by nuclear missiles
  - InsertRow(), supported by Microsoft Excel
  - ClickHyperlink(url), supported by humans
- Symbolic (Y)
  - ListOfParagraphs(), supported by Word documents
  - GridOfCells(), supported by spreadsheets
  - LevelOfEncryption(), supported by bank database

Problem Frames

There are 5 basic problem frames.

- Required behavior
  - Control part of the physical world to satisfy a condition.
- Commanded behavior
  - Control part of the physical world according to operator instructions.
- Information display
  - Obtain state/behavior information from the physical world and present it as required.
- Simple workpieces
  - Build a tool to create & edit persistent information objects
- Transformation
  - Transform information inputs to required outputs

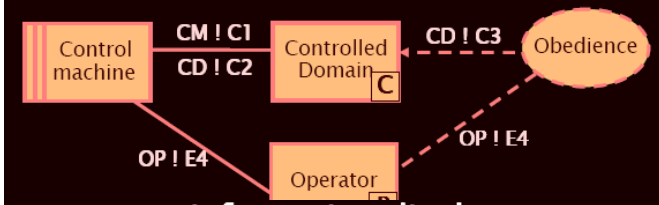
Required behavior

- Machine sends commands (C1) to controlled domain, which may provide feedback (C2)

- The requirement is that the controlled domain must demonstrate some behavior (C3).
- Note that the required behavior (C3) is different from the commands (C1) that are sent to try and cause that behavior.

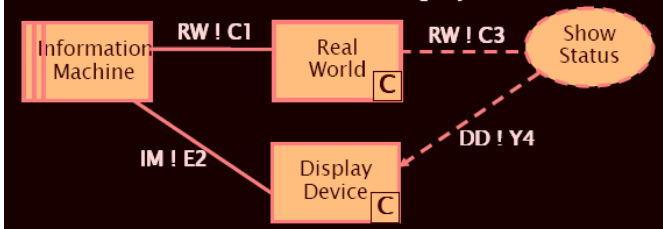
Commanded behavior

- Now a human operator sends certain events (E4) that implicitly specify the required behavior (C3).



Information display

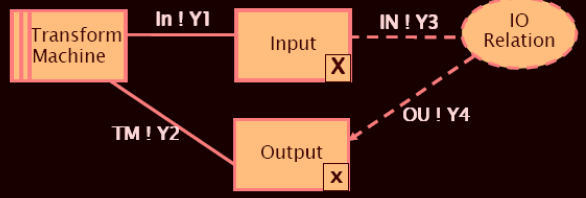
- The real world (or sometimes a lexical domain) sends some phenomena (C1) to the machine, which sends commands (E2) to the display device.



- Note that the real state of the world (C3) might not be entirely visible to the machine, yet the symbolic state (Y4) of the display should still be right!

Transformation

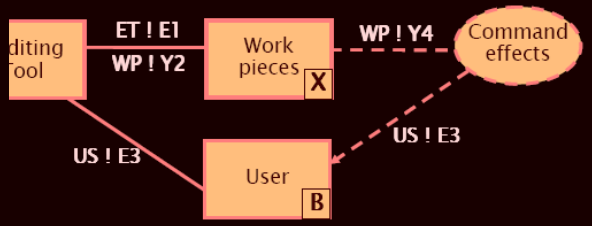
- The machine reads the input document's symbolic state (Y1) and actually constructs a totally new symbolic state (Y2) in an output document.



- Usually the symbolic states seen by the machine (Y1 and Y2) match the true states (Y3 and Y4).

Workpieces

user's editing commands (E3) implicitly specify hat the document's symbolic state (Y4) should be.



many cases, the symbolic state seen by the achine (Y2) matches the real symbolic state (Y4).

News article, 20 Oct 1992

AMBULANCE CHIEF QUITS AFTER
PATIENTS DIE IN COMPUTER CRASH
By Ian MacKinnon and Stephen Goodwin

The Chief executive of the London Ambulance Service resigned yesterday over allegations that up to 20 people may have died because of the collapse of a new computer system controlling emergency calls. Virginia Bottomley, Secretary of Sate for Health, was forced to announce an external inquiry into the 36 hours over Monday and Tuesday which led to delays of up to three hours in ambulances arriving.

…

Source: Lecture note by Jim Herbsleb, http://conway.isri.cmu.edu/%7ejdh/MethodsF06/lec/probframes/prob-fr-3b.ppt

London Ambulance Manual System Problems

- identification of the precise location can be time consuming due to often incomplete or inaccurate details from the caller and the consequent need to explore a number of alternatives through the map books;
- the physical movement of paper forms around the Control Room is inefficient;
- maintaining up to date vehicle status and location information from allocators' intuition and reports from ambulances as relayed to and through the radio operators is a slow and laborious process;
- communicating with ambulances via voice is time consuming and, at peak times, can lead to mobilization queues;
- identifying duplicated calls relies on human judgment and memory. This is error prone;
- dealing with call backs is a labor intensive process as it often involves CA's leaving their posts to talk to the allocators;
- identification of special incidents needing a Rapid Response Unit or the helicopter (or a major incident team) relies totally on human judgment.

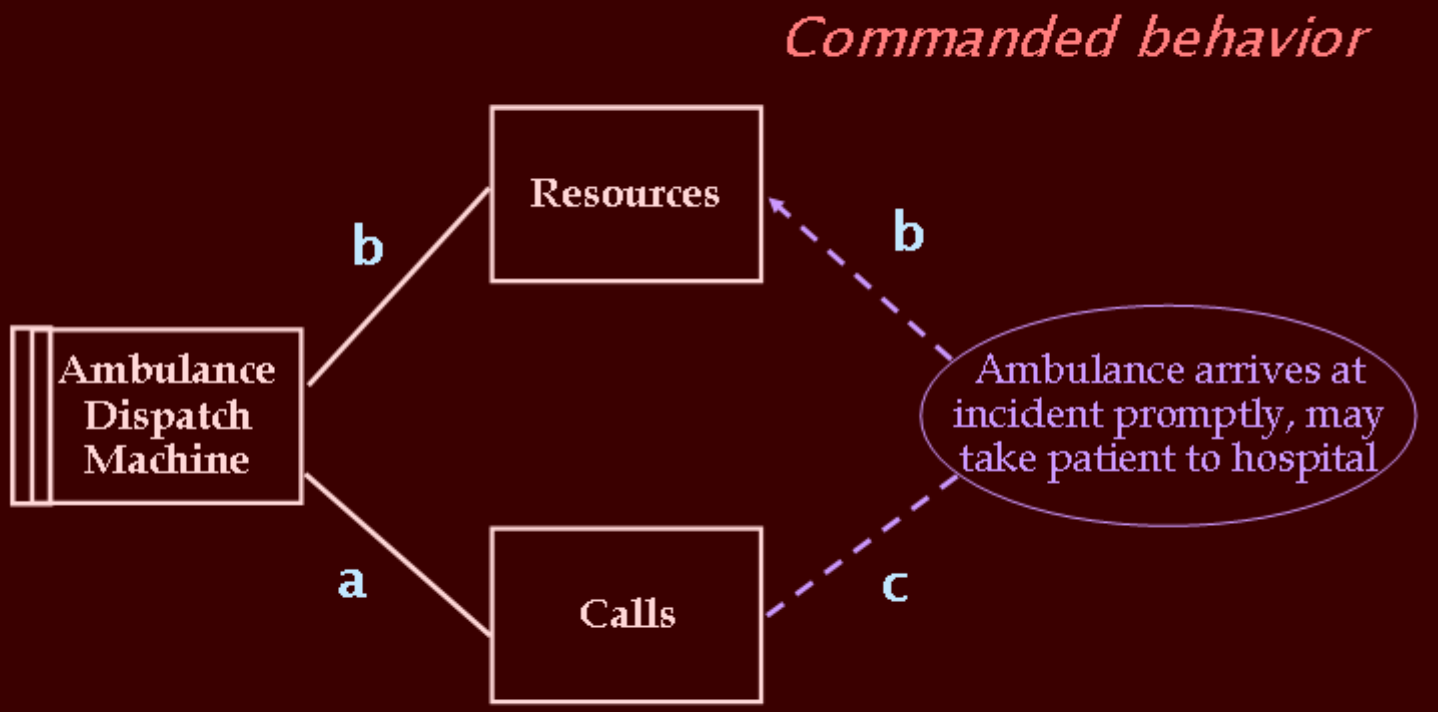
Source: Lecture note by Jim Herbsleb, http://conway.isri.cmu.edu/%7ejdh/MethodsF06/lec/probframes/prob-fr-3b.ppt

Critical Requirements

- Ambulance dispatch functionality
  - Calls report incidents and other needs for transport
  - An ambulance arrives at the location of an incident promptly; the ambulance may take patient(s) to hospital
- Other requirements
  - Timely response without communication overload
  - Resilience to faulty communication
  - Resilience to independent field decisions by personnel
  - Incremental information about incident
  - Efficient use of resources, efficient response
- System considerations
  - Incremental deployment
  - Fit with existing system processes

Source: Lecture note by Jim Herbsleb, http://conway.isri.cmu.edu/%7ejdh/MethodsF06/lec/probframes/prob-fr-3b.ppt

First cut at context and problem



a: 911 call

b: dispatch message

c: requests

Institute for Software Research, International

Source: Lecture note by Jim Herbsleb, http://conway.isri.cmu.edu/%7ejdh/MethodsF06/lec/probframes/prob-fr-3b.ppt

Recalling steps in problem frame modeling

Basic steps in applying problem frames

1. Break the context into pieces (called *domains*).
2. Identify the shared phenomena (called *interfaces*) among the domains.
3. Represent the domains and their interfaces in a *context diagram*
4. Add the conditions (called *requirements*) that the software must bring about.

- A context diagram that has been augmented with requirements is called a *problem diagram*.
- A problem diagram that recurs a lot is called a *problem frame*.

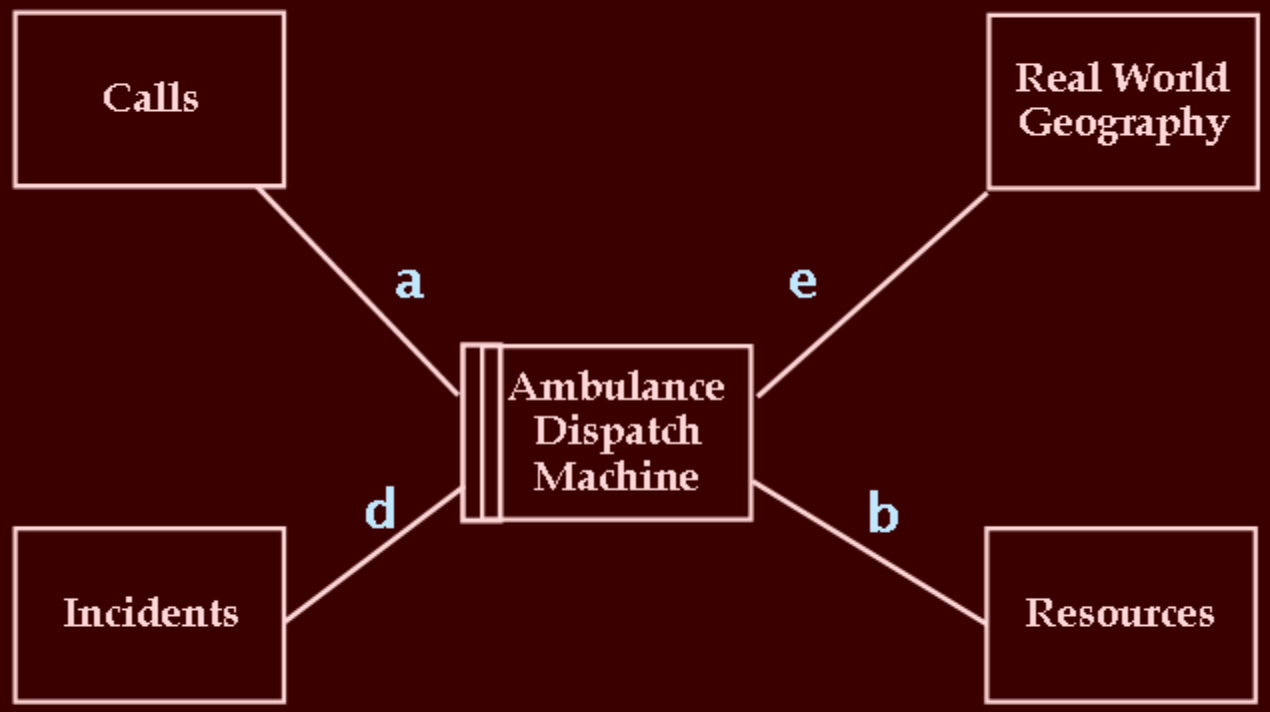
Source: Lecture note by Jim Herbsleb, http://conway.isri.cmu.edu/%7ejdh/MethodsF06/lec/probframes/prob-fr-1.pdf

Problem Domains

- *Calls*: telephone calls from the public and doctors
- *Resources*: ambulances, personnel, special equipment
- But …
  - Calls do not correspond directly to incidents
  - Detailed knowledge of geography is required to interpret calls and to know which ambulance to send
- So add domains …
- *Incidents*: discrete events that require ambulance response
- *Geography*: Streets, addresses, hospital locations, etc

Source: Lecture note by Jim Herbsleb, http://conway.isri.cmu.edu/%7ejdh/MethodsF06/lec/probframes/prob-fr-3b.ppt

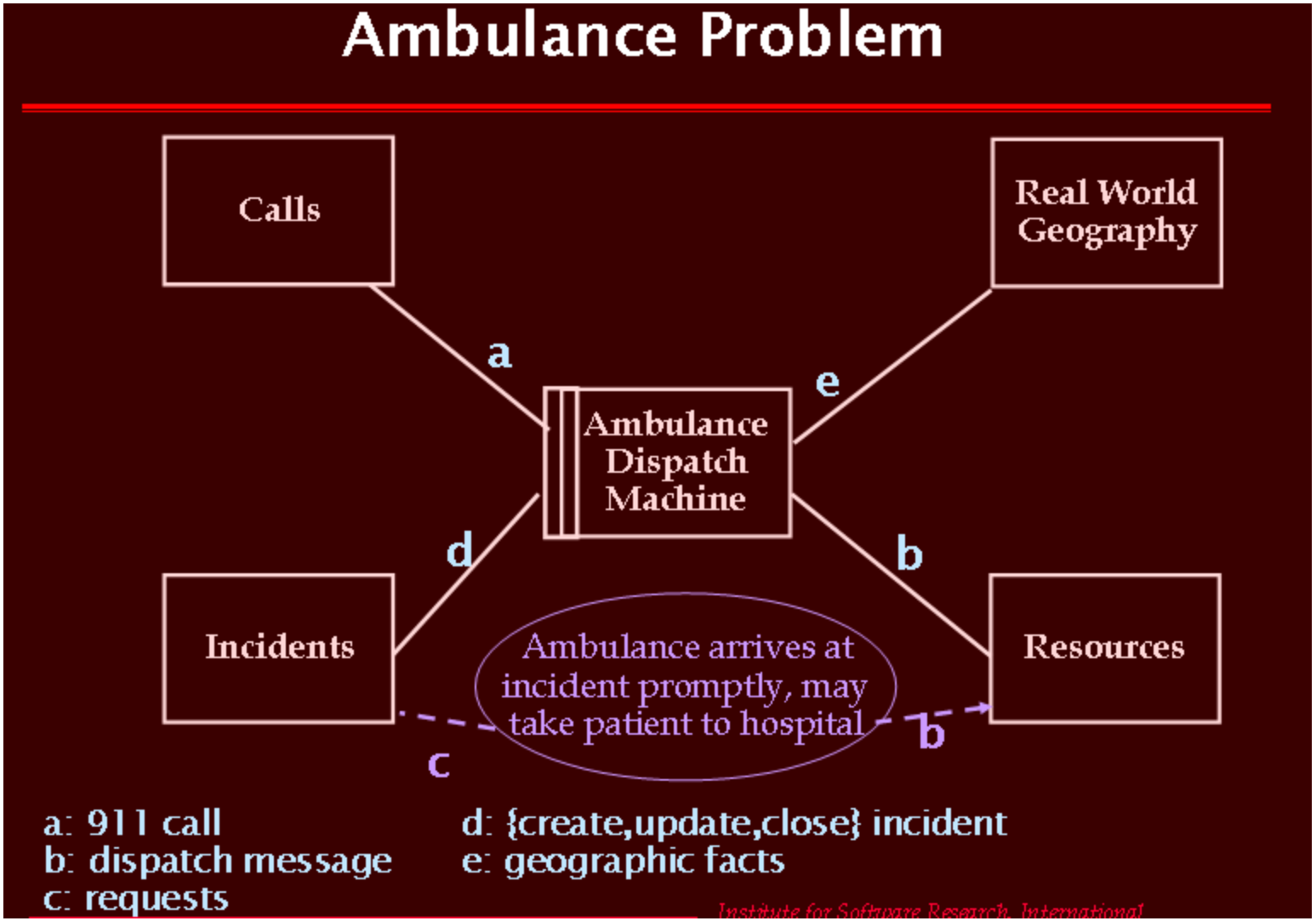
Ambulance Context



a: 911 call
b: dispatch message
c: requests

d: {create,update,close} incident
e: geographic facts

Source: Lecture note by Jim Herbsleb, http://conway.isri.cmu.edu/%7ejdh/MethodsF06/lec/probframes/prob-fr-3b.ppt



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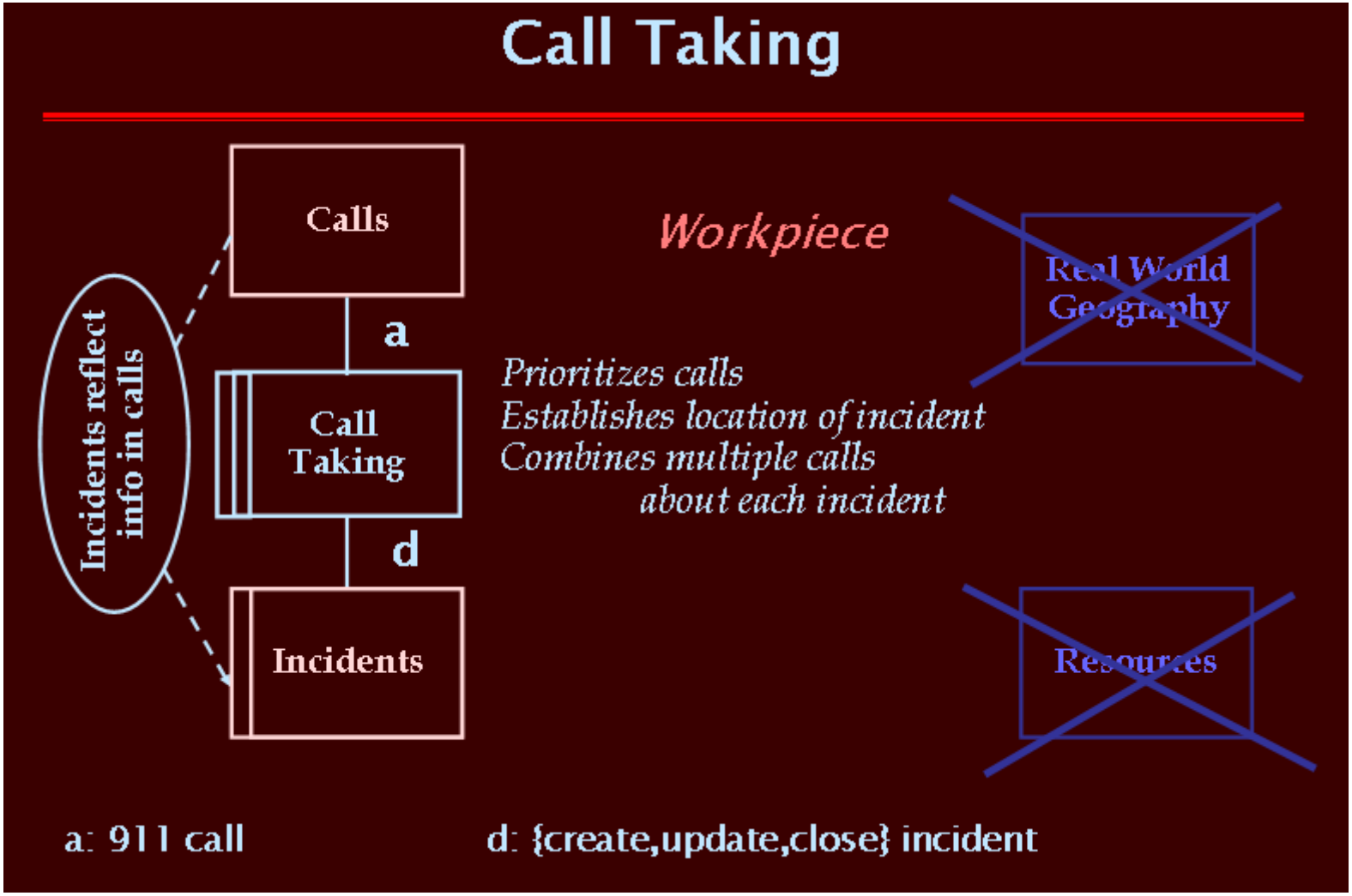

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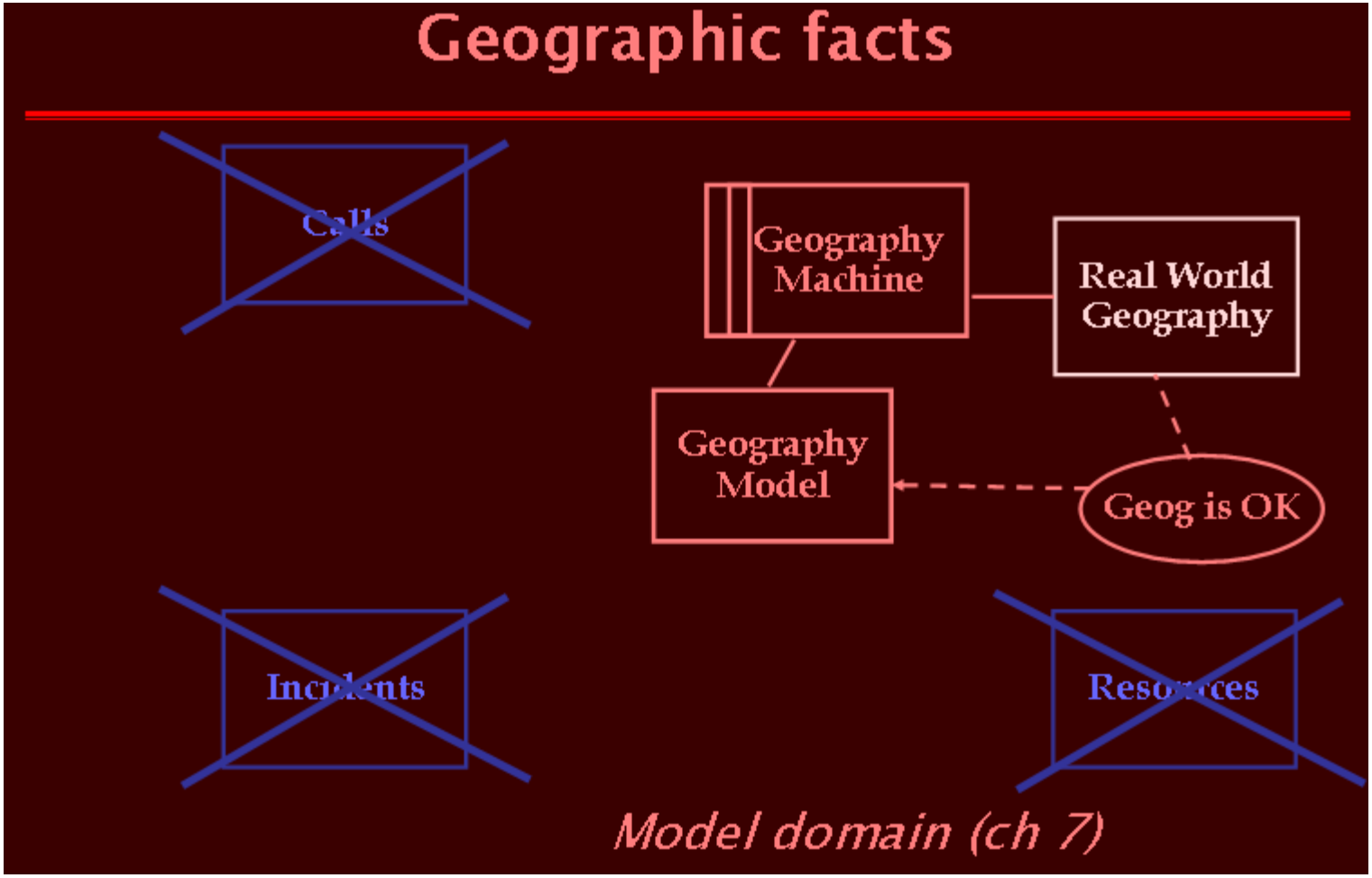

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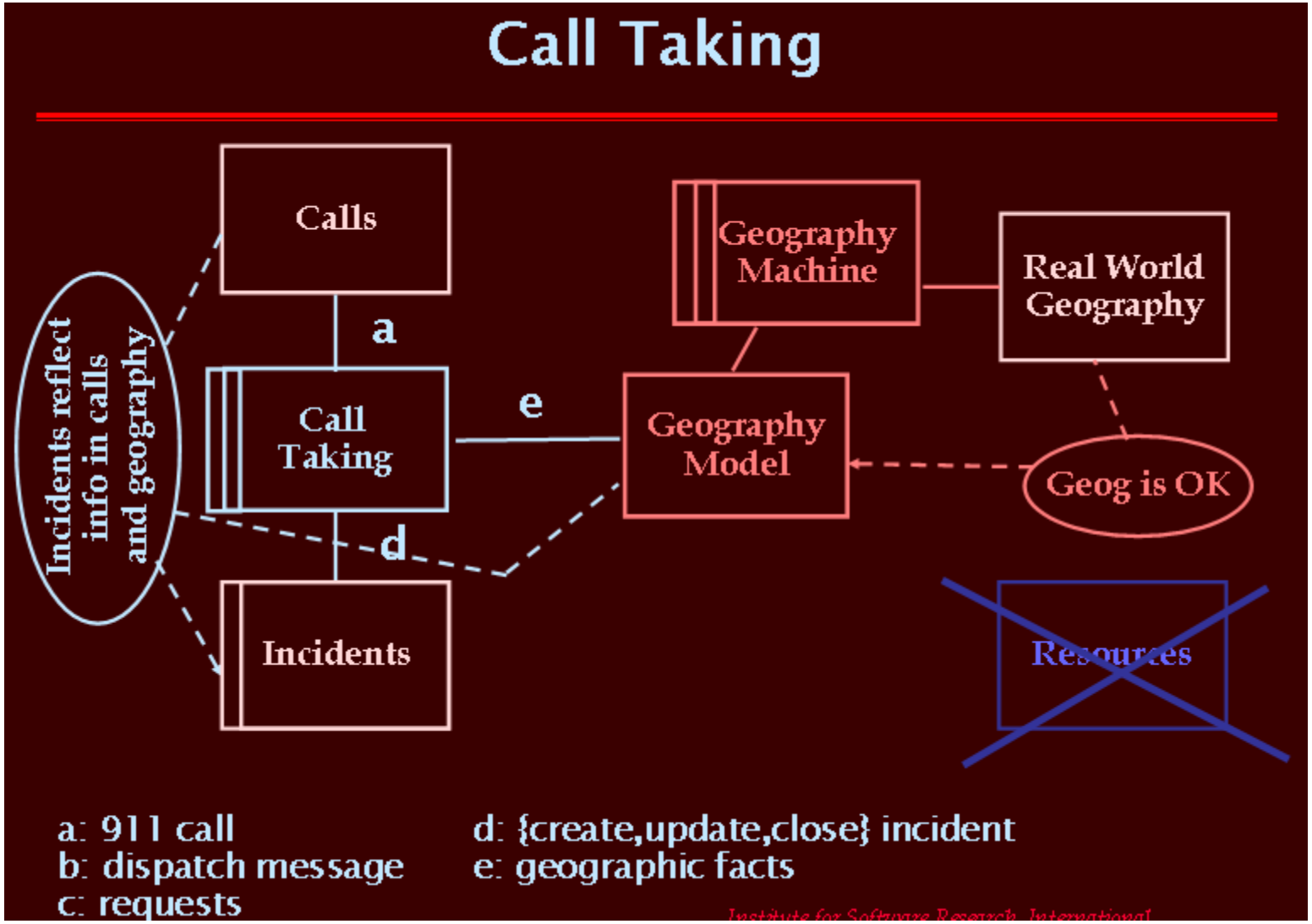

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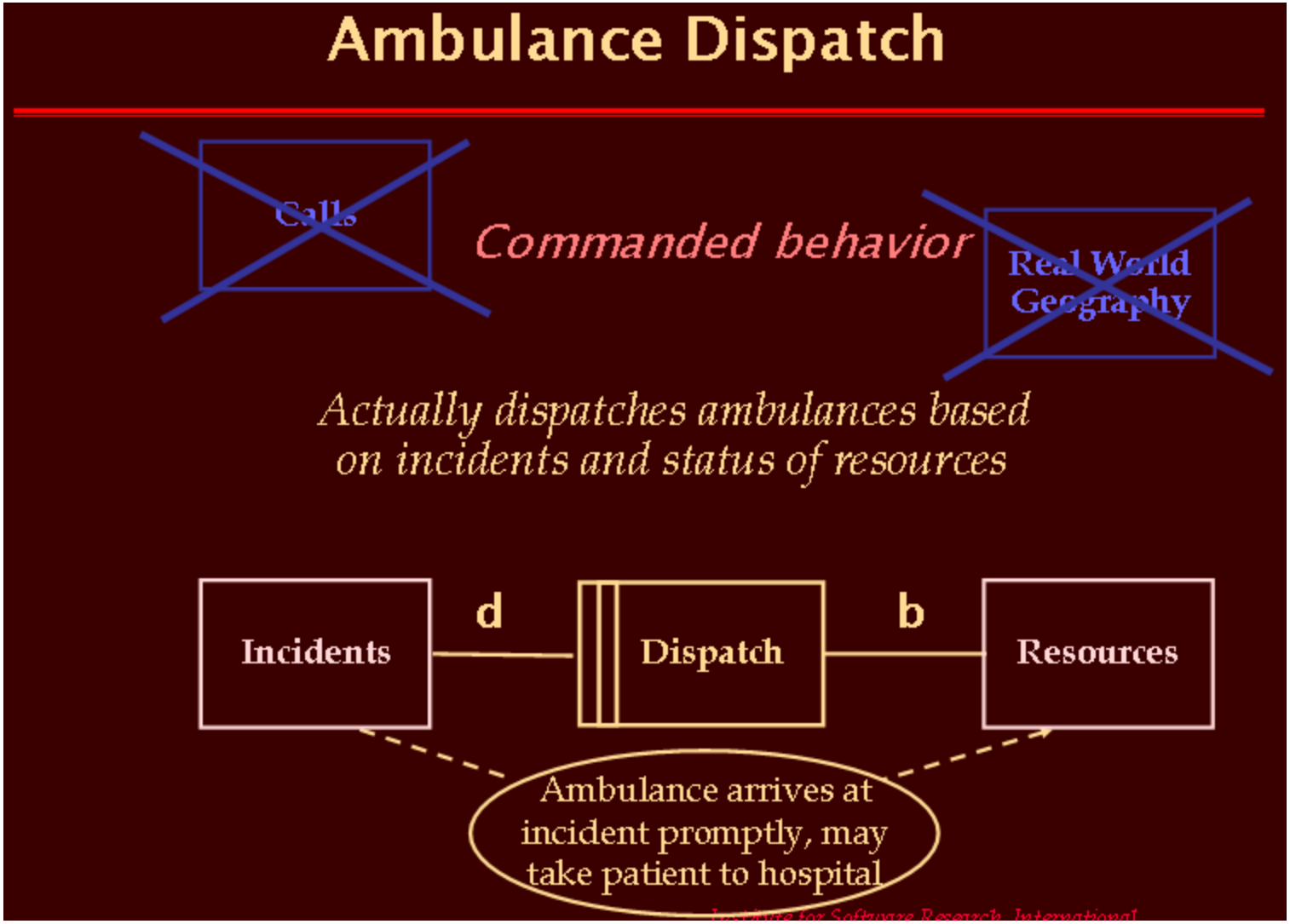

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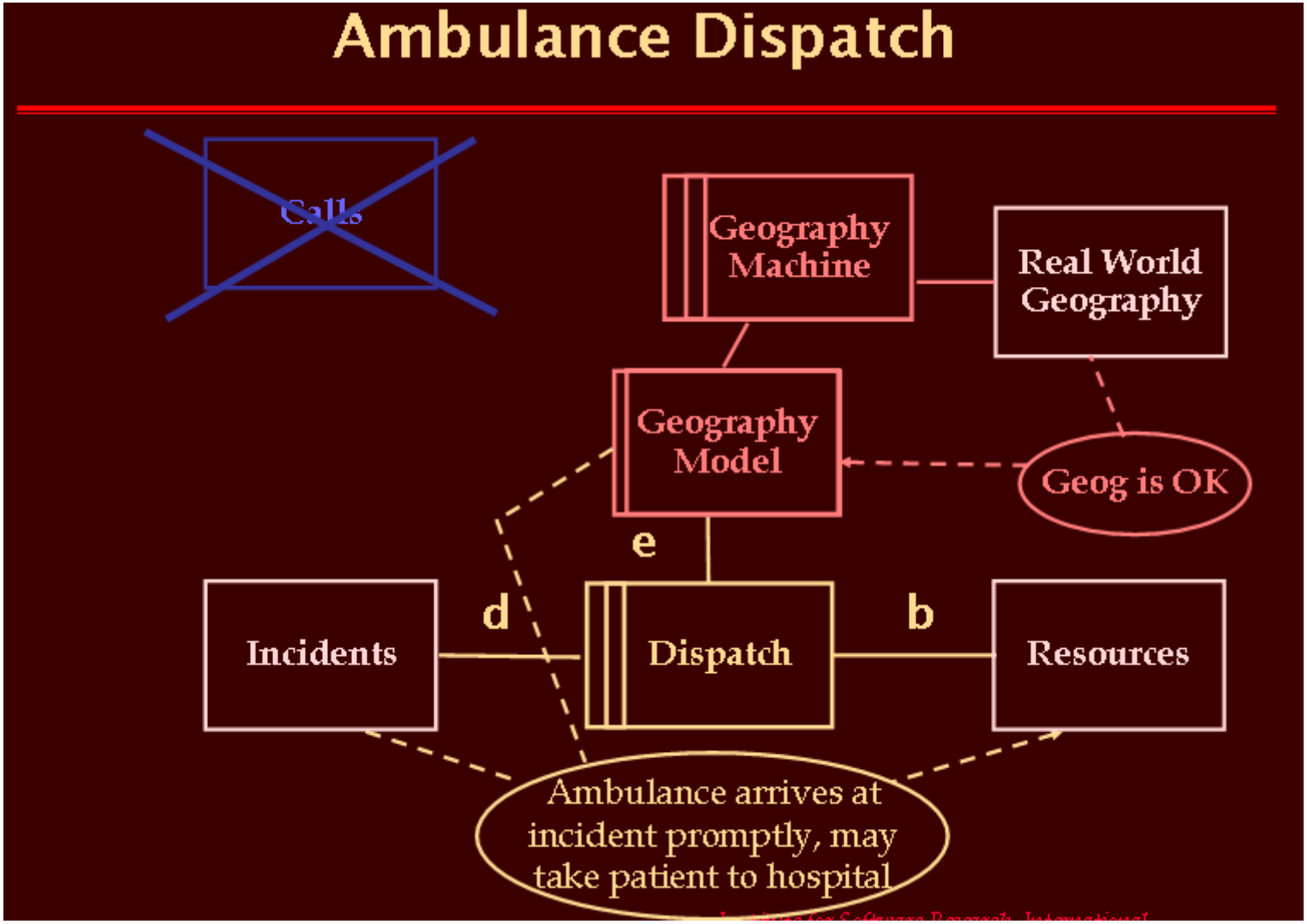

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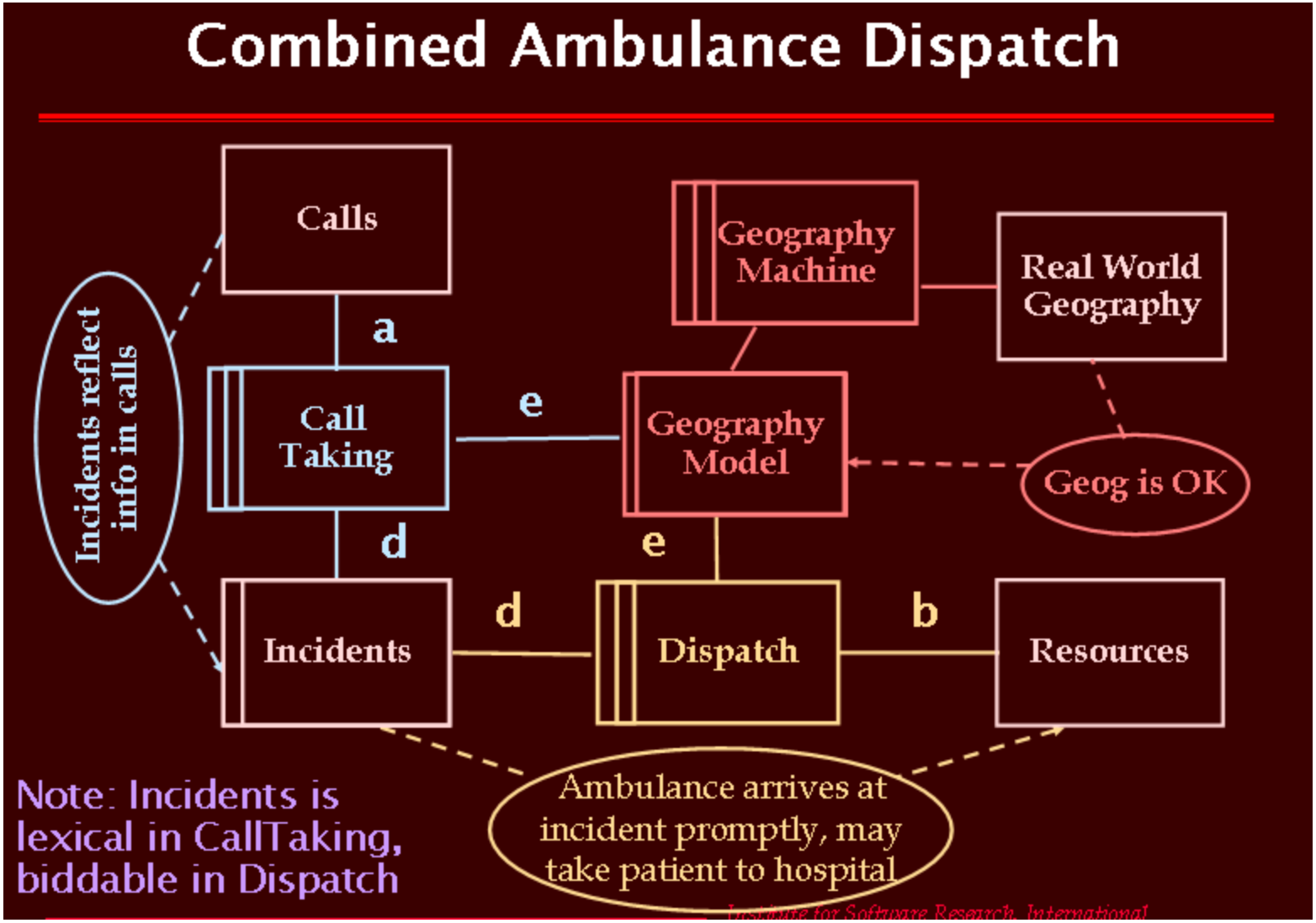

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