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Community Sourced Knowledge: Solving the Maintenance Problem

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14. ABSTRACT In response to the maintenance problem, the delta between the knowledge on hand and the knowledge required, many system maintainers have self organized into a collaborative community to bridge this knowledge gap. There is evidence that this community of maintainers is succeeding. Our research examines a community of about 1000 system maintainers that includes stakeholders from every aspect of the software life cycle. These members generate community-sourced knowledge to address the maintenance problem. This multidisciplinary research provides insight into the behavior of practitioners who operate in a dynamic and often unorganized post-development environment. We also describe the ethnography of the group and patterns of behavior that emerge through the collaboration process and detail how information and knowledge are validated. From the coalescing of the discoveries, we develop benchmarks of performance for collaboration and knowledge sharing for the system-maintenance domain.				
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Background

The Maintenance Quagmire

Maintenance of software intensive systems is in a quagmire and is influenced by social-technical issues (Northrup, et.al.,2006), developmental frameworks (Sheard, 1997), and the fact that software evolves (Pfleeger and Atlee, 2006)

The Maintenance Problem

The maintenance problem is the knowledge gap; the delta between the knowledge available and the knowledge required to resolve a maintenance problem

The Maintenance Problem

- Is costly: ~half of the maintenance effort is spent understanding the problem (Pfleeger and Atlee, 2006)
- Is compounded by documentation and operating procedures that are non-existent, incomplete, or outdated
- Communication once, F2F, now has a myriad of communication channels to include IP, RF, and satellite communication to all corners of the globe

Response by the Individual and Organizations

[Maintainers] have become part historian, part detective, and part clairvoyant (Condi, 1989)

Inverse Peter Principle 'People rise to an organizational position in which they become irreplaceable, and get stuck there forever' (Boehm, 1981)

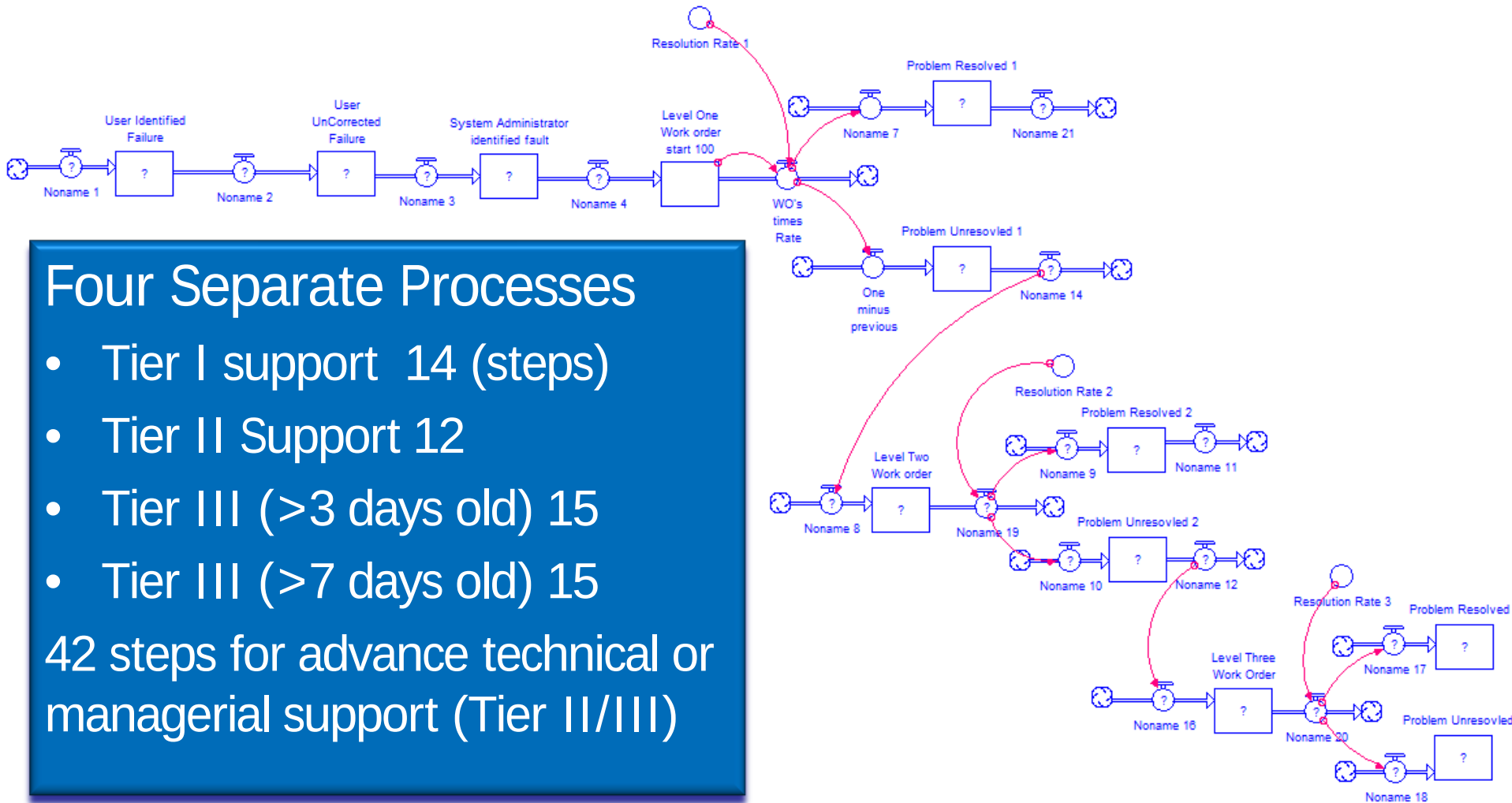
The Paradigm Shift

System maintenance is plagued by the knowledge gap and currency/relevance of the knowledge. In response to the knowledge gap, the community of maintainers has **self organized** to tackle the maintenance problem. The normative behavior of the community of system maintainers is experiencing a **cultural shift** from a culture of need-to-know, a practice that restricts the information flow, to a culture of **need-to-share** that puts the information and potential knowledge in an open forum for public consumption in a form of **Mass Collaboration** that enables **Knowledge to Flow**.

Architecture for Maintenance Support

How the work gets
done

The Published Process for an Ultra Large DoD Organization



Four Separate Processes

- Tier I support 14 (steps)
- Tier II Support 12
- Tier III (>3 days old) 15
- Tier III (>7 days old) 15

42 steps for advance technical or managerial support (Tier II/III)

The Process for an Ultra Large DoD Organization

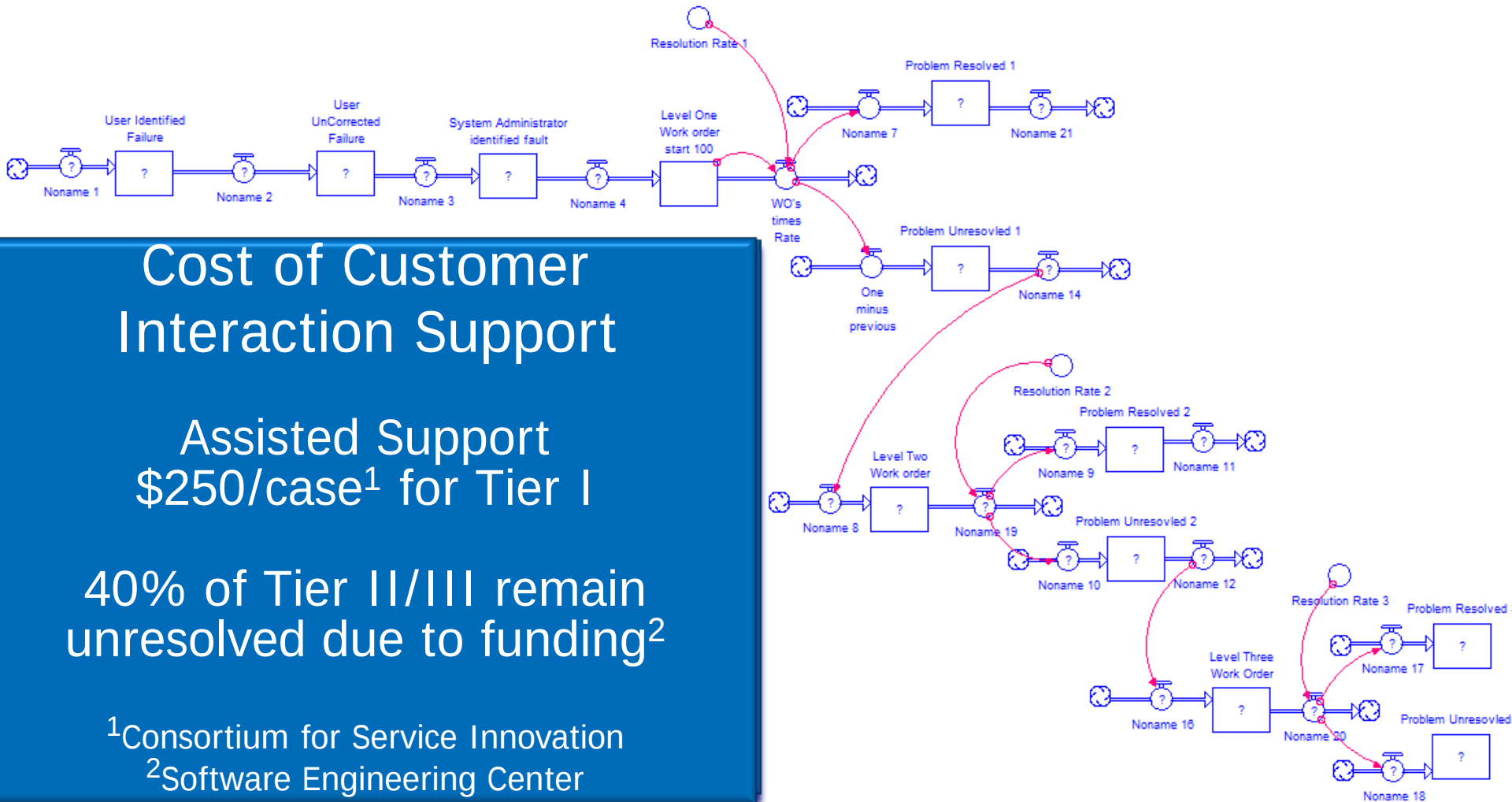
Cost of Customer
Interaction Support

Assisted Support
\$250/case¹ for Tier I

40% of Tier II/III remain
unresolved due to funding²

¹Consortium for Service Innovation

²Software Engineering Center



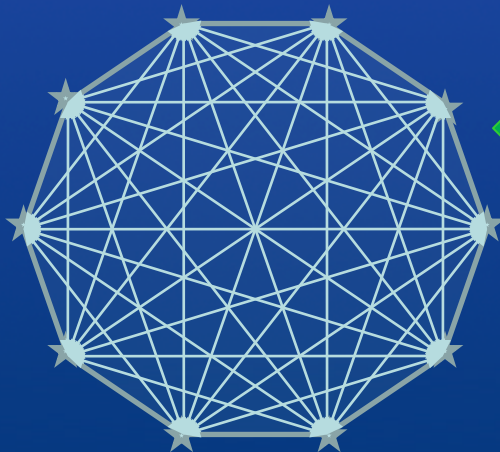
Community Sourced Knowledge: Mass Collaboration

The Alternative



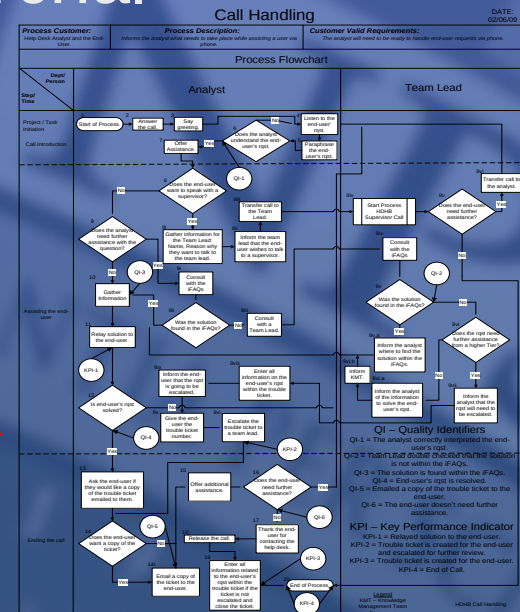
Bridge the Knowledge Gap: Eliminating the Blind Spots

- Have the conversation with the extended community (Denning & Dunham, 2010)
- Connect the people that have an interest in your operating environment
- Develop a maintenance support structure that is Flat or Federated vs. Hierarchical



This

!This



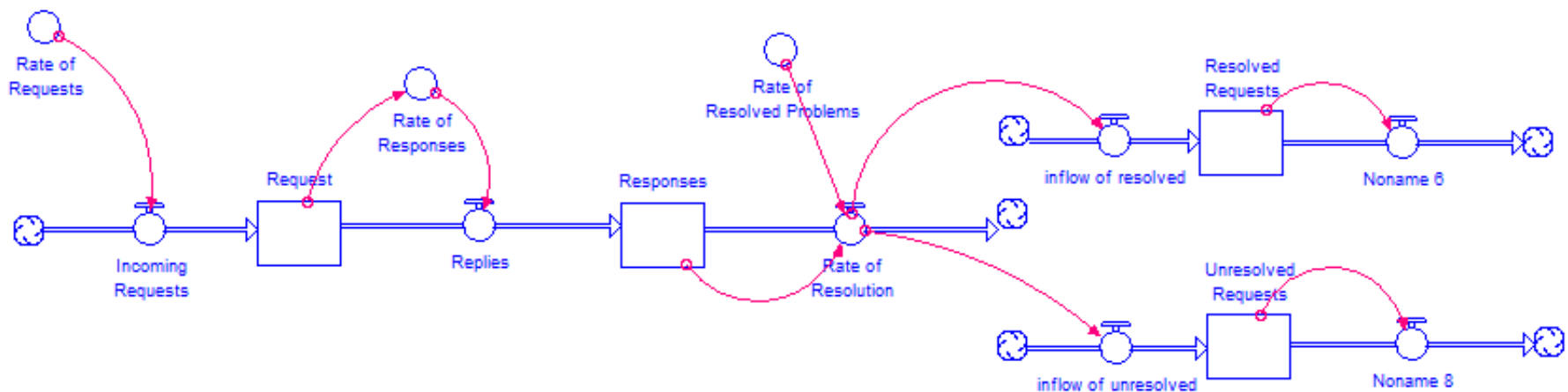
Mass Collaboration

One to Many : Many to One

One Information Request is “Pushed” to all subscribers

Community members self select what they will respond to based on their expertise and level of interest

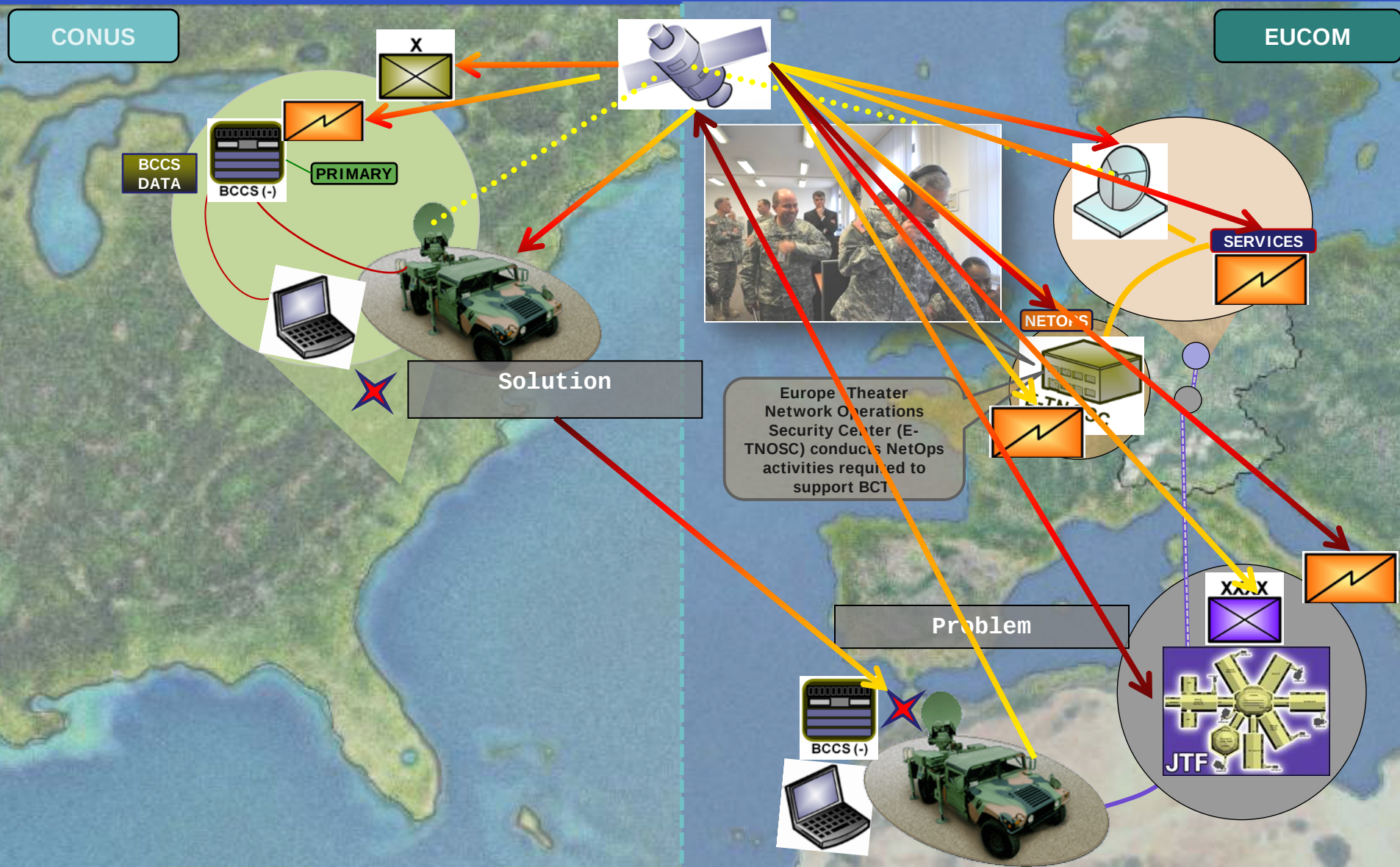
Broadcast or net-call to all subscribers



The Current Process - Hierarchal



Mass Collaboration



How Responsive is the Community?

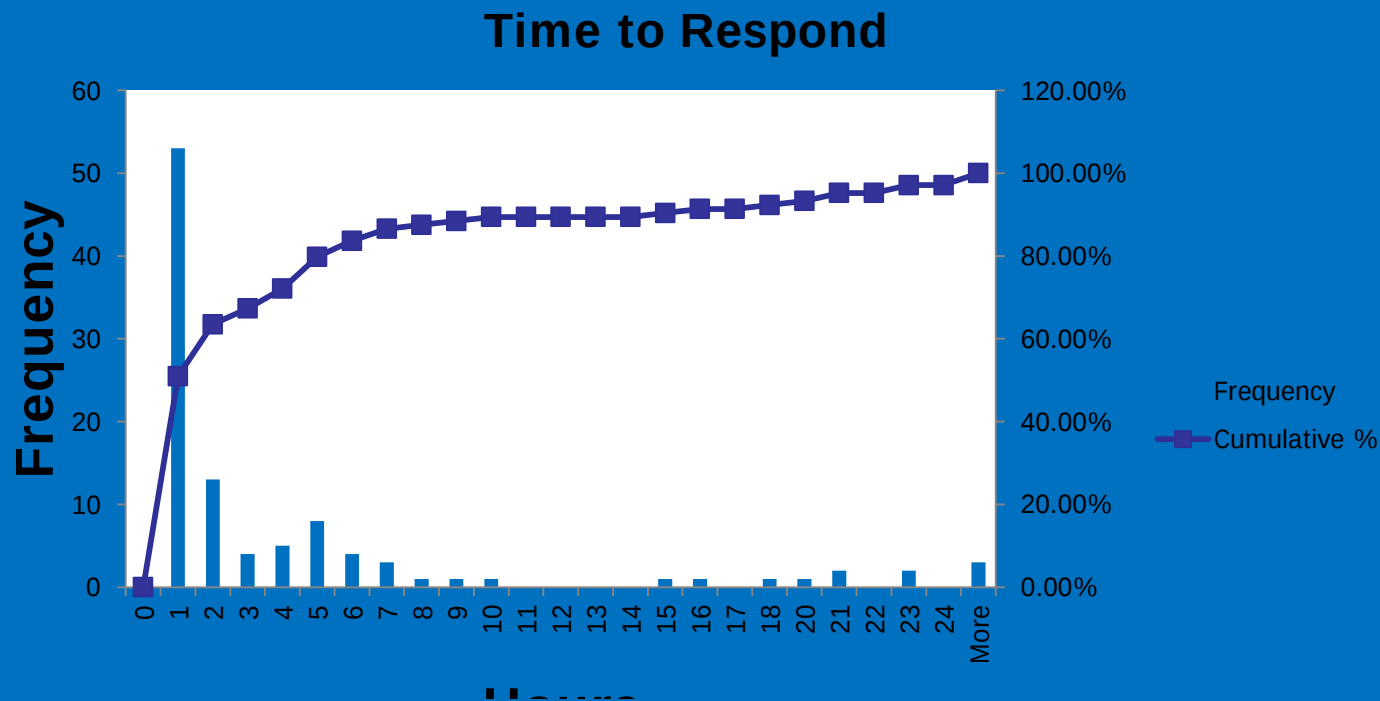
How fast are they?



They do it really Fast

51% of the responses are within 1 Hour

99% of the responses are within 48 Hours



54% Reported savings of 3-4 Hours over other options (hours saved)

43% Reported saving 1-2 Days over other options (days saved)

What does the Community do?

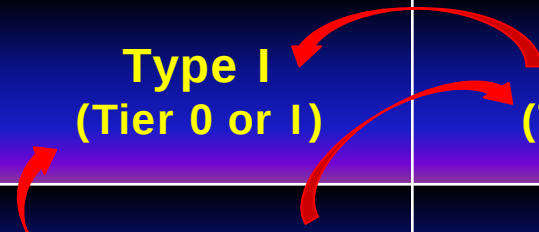
What type of
problems do they
solve?

They Satisfice* Problems and Reduces Complexity

They mash up problems with solution that reduces the complexity

- 72% Fully Resolved, Reduced to Type I
- 79% Complexity Reduced to Type I or II

Categorization of problems	Known Solution	Unknown Solution
Known Problem	Type I (Tier 0 or I)	Type II (Tier II/III)
Unknown Problem	Type III (Tier II/III)	Type IV (Tier III/Wicked)



12% to 19% improvement over the 60% SEC resolution rate

*Simon, 1996

How effective is the process

What type of help
are you going to get?

Experts and Expertise

Informants were asked to rate the quality of the dialogue/response.

83% reported that they provided expert* advice
(does everyone think they are an expert?)

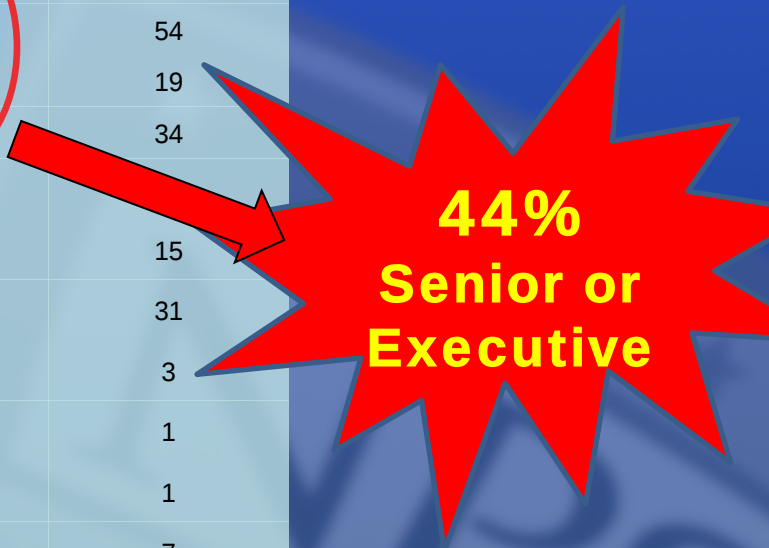
77% of those who received the information
classified the response as expert knowledge

*An expert was defined to the respondents as
someone who has special skills, talent,
knowledge or know-how in the domain in
question

Who are the experts?

~ one thousand members of a community sourced knowledge group

Answer Options	Response Percent	Response Count
Executive	4.1%	11
Senior Supervisor, Manager . . .	20.1%	54
Senior Professional/Analytical. . .	7.1%	19
Senior Scientific, Engineering . . .	12.7%	34
Mid Level Supervisor, Manager. . .	24.3%	
Middle Professional/Analytical. . .	5.6%	15
Mid Level Scientific, Engineering,	11.6%	31
Junior Supervisor, Manager . . .	1.1%	3
Junior Scientific, Engineering. . .	0.4%	1
Administrative staff	0.4%	1
Special staff	2.6%	7
Support staff	1.9%	5
Student	1.1%	3
Retired	0.7%	2
Other	6.3%	17
<i>answered question</i>		268



44%
Senior or
Executive

Resource Comparison

Comparison	Community Sourced Knowledge	Hierarchal Support Structure
Cost	<\$1 per member	\$230 per incident (Tier I support)
Problem Solvers	Experts	Novice (Tier I) until escalated
Resolution Rate (type II or III)	72-79 %	60 %
Time to Respond (type II or III)	50% w/in 1 hour avg 6 responses	No data available (Data not collected by diff)

**3-4 hours
to 1-2 days**

Summary

- Create an architecture that is people centric
- Capitalize on the knowledge base that resides in the community
- Dialogue is not limited to traditional organizational boundaries
- Focus on fixing the problem, not indentifying fault
- Discussions/dialogue are with impunity

The result is a faster, expert informed community, with more time for action and less time searching for understanding at an almost zero cost to stakeholders

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