Decision-Making Under Uncertainty

Richard de Neufville
Professor of Engineering Systems
MIT Institute for Data, Systems, and Society

Obrigado pela apresentação

é realmente um prazer estar com vocês,
ter a oportunidade de conhecê-los, e
para compartilhar algumas ideias com vocês

It's really a pleasure to be with you,
to have the opportunity to get acquainted,
and to share some ideas with you

Decision-Making Under Uncertainty
Outline

THE THOUGHT: Because of Uncertainty There is no overall Optimum Decision

- **Tension between**
  - **Expected Performance and Risk**
- **Decision-Makers disagree about trade-off**

Role of Analyst

- **Define performance of alternatives**
- **Define Dominant, Preferred Choices**
- **Present, Explain Risk-Reward Trade-offs to Decision Makers**

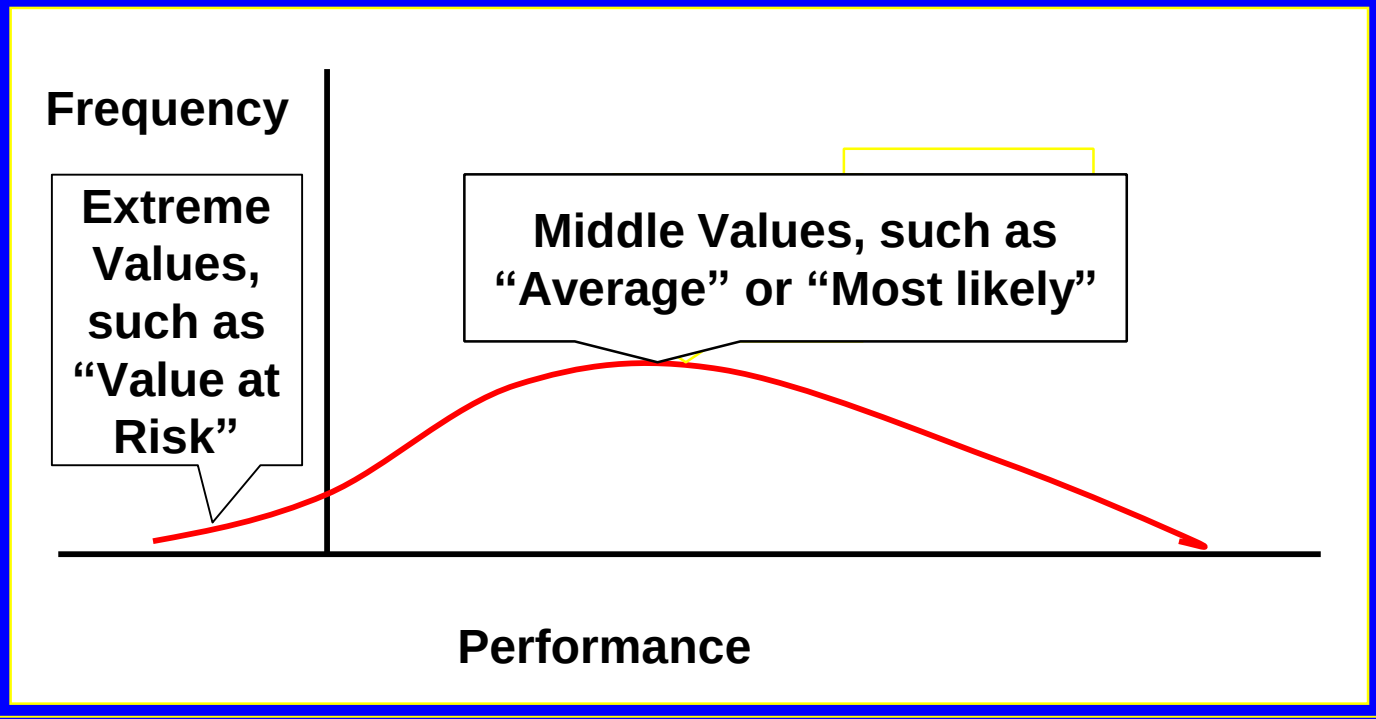
Performance of a plan is uncertain

Future performance depends on unpredictable future events, such as:

- Environment
- Resources available
- Production Productivity
- Financial, legal, or other restrictions
- Et cetera

Future performance is a “distribution”

Example distribution of Performance



Distribution description needs at least 2 parameters: for middle and extremes

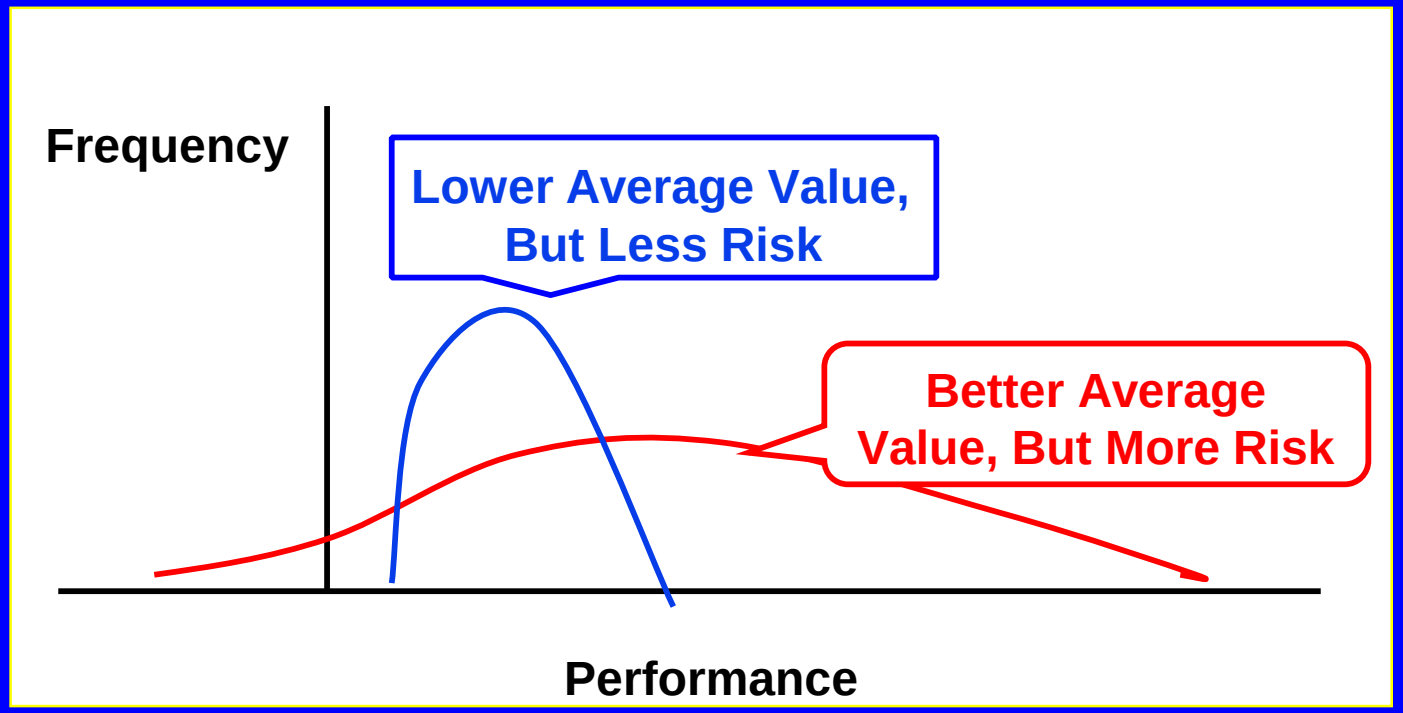
Essential Problem for Decision-Making under Uncertainty

- Two parameters important for choice
- We care about performance: Reward
- Also care about extremes: Risk

- Reward and Risk not really comparable
- Decision-makers differ about importance of Risk -- their degree of "Risk Aversion"

This means that there is no solid basis for defining best choice

Practical Example of Choice



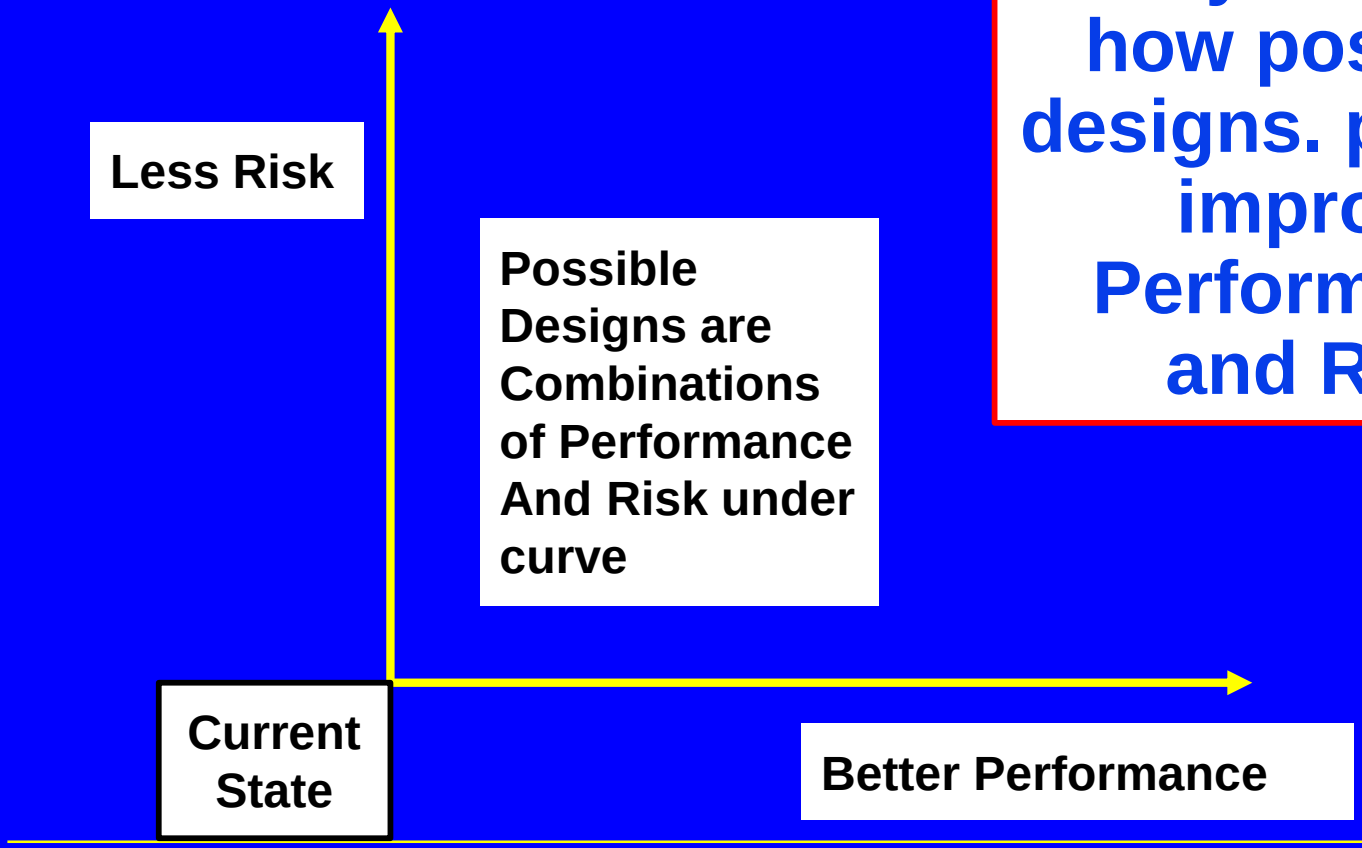
Which Risk-Reward combination better?
Personal Preference not Technical Answer

What is role of analyst?

Three Essential tasks:

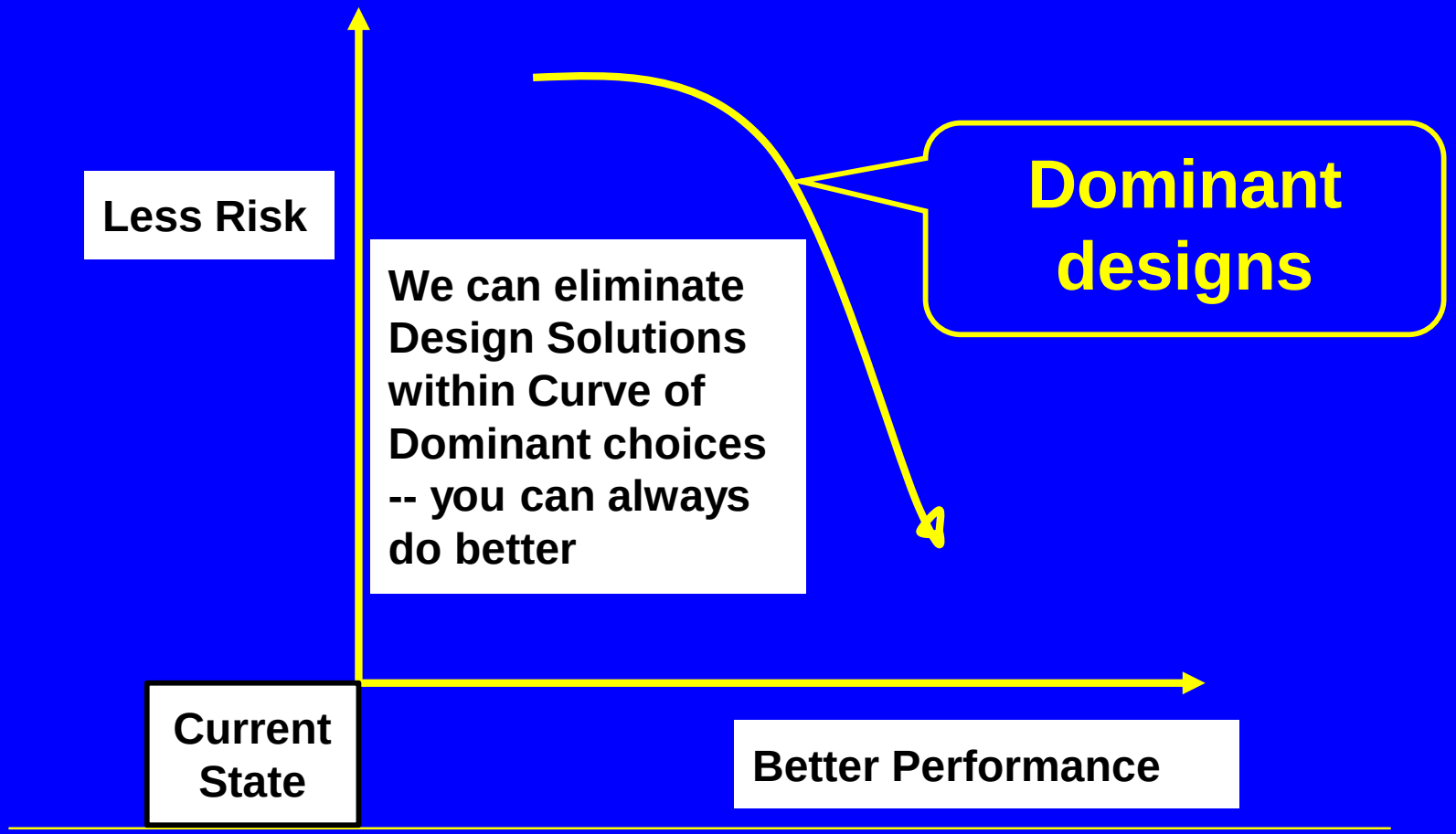
1. **Define Performance and Risk of Possible Designs and Policies**
2. **Define Define Dominant, Preferred Designs and Policies**
3. **Present, Explain Risk-Reward Trade-offs to Decision Makers**

Define improved Performance and Risk of Possible Designs and Policies

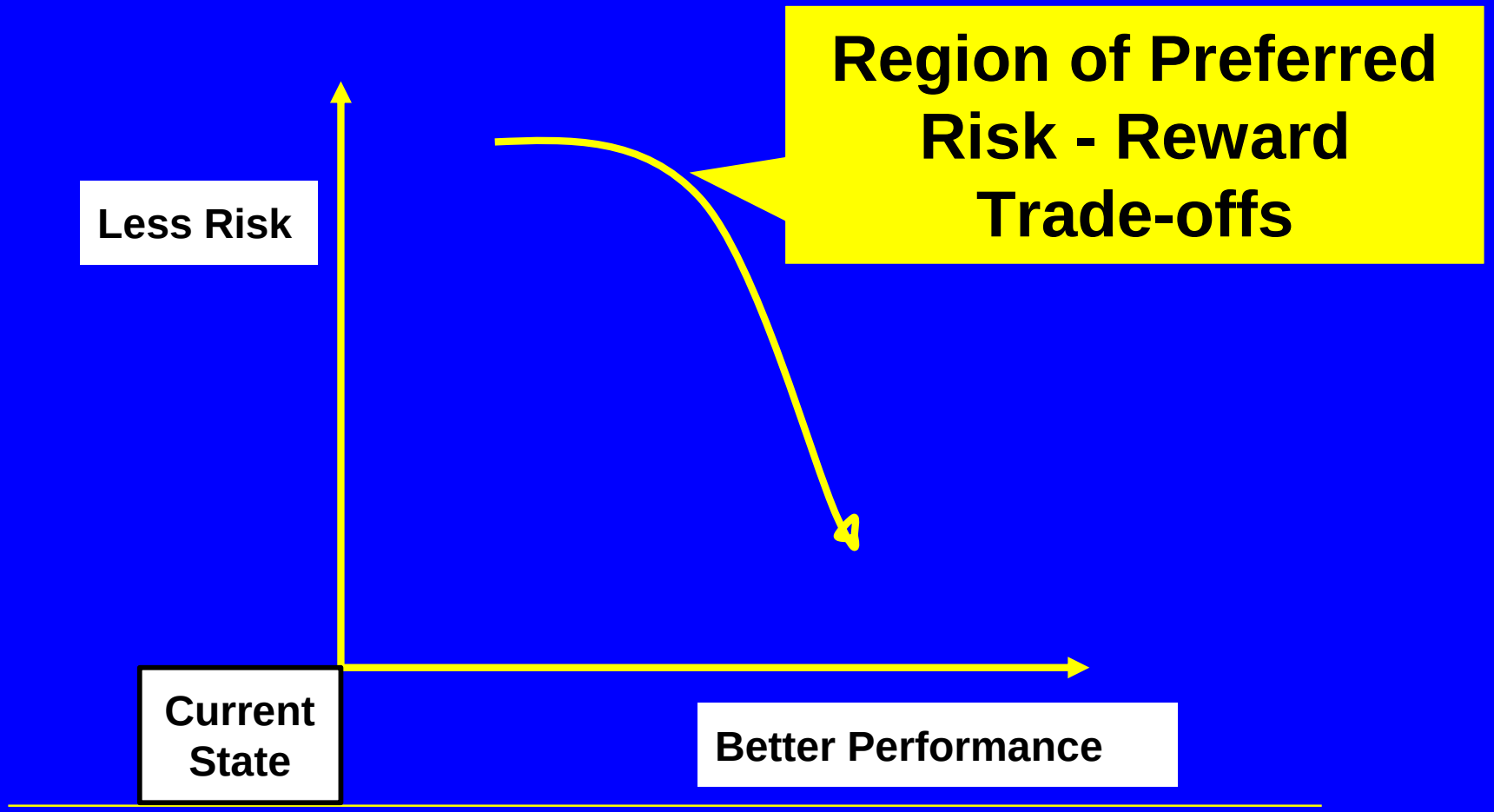


Analyst defines how possible designs. policies improve Performance and Risk

Define Dominant Designs and Policies
Eliminate those dominated



Define Preferred Designs and Policies
Those with interesting trade-offs



Explain Risk-Reward Trade-offs to Decision Makers

- As Reward and Risk not comparable, and
- As Decision-makers differ about importance of Risk versus Reward
- Analyst Cannot Define Best Decision

This means that there is no solid basis for defining best choice

As decision-makers, stakeholders differ
Negotiations define ultimate choice

Overall Thought

THE THOUGHT:

Because of Uncertainty
There is no overall Optimum Decision

There is Inevitable Tension between
Expected Performance and Risk

Decision-Makers disagree about
Risk-Reward trade-ofts