Using Contests to Stimulate Innovation

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NASA Tournament Lab

Uncertainty Haunts Most Innovation Efforts....

“When you come to research and development you can’t answer any of the questions.. […].. You don’t know when you are going to get the thing, whether it’s going to work or not and whether it’s going to have any value whatsoever”

Charles Kettering
(VP, General Motors
Inventor: Electrical Starting Motor, Ethyl Gasoline, Freon, 186 Patents)

.....Finding the Right People is also a Major Challenge

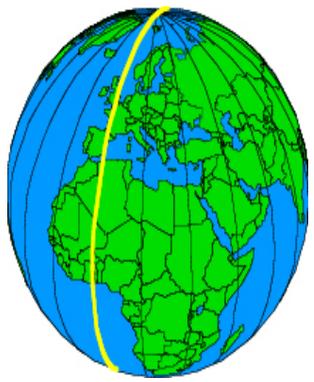
“No Matter Who You Are Most of the Smartest People Work for Someone Else”

Bill Joy
(Sun Microsystems, BSD Unix, Java)

Models for Organizing Creative Effort are also Changing

Contest are a Historically Important ***Alternative*** Institution for Driving Innovation....

The Duomo - Florence
1418 - Up to 2,000 Florins



The Longitude Prize
1714 - Up to £20,000

Invention of Food Canning
1800 - Up to 12,000 Francs

....Currently Popular as Well.....

Ansari X-Prize – Space Travel
1996 – $10,000,000

Netflix Prize - Movie Rec.
2006 - 2009
Over 5000 Teams - $1M

Local Motors – Car Design
2008 – Over 35000 Submits

Competing Logics for Organizing Innovation

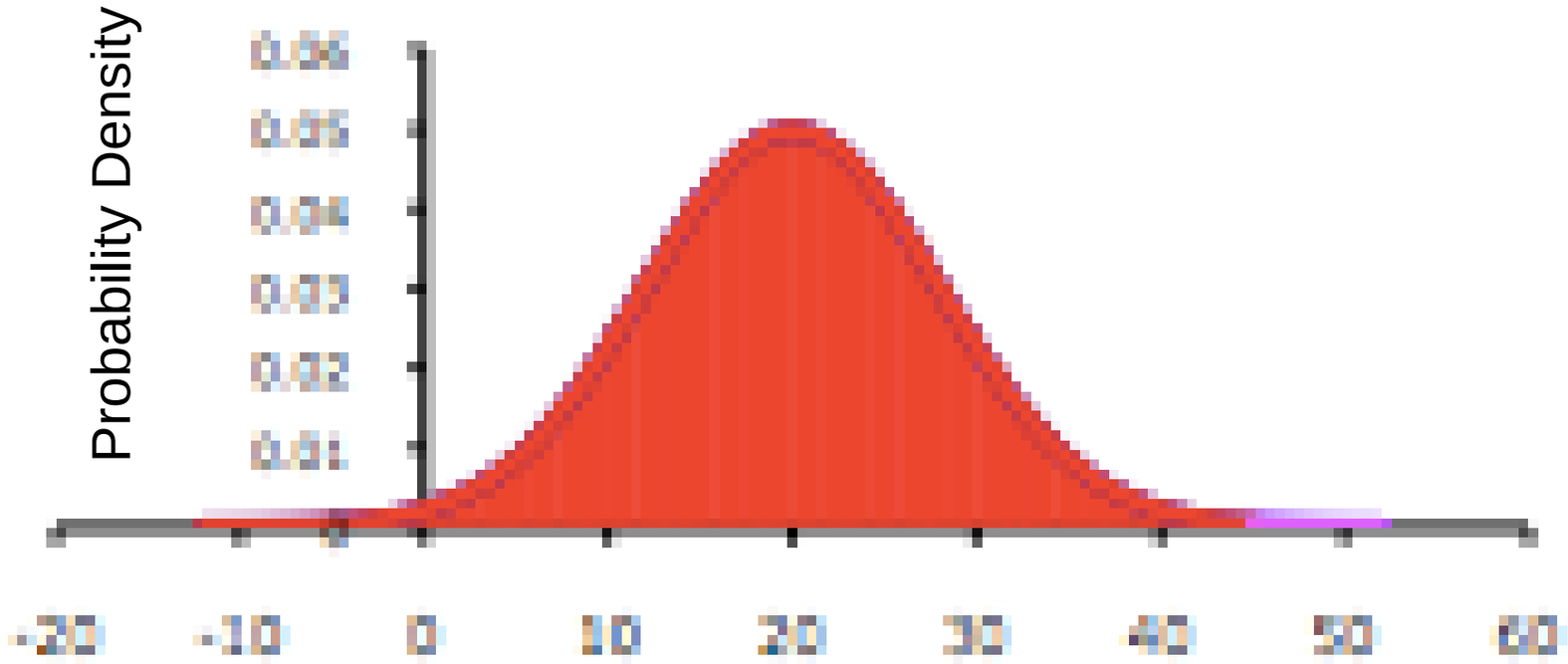
Internal Development

Define the Problem
Find the “Right” Workers
Incentivize Effort
Monitor Effort
Motivate and Energize Workers
Redefine the Problem
Develop Criteria for Evaluation
Pray for Performance

Contest

Define the Problem
Develop Criteria for Evaluation
Set Prize
Attract Solvers
Test Solution
Pay for Performance

Contests Enable Discovery of “Extreme Value” Outcomes Through Lots of Entry

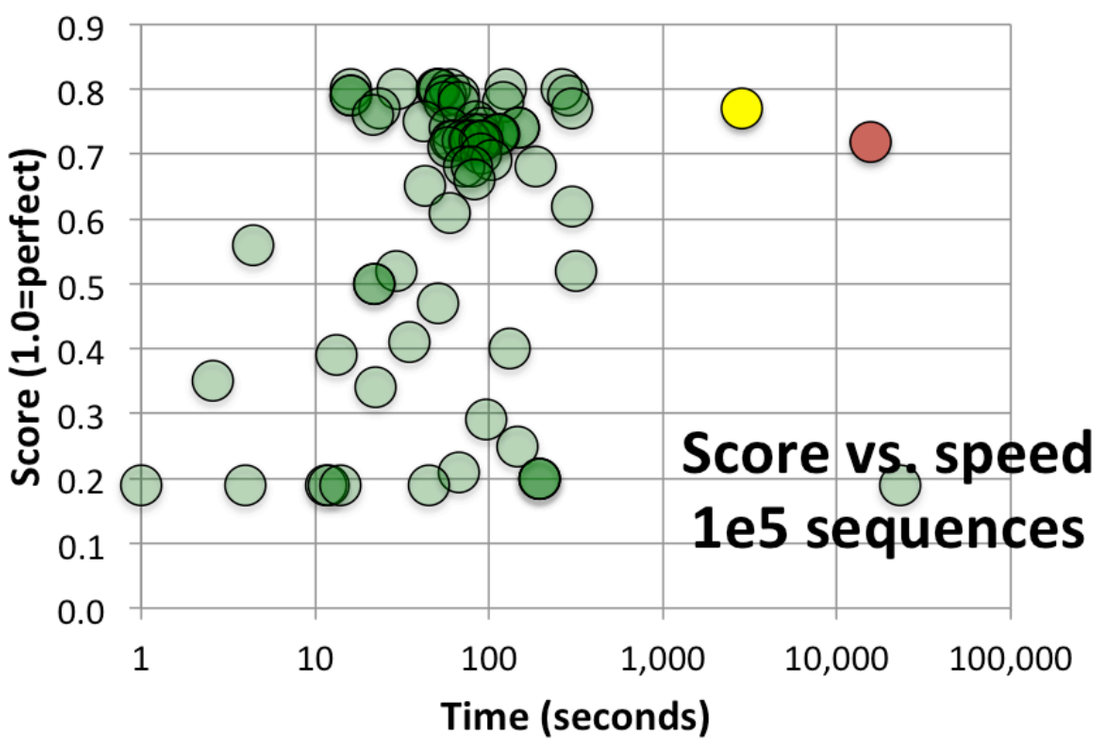


Harvard Medical School Contest for Biology Big Data Problem in Genomics

- Objective: Improve on NIH MegaBlast algorithm for nucleotide sequence alignment
- Experiment: Generate and evaluate external solver participation in development of gene-sequencing tools applied to immunoglobulin and antibody genomics
- Two week long competition - $2000 prize pot x 3 on TopCoder.com

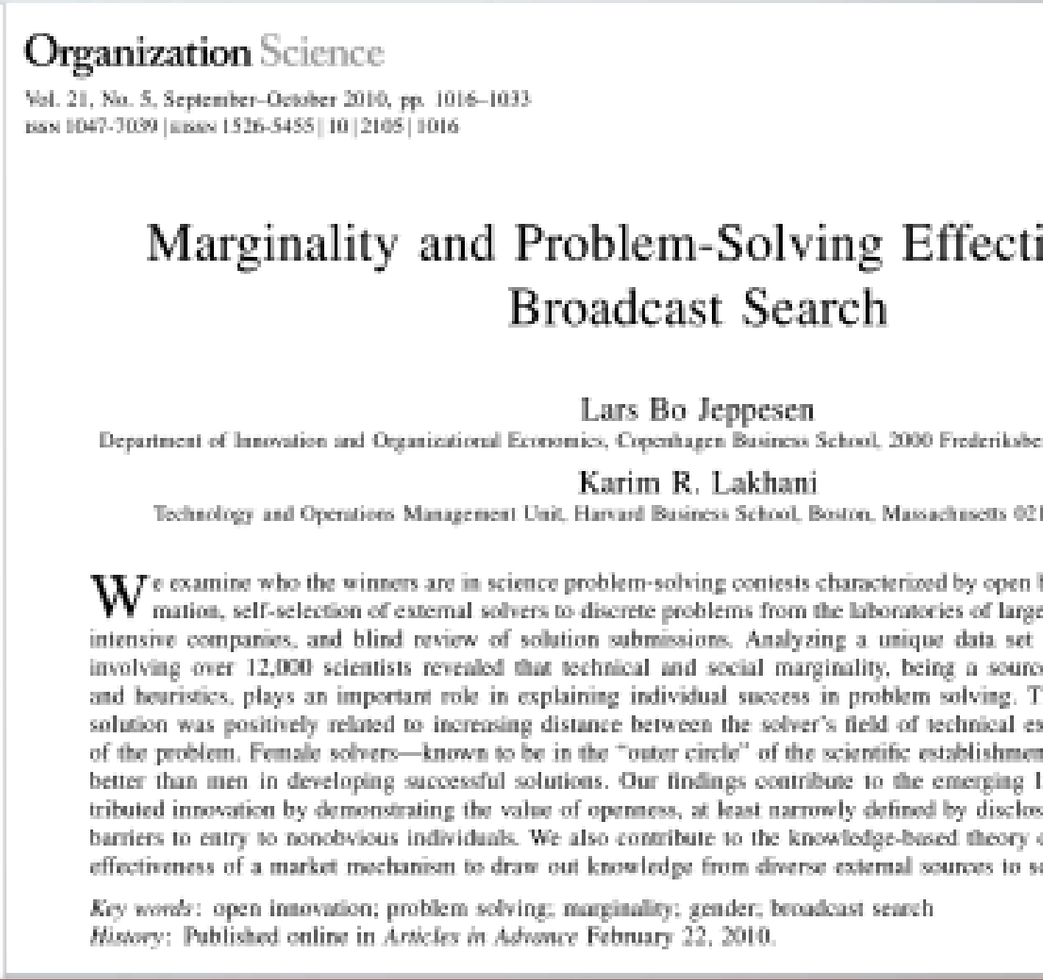
Contest Results Shows the Discovery of Extreme Value Outcomes Relatively Quickly

- 122 coders submitted 654 submissions
- 34 coders exceeded state of the art by 10^2 - 10^5
- 89 different approaches to solve problem identified
- Winners from Russia, France, Egypt, Belgium & US
- Annotate 10 million sequences in < 3 mins; Quarter billion sequences in ~ 1 hour on laptop



Unconventional Individuals Win in Innovation Contests

- Study of 166 problems involving over 12000 scientists from InnoCentive
- Focus on what predicts winners
- What explains who creates a winning solution?
  - Technical Marginality: Increasing distance between solver's own field of expertise and the problem field
  - Social Marginality: Women scientists, when they enter, more likely to win



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Marginality and Problem-Solving Effecti
Broadcast Search

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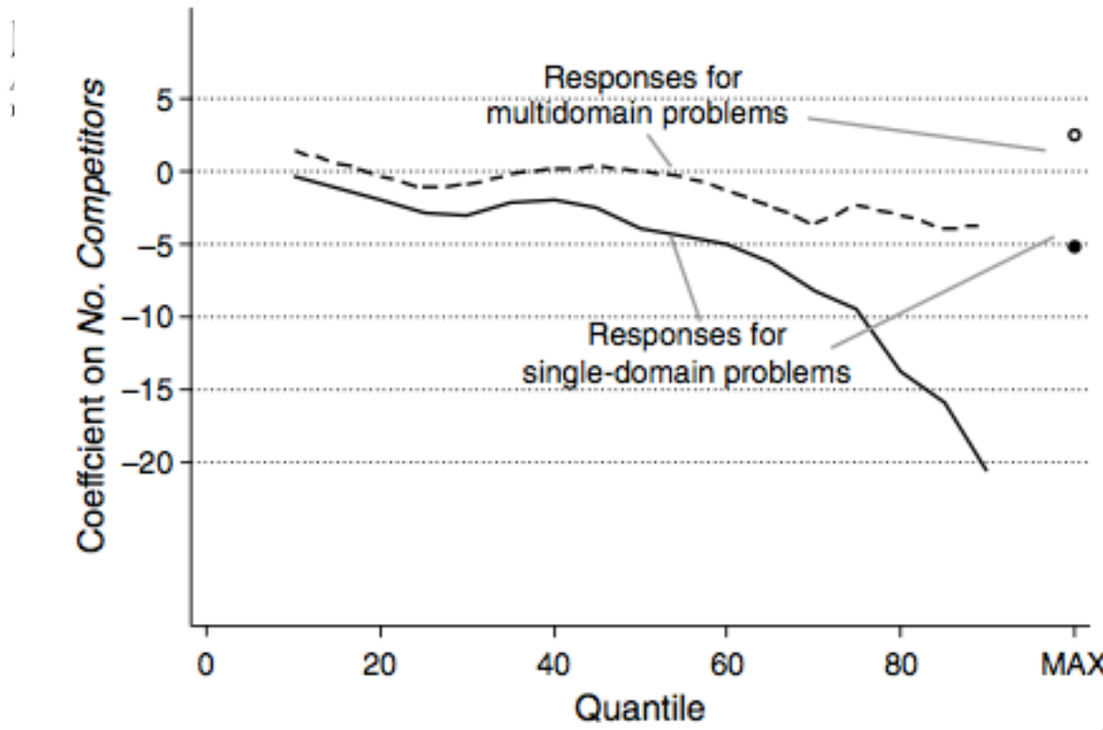
We examine who the winners are in science problem-solving contests characterized by open
mation, self-selection of external solvers to discrete problems from the laboratories of large
intensive companies, and blind review of solution submissions. Analyzing a unique data set
involving over 12,000 scientists revealed that technical and social marginality, being a source
and heuristics, plays an important role in explaining individual success in problem solving. T
solution was positively related to increasing distance between the solver's field of technical ex
of the problem. Female solvers—known to be in the "outer circle" of the scientific establishmen
better than men in developing successful solutions. Our findings contribute to the emerging l
tributed innovation by demonstrating the value of openness, at least narrowly defined by disclos
barriers to entry to nonobvious individuals. We also contribute to the knowledge-based theory
effectiveness of a market mechanism to draw out knowledge from diverse external sources to s

Key words: open innovation; problem solving; marginality; gender; broadcast search
History: Published online in *Articles in Advance* February 22, 2010.

Innovation Contests Well Suited for High Uncertainty Problems - TopCoder Data > 800 contests ~5000 coders

- Key question in contest design is about how many competitors should enter?
- Lots of entry means lower probability of winning - less incentives to work hard
- But this could be offset by finding an outlier response as more people come on
- Problem uncertainty moderates outcomes



WELCOME TO THE

NASA TOURNAMENT LAB

NASA

Tournament Lab

What is NASA Tournament Lab?

Operational Virtual Facility developed between NASA, Harvard, and TopCoder

Two Objectives –

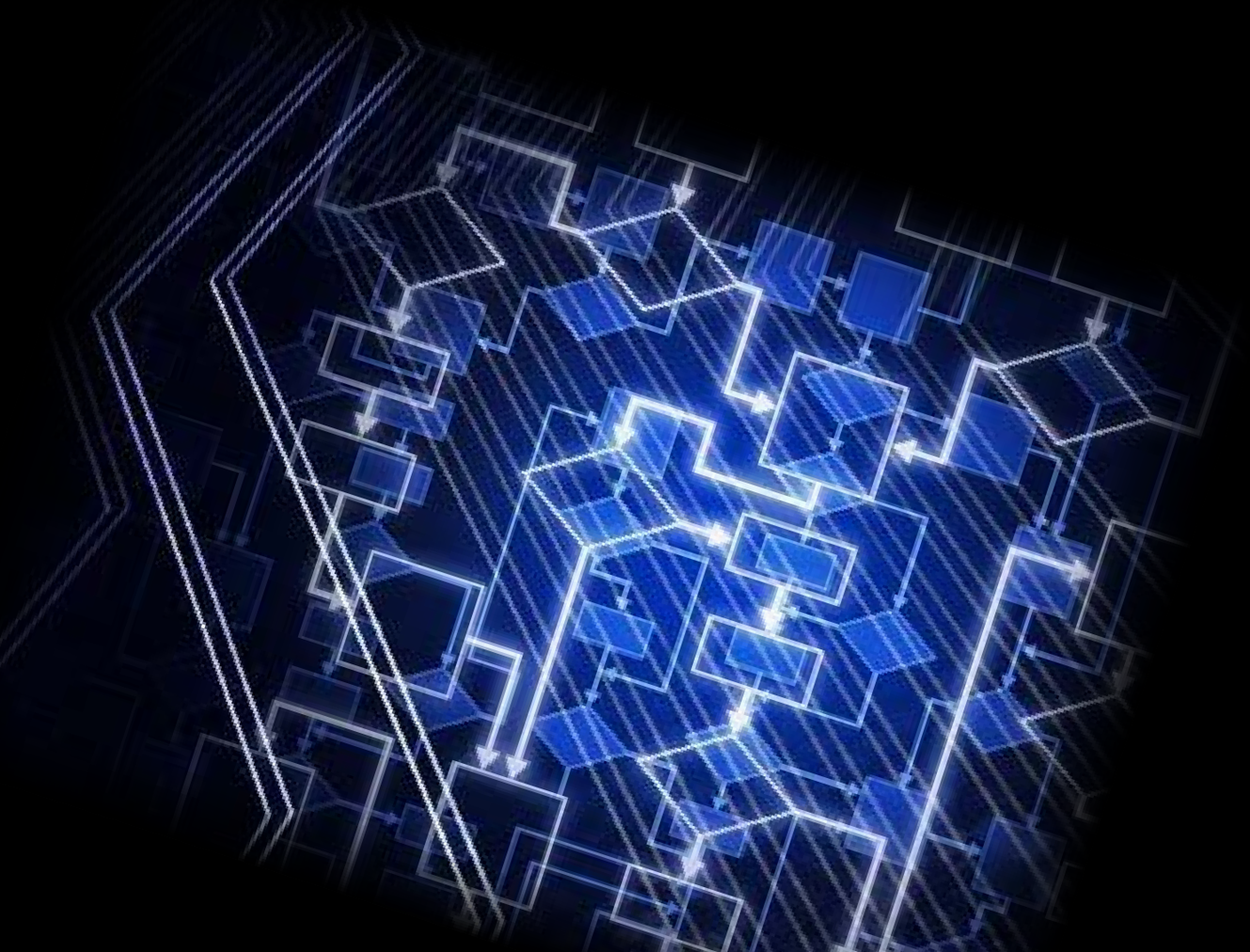
1 Create novel, high quality working software for algorithmic / computational Challenges

2 Contribute towards the development of empirically validated science of innovation tournaments

Utilize the principles of distributed innovation to allow participants worldwide to contribute to solving mission challenges by developing innovative computational algorithms.

Algorithm Competitions

Leverage Competition to Optimize Complex “Big Data” Algorithmic Problems



Medical Kits… In Space

- Given potential medical supplies construct an optimal medical kit
  - Minimize the risk of mission evacuation from a bad health outcome
  - Minimize both weight and volume
  - Each medical supply has additional properties to consider
    - Reusability
    - Effectiveness on range of possible medical events and conditions

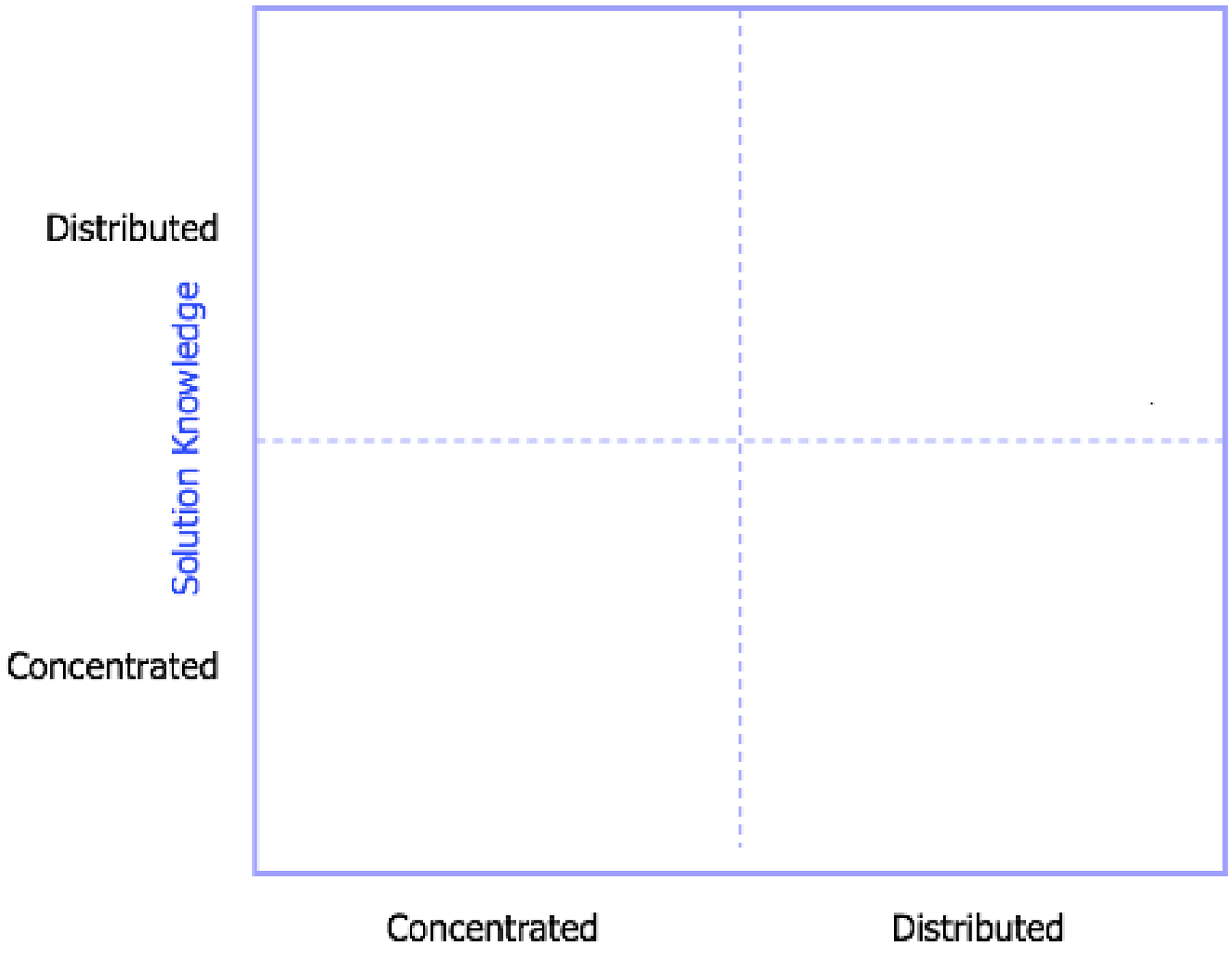
- NASA provided simulated medical event data from previous research
- Allowed for accurate evaluation of computed medical kits

Medical Kits… In Space

- Competition ran for 10 days
- 439 total contest participants
- 5,994 code submissions
- Cash prizes and 6 VIP Shuttle launch passes given out

- Winning solution performs kit optimization in 30 seconds, compared to 3 hours for NASA's previous best known solution (***360X***) improvement.
- NASA researchers "blown away" with the results
- Winning algorithm "works like a dream" in its use to redesign the medical kits used in space missions.

A Framework for Open Innovation



Thanks!