Defect Detection and Prevention (DDP) -a Tool for *Risk-Informed Decision Making*

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? **Software (and how to use it) to help:**

! **GATHER information from experts,**
COMBINE the information they provide,
INFER consequences from combination,
PRESENT results for experts' scrutiny.

✓ **NET RESULT: pool experts' knowledge so as to make better-informed decisions**

DDP -when is it useful?

NASA: new missions, new technologies
You? new ventures, new markets, new products

NASA: propulsion, navigation, software, science, …
You? manufacturing, sales, marketing, support, …

Groundbreaking (past experience insufficient guide)	Multi-disciplinary (no one person knows everything)
Resource constrained (solutions difficult to find, many risks)	Need decisions early (big effect, but information sparse)

NASA: cost, schedule, power, mass, volume, …
You? cost, time to market, performance, …

NASA: choose missions, technologies, vendors, …
You? select next product, establish partnerships, …

DDP – what's involved

What do you want?

"**Objectives**"
"Requirements"
"Goals"
"Needs"

Mick Jagger (Rolling Stones):

"You can't always get what you want"

Descoping – strategic abandonment of objectives.

Reprioritize objectives; primary, secondary…

Determine attainment if given additional resources ($, mass, …)

What can get in the way?

"**Risks**"
"Failure Modes"
"Defects"
"Obstacles"

Dr. Michael Greenfield (NASA HQ):

"Risk as a resource"

Trade risk for other resources.

Use risk as an intermediary between other resources.

Issues outside of technologist expertise.

Issues unique to flight development.

What can you do about it?

"**Mitigations**"
"Solution Options"
"Preventions, Analyses, Controls,Tests – PACTs"

Matt Landano (JPL):

"Do the right thing & do it right"

Can't afford all possible mitigations, so must choose judiciously.

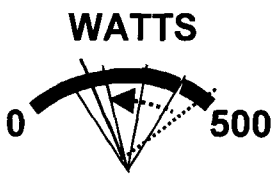
Know the purpose(s) of each mitigation.

Example benefits attained through DDP:

- **Cost & Time Saved** (per study cost: $10K - $30K)
  - At least two instances of **savings > $1M**

    - E.g., Storage technology study revealed *problematic (at risk) overly-stringent requirement*, whose removal permitted dramatic cost & time savings. Technology near cancellation became proposal-winning concept. Requirements honed to requisite level of mission specificity.

- **Designs Improved**
  - **Savings of critical resources** (power, mass, …) seen in comparison of designs before & after DDP sessions



    - E.g., *Risk-informed* redesign of flight experiment systems architecture: power needs decreased by 68%, mass decreased by 13%, cost decreased by 9%, major category of risk changed from architectural to well-understood design.

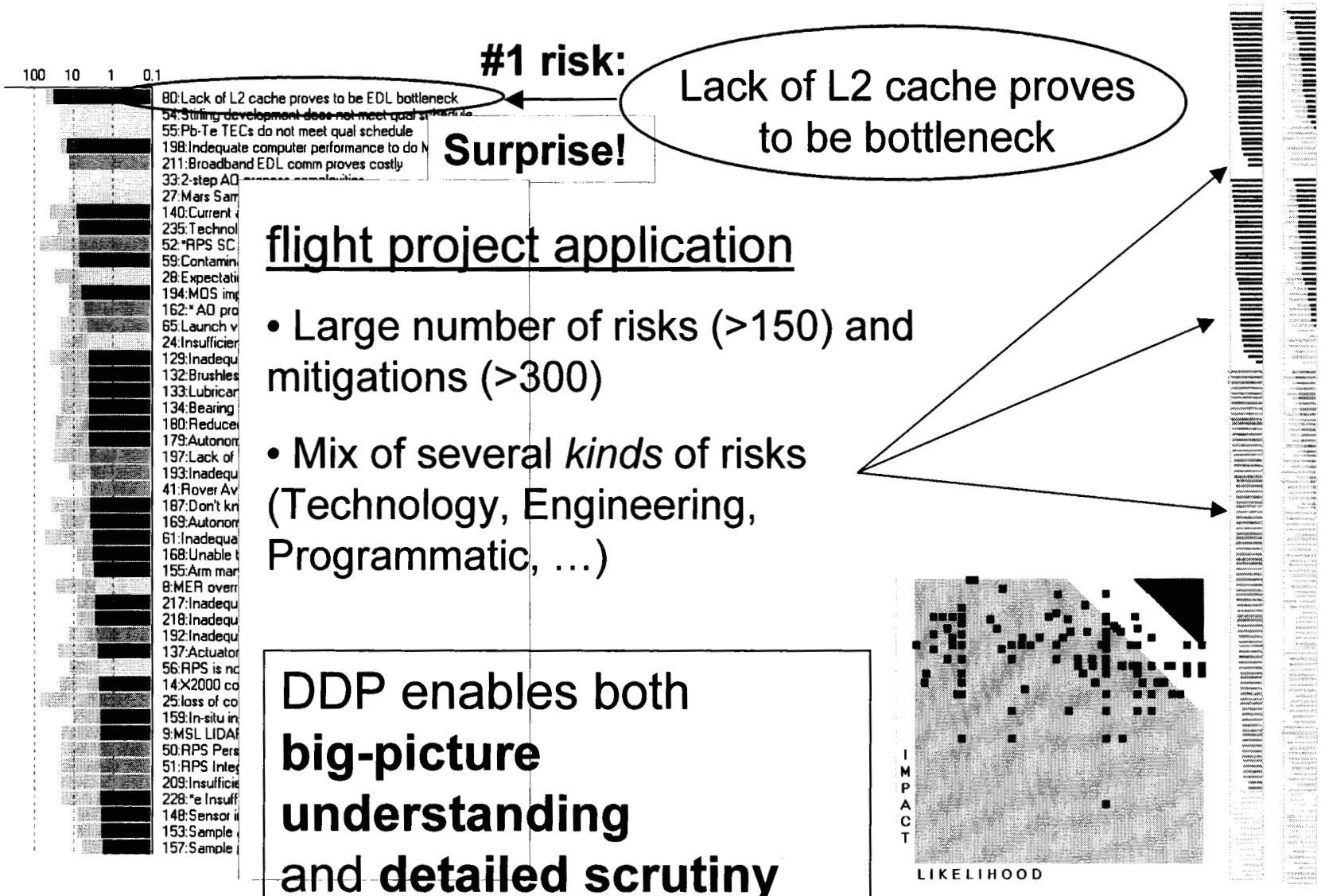
- **Thorough and Early Risk Identification and Mitigation**
  - **Technology-to-flight entire range of risks identified, and mitigations planned**

    - E.g., testing commensurate with anticipated mission radiation dosages; pinpointed use of antiquated design tools as a contributing risk factor; …

- **Technology Adoption**
  - Achieved **sufficient understanding of benefits/risks to make "go" decision**

    - E.g., GUI-driven autocoding adapted to run as flight instrument controller: benefits understood, risks unknown; *identified risks* (e.g., unrelocatable code) & *mitigations*. Agency usage, industry business case expansion.

Risk insights from DDP



flight project application

- Large number of risks (>150) and mitigations (>300)
- Mix of several *kinds* of risks (Technology, Engineering, Programmatic, …)

DDP enables both **big-picture understanding** and **detailed scrutiny**

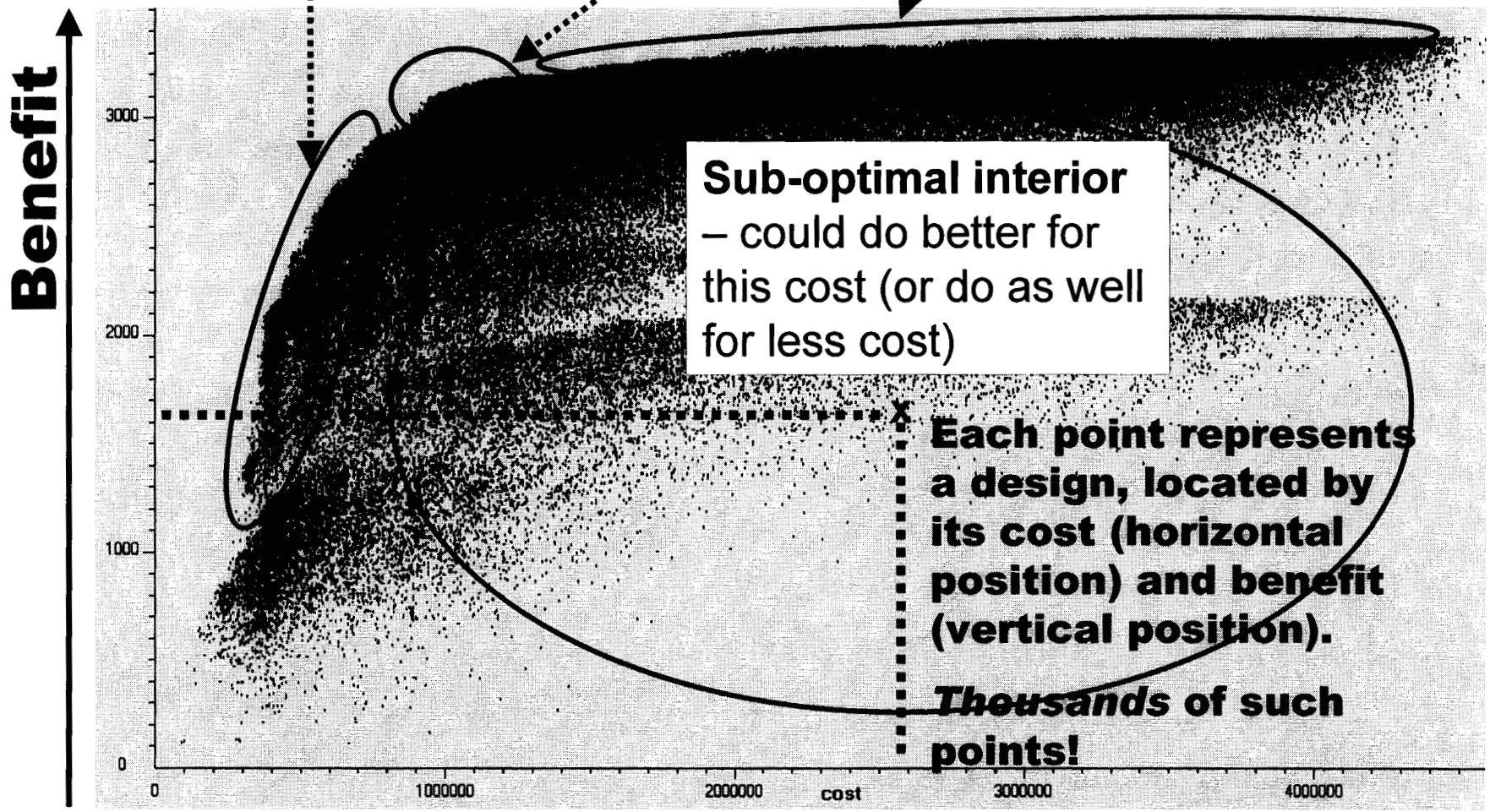
Actual data as used in a DDP study

Many *ask* for more $ – who should get it?

Significant improvement possible; excellent **case for more funding!**

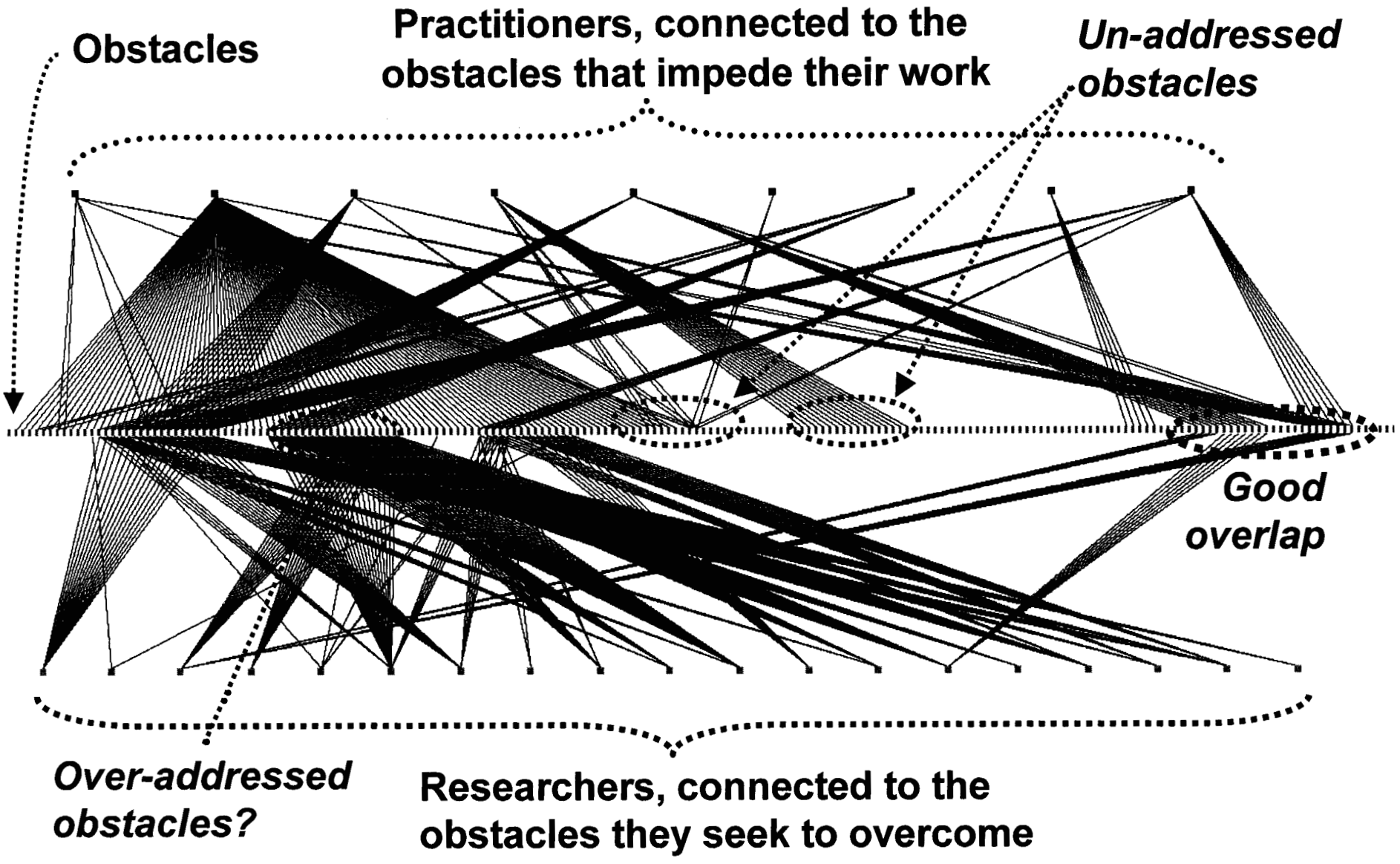
Sweet spot!

Region of diminishing returns; **overspending** (unless *very* risk averse!)



Actual data as used in a DDP study

Portfolios – matching efforts to needs



Actual data as used in a DDP study

DDP -status

Licensing:

TODAY! DDP software & training materials (courseware)

- ✓ 100% in-house developed (no third-party complications)
- ✓ Runs stand-alone on Windows platforms (e.g., laptop)
- ✓ Already exists and has seen several years of use

To the best of our knowledge DDP is unique in its niche	We are always looking for new areas of application

Partnerships:

TOMORROW? In progress, extensions to:

Fit into fast-paced collaborative engineering settings
Partner with downstream design and analysis tools
Pre-populate with knowledge-bases of data
Broaden, e.g., with "uncertainty" distributions (90% sure)