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TFDEA: A New Approach for Technology Forecasting of New Product Development Targets

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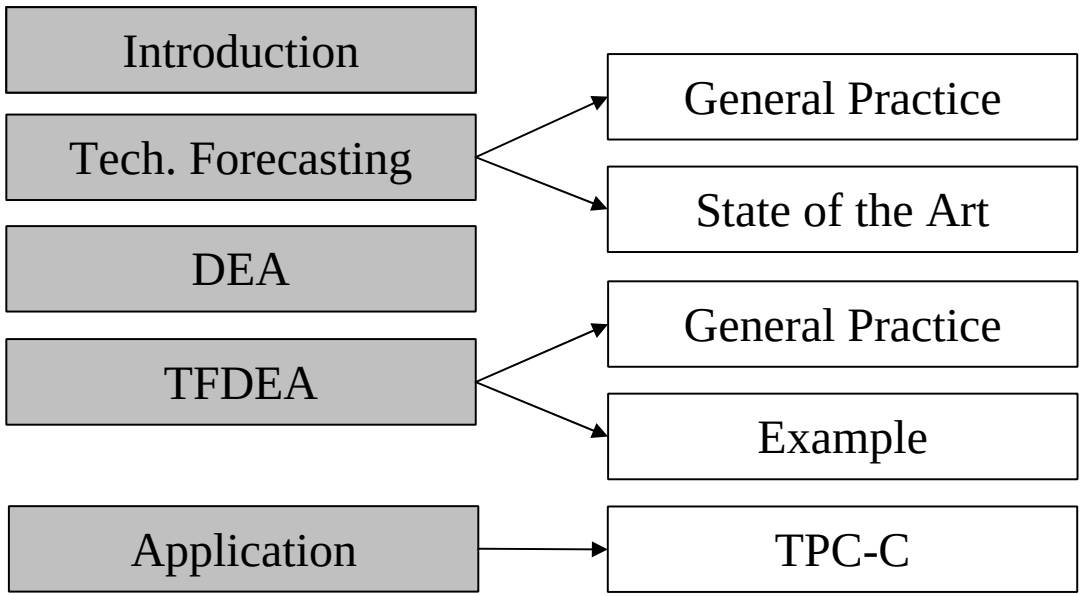
Presentation Flow



Introduction

- *GAP1: Current quantitative technology forecasting techniques do not handle variable trade-offs.*
- *GAP2: Current DEA tools do not handle single occurrence DMUs with variable time periods.*

Research Objectives

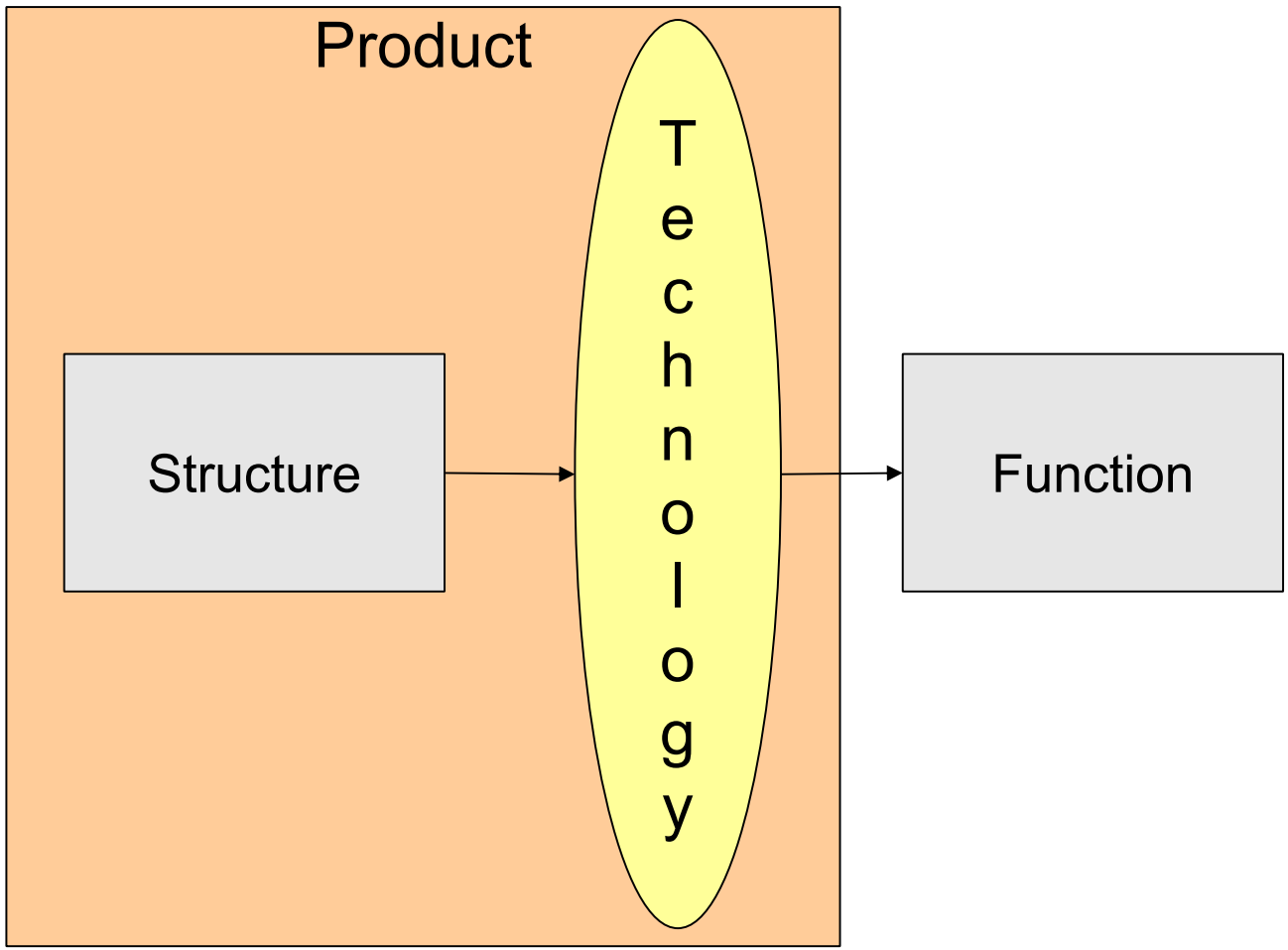
- Methodology:
  - Develop a methodology for technology forecasting which provides a robust means to measure the SOA and its progress by extending current temporal DEA to allow for DMUs which are introduced only once at irregular intervals.
- Application:
  - Apply the methodology to a straight forward real world application.

Technology Forecasting

- ***What is technology forecasting?***
  - ***"to predict the future characteristics of a useful machine"***
- ***What's a machine?***
  - ***Not only physical devices, but tools, techniques and procedures that provide some function to an end-user.***

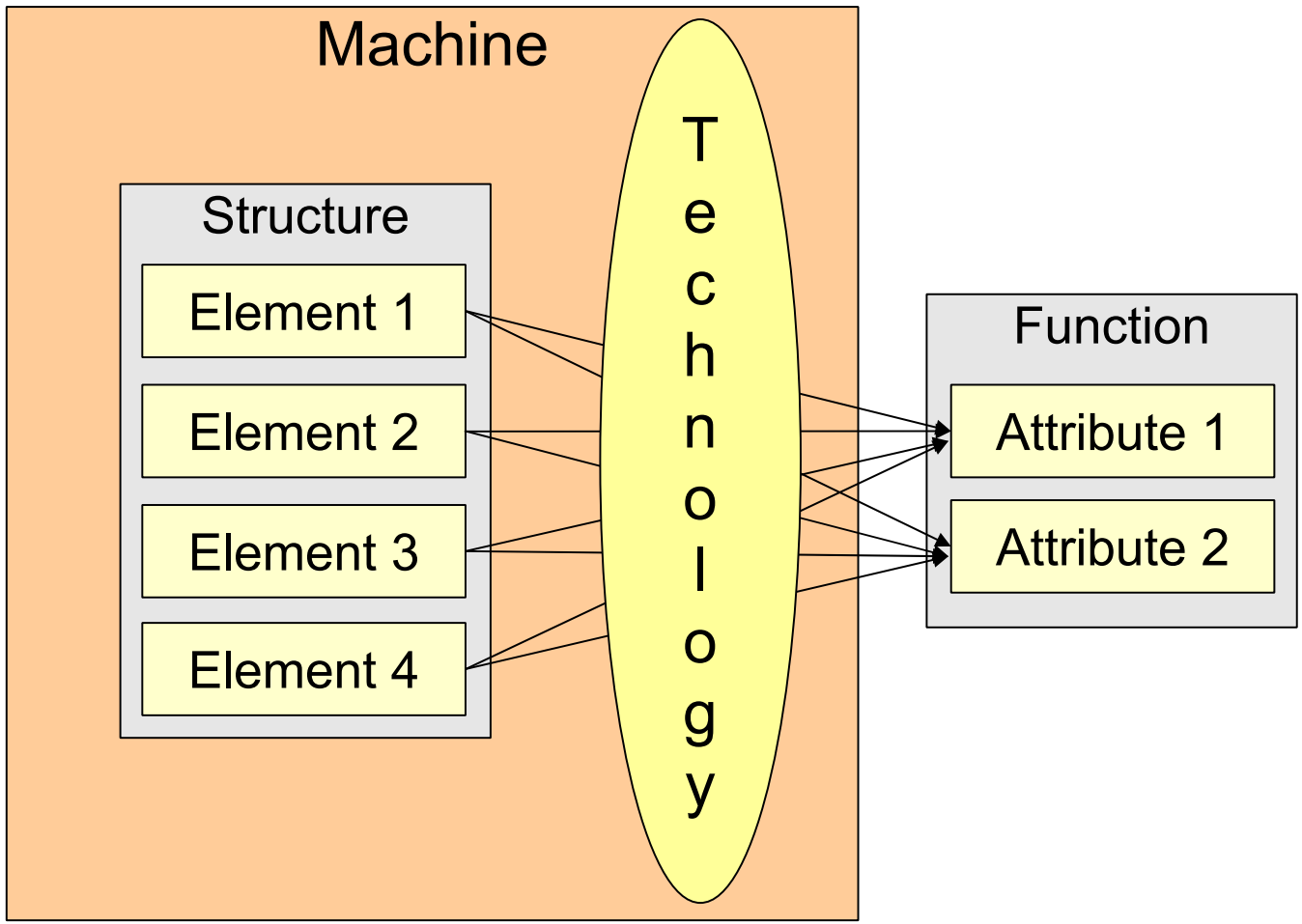
J. P. Martino, "Technological Forecasting for the Chemical Process Industries," Chemical Engineering, pp. 54-62, 1971.

What is technology?

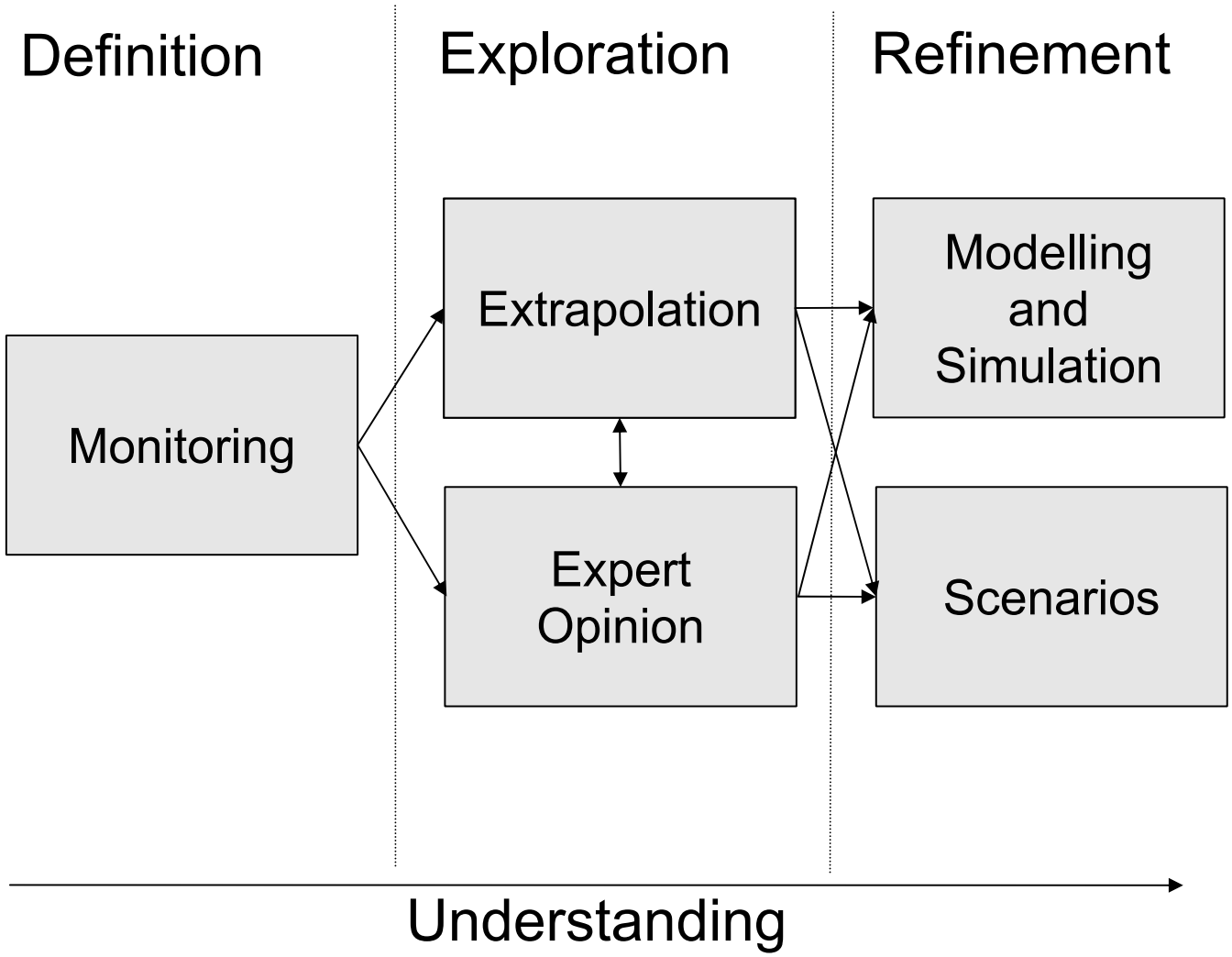


*Knight '74

What is technology, really?



How is it currently done?



What are the challenges?

- *It is difficult to assign a single attribute to the measurement of a technology.*
- Typically only addresses a technological approach not a single technology.

How are these challenges addressed?

- *State Of the Art (SOA)*

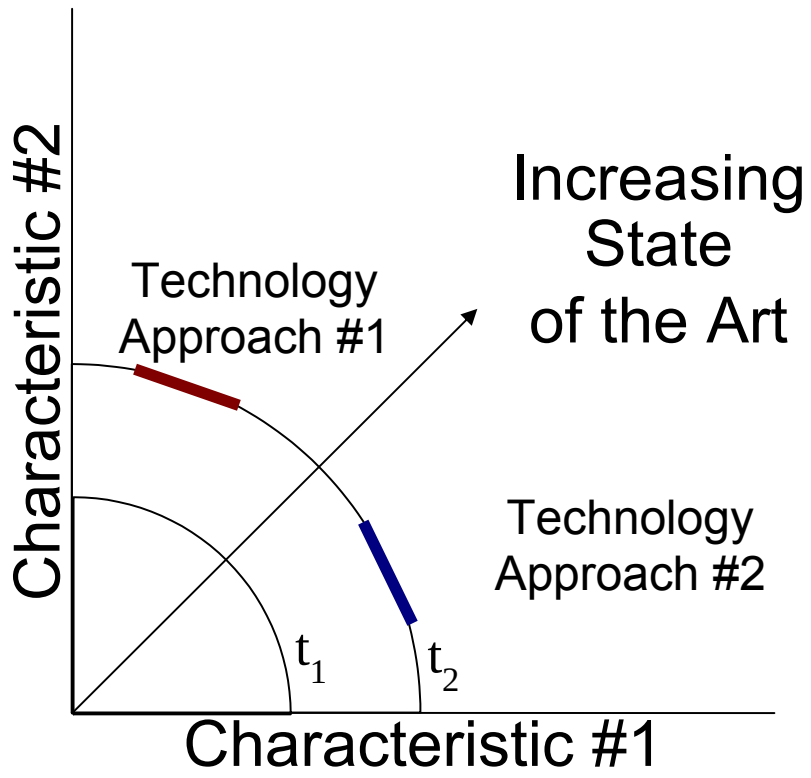
"The best implemented technology as reflected by the physical and performance characteristics actually achieved during the time period in question"

–Dodson, TFSC 1 1970

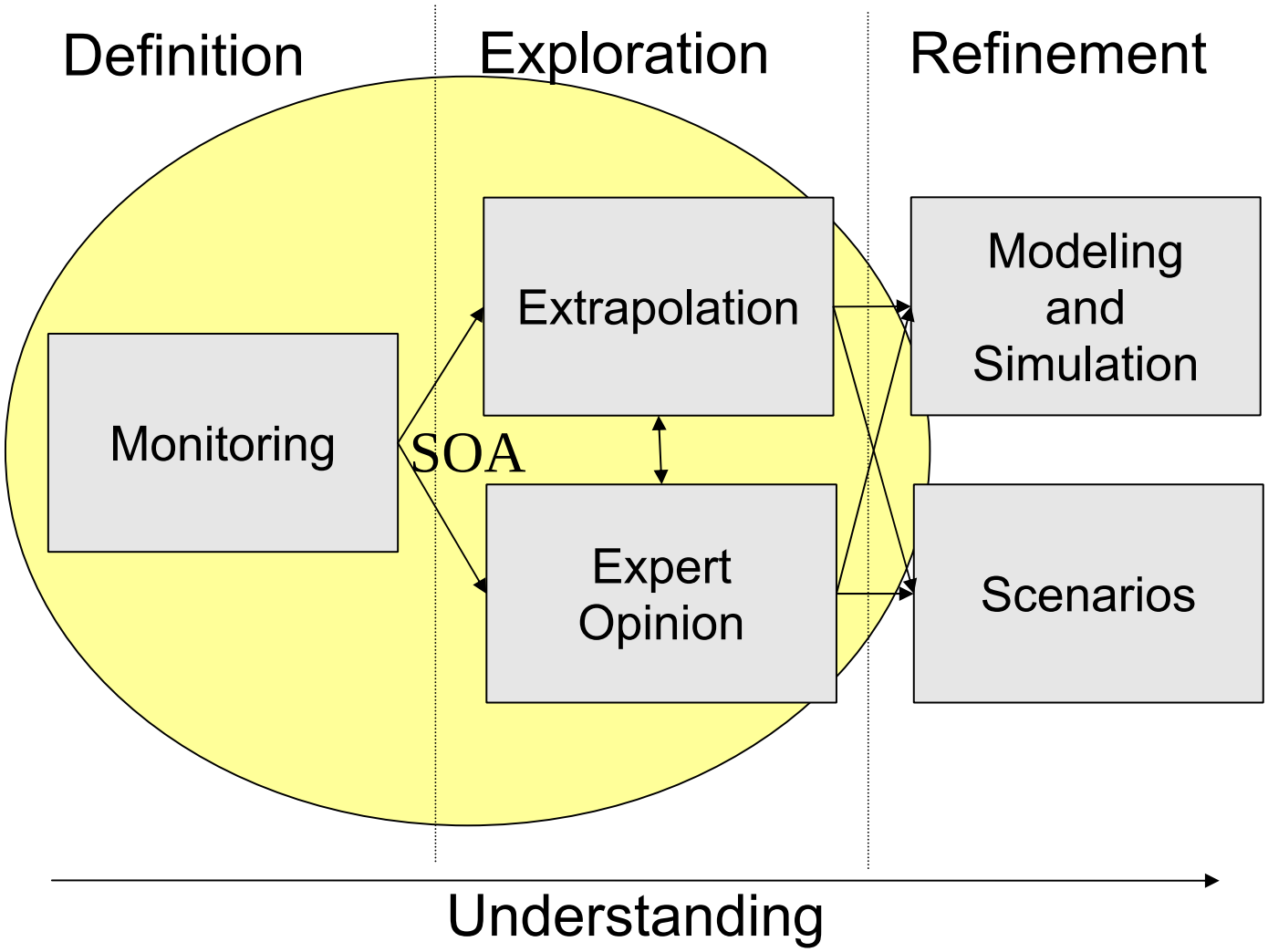
How can SOA be used?

- *Given that technology is never better than State-of-the-Art, an index may be used to measure relative to the SOA.*
- *Over time a products technology index will change – tracking that change will allow for future predictions.*

What is the SOA?



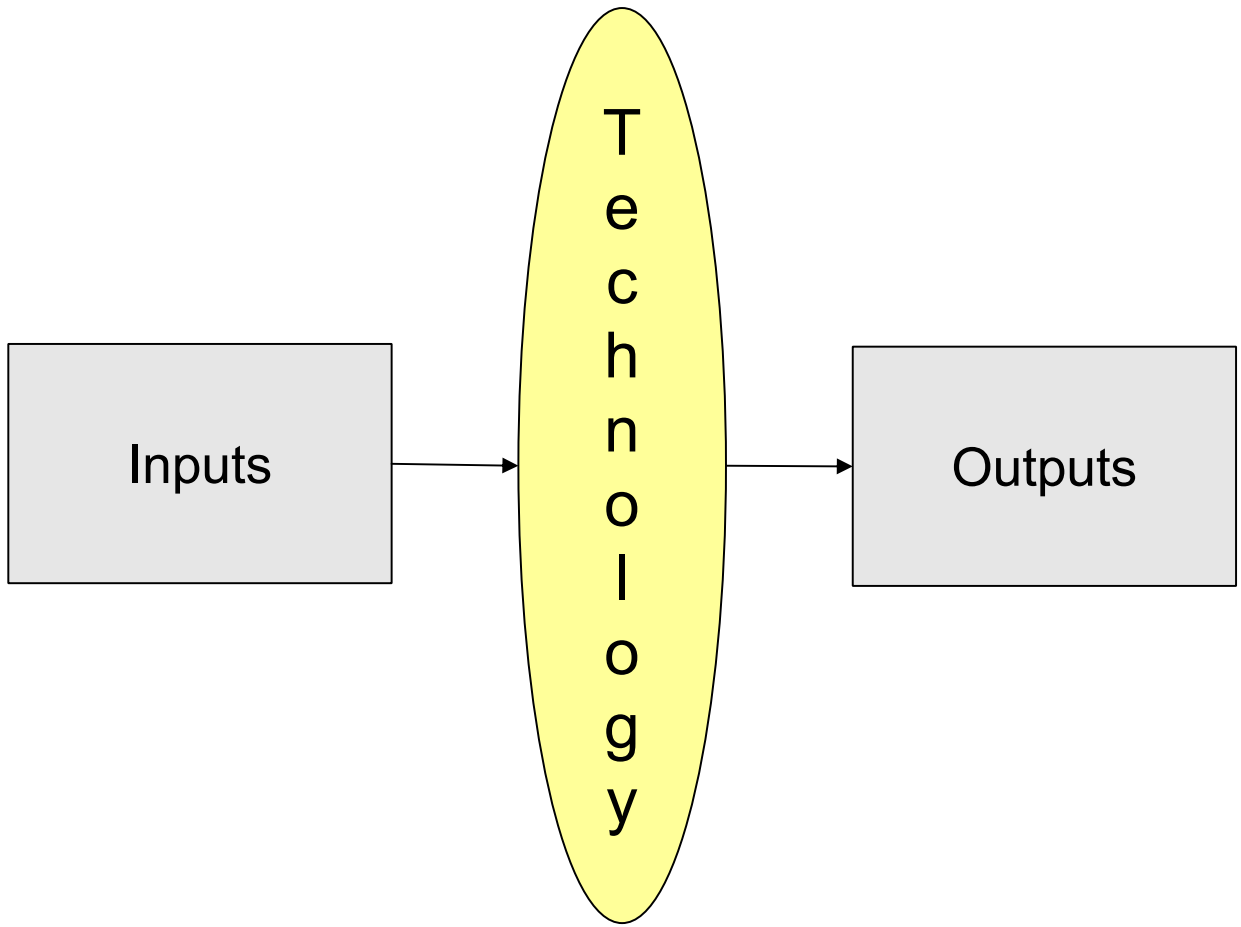
Where does SOA fit?



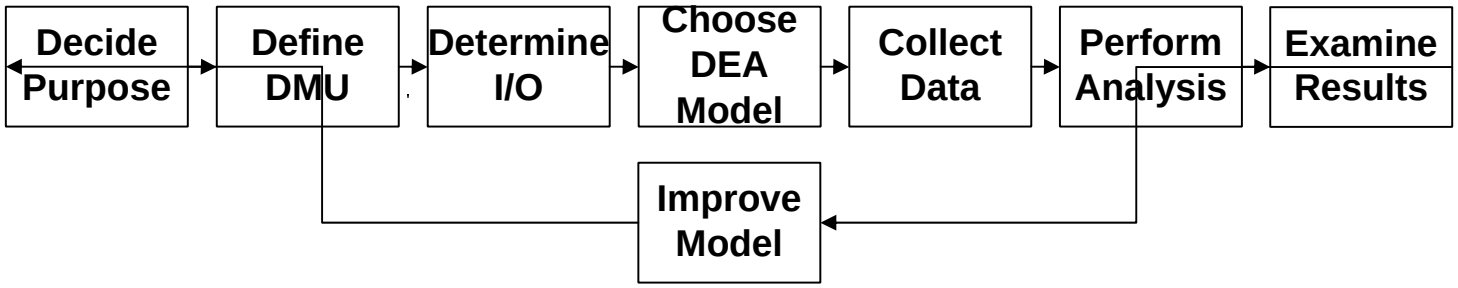
Steps to Forecast SOA

T. J. Gordon and T. R. Munson, "A Proposed Convention for Measuring the State of Art of Products or Processes," *Technological Forecasting and Social Change*, vol. 2 pp. 1-26, 1981.

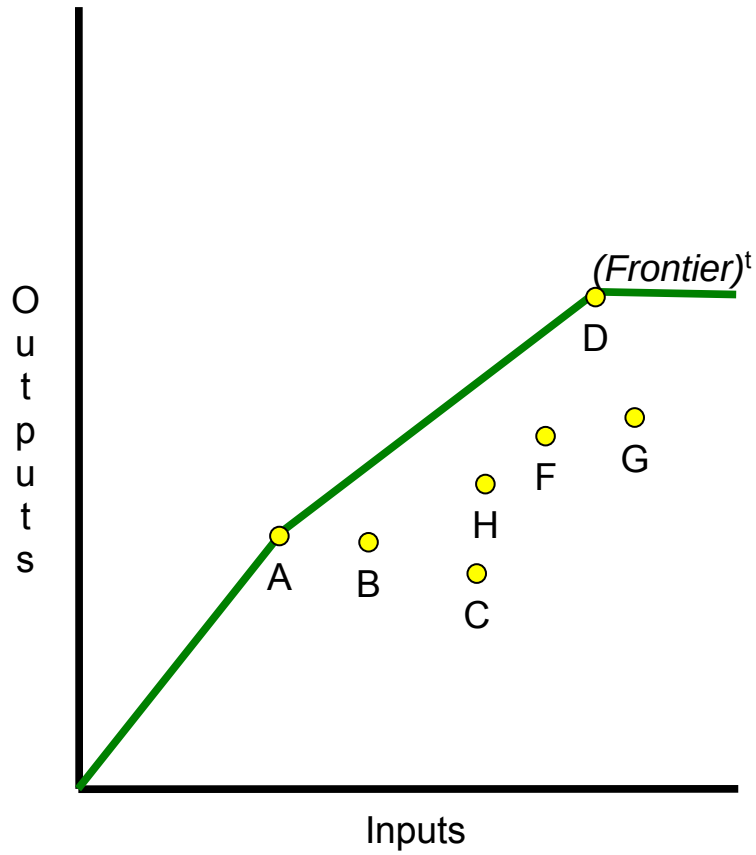
What does DEA measure?



Steps For DEA

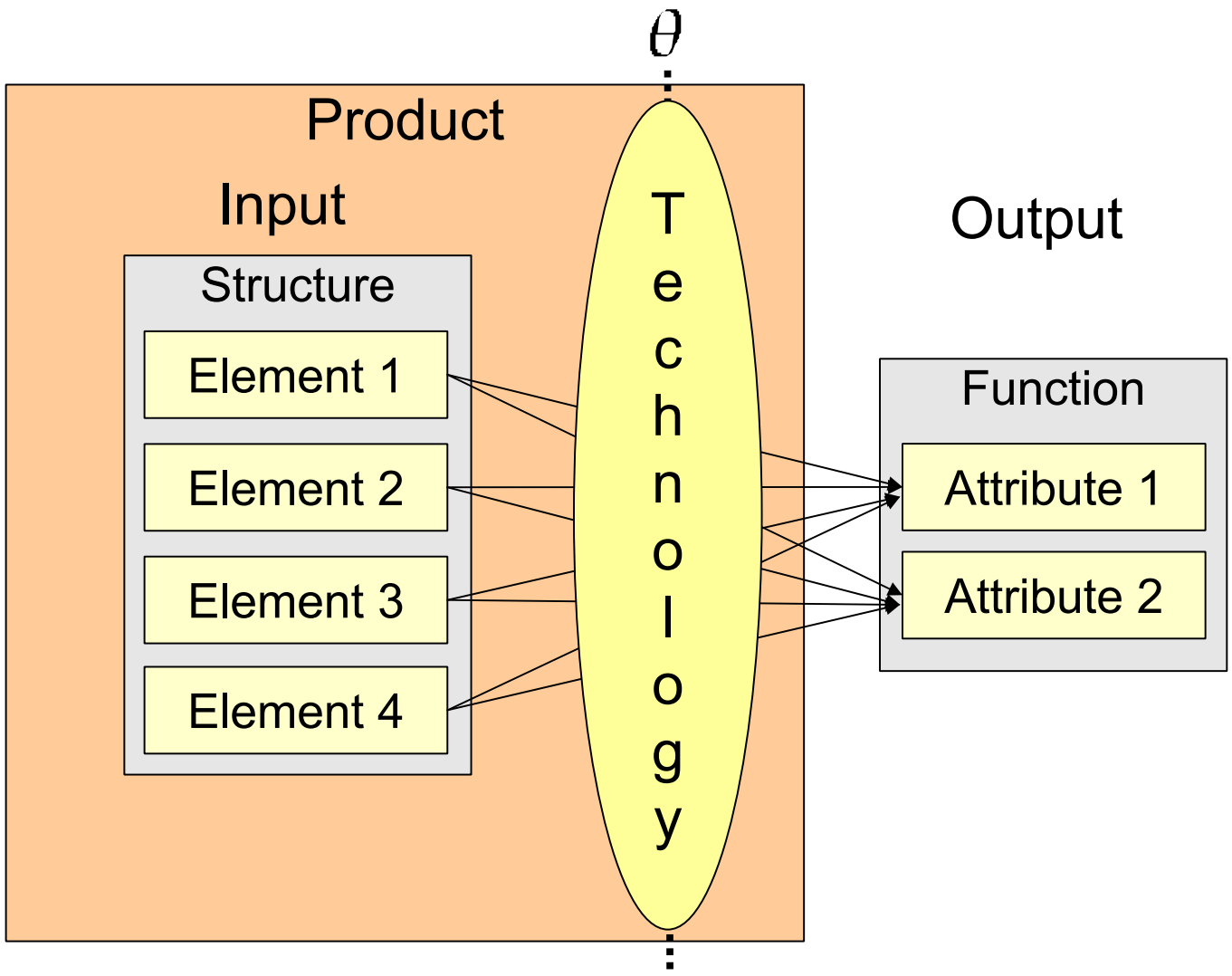


Data Envelopment Analysis



- Builds an efficiency envelope relative to its peers (extreme-point method)

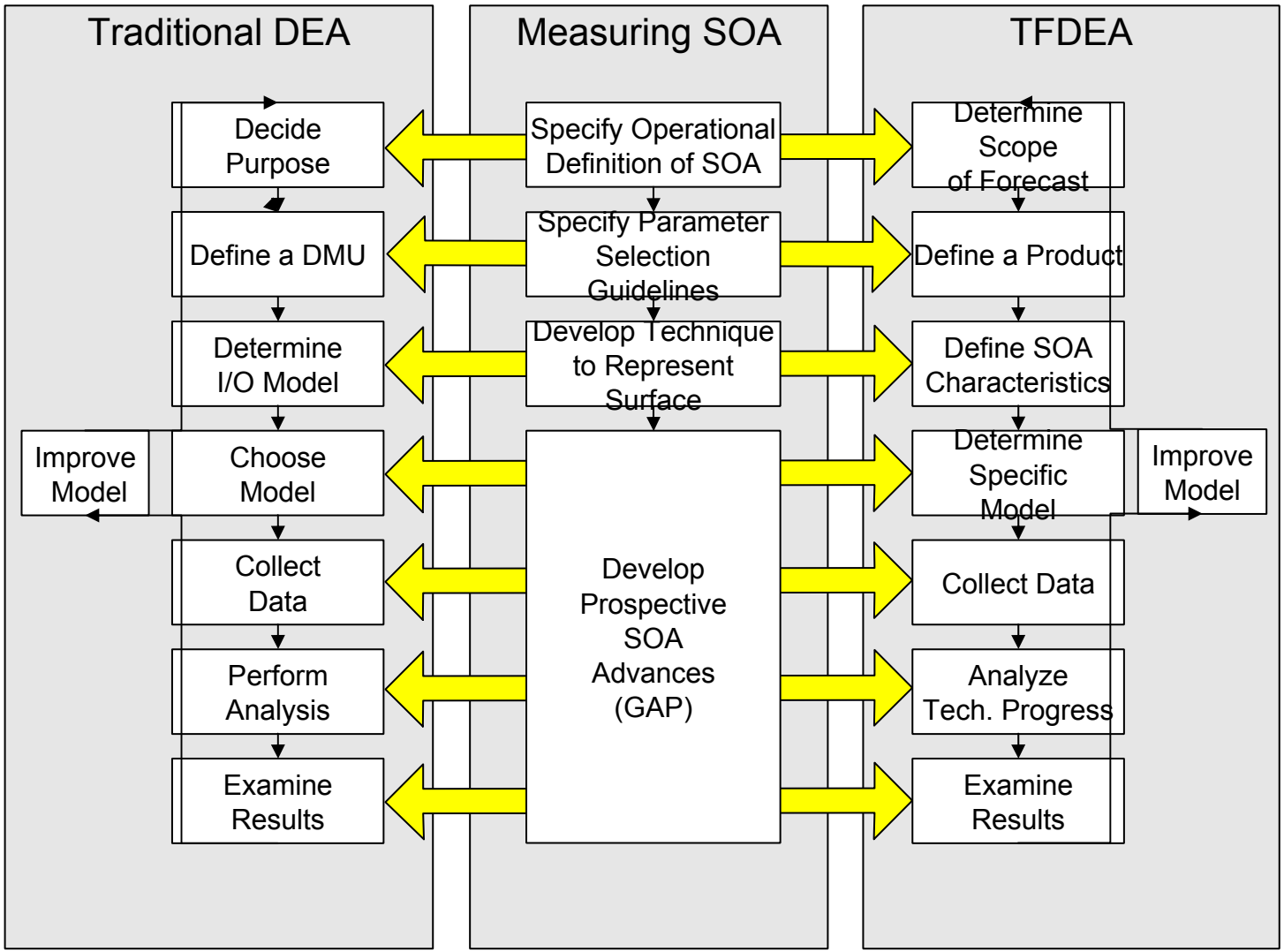
How do they go together?



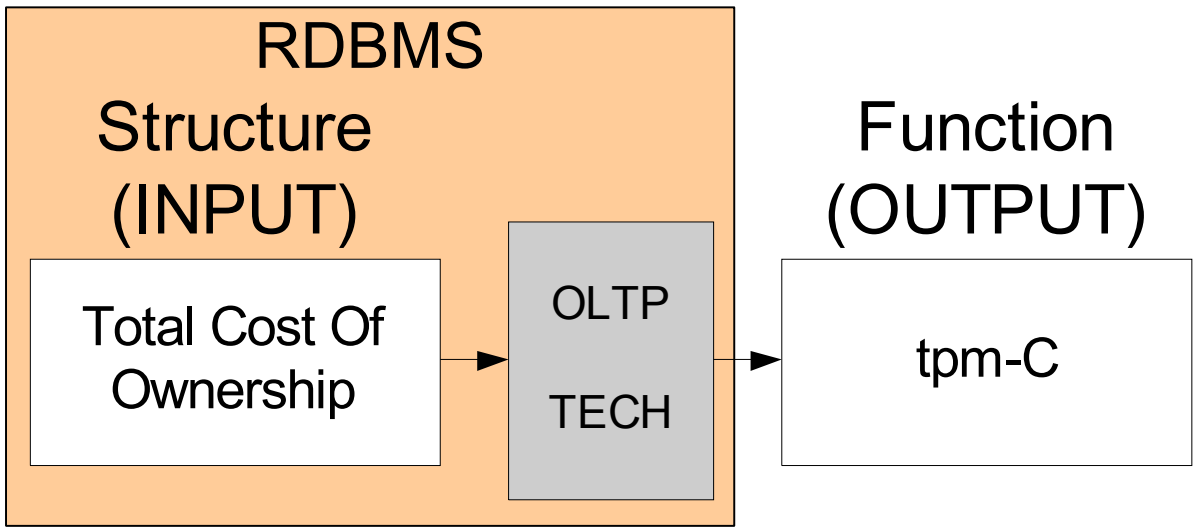
How do they fit together?

Gap: General forms do not take into account the dynamic nature of trade-off surfaces.	Attr: DMUs are independently rated against peers which are explicitly identified by DEA.
Gap: Do not address the "best" available technology.	Attr: DEA is an extreme point method.
Gap: Current methods are limited to a single output.	Attr: DEA can handle multiple inputs and outputs simultaneously.
Gap: Current methods require independent attributes.	Attr: DEA does not require attribute independence.

How do they fit together?



Example - RDBMS

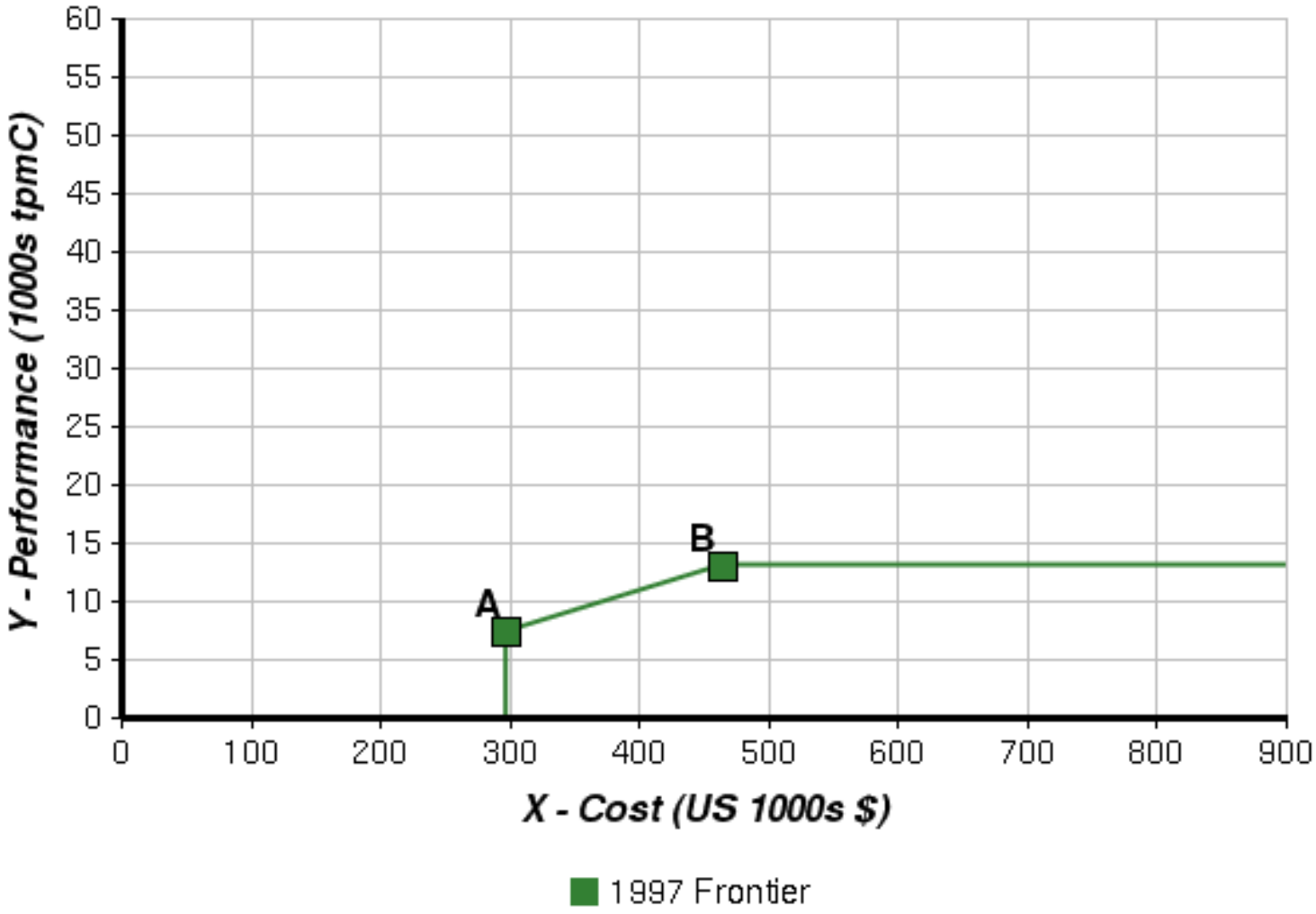


TPC Data

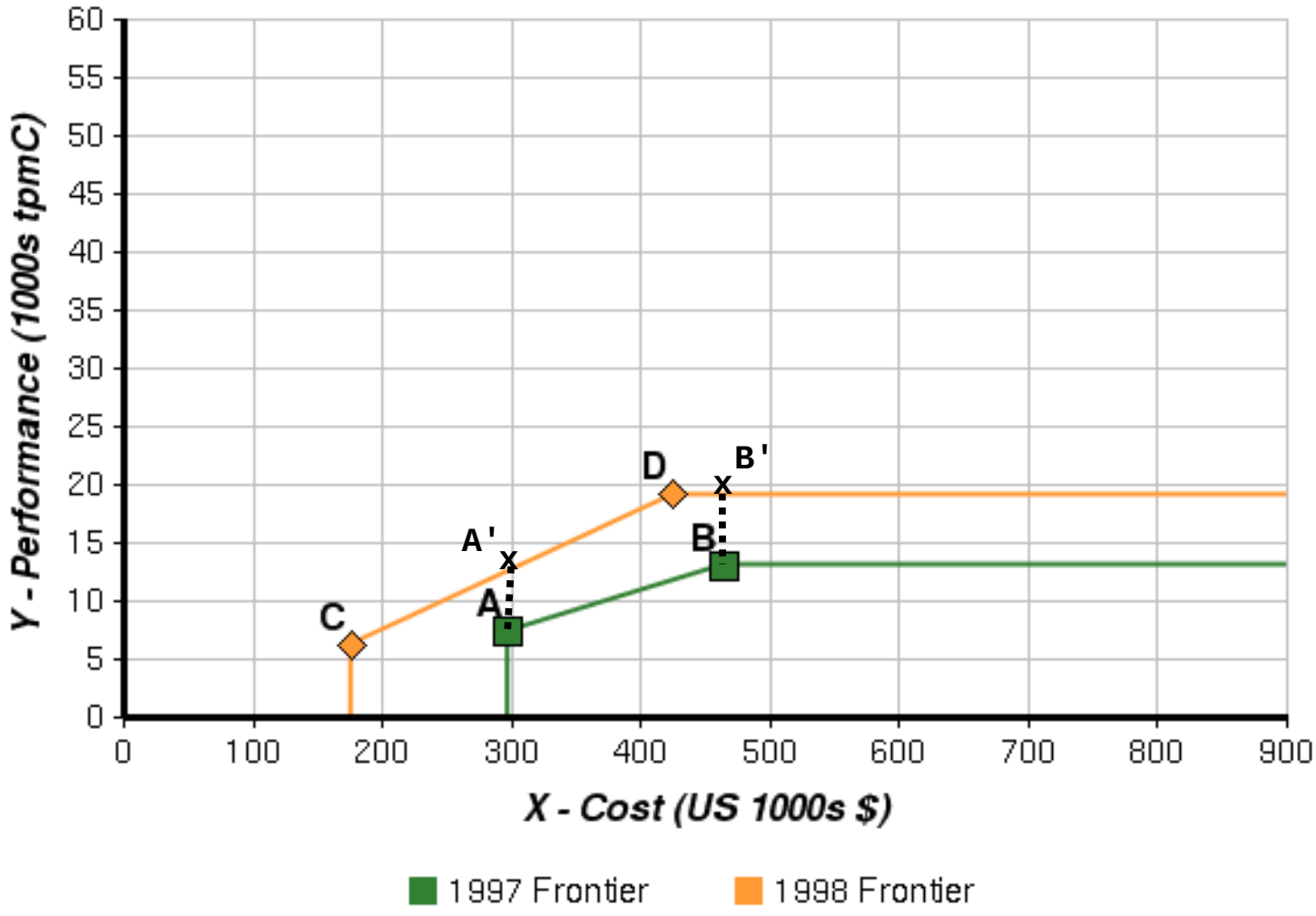
Product	Name	Year Released	Total Cost($)	Perf. (tpmC
A	Unisys Aquanta QR/6 c/s	1997	297392	7407
B	ALR Revolution 6X6 (1MB L2) c/s	1997	463821	13089
C	Compaq ProLiant 3000 6/450-512 1	1998	176042	6290
D	Unisys Aquanta QR/2V Server	1998	424297	19118
E	Compaq Proliant 3000-6/600-1P	1999	160643	8050
F	Compaq Proliant ML570	2000	201717	20207
G	Dell PowerEdge 6450	2000	334936	31231
H	Unisys e-@action Enterprise Server	2000	797935	61390

Source: Transaction Processing Council (TPC) www.tpc.org

Identification of the SOA



Mapping Progress



How do we represent it?

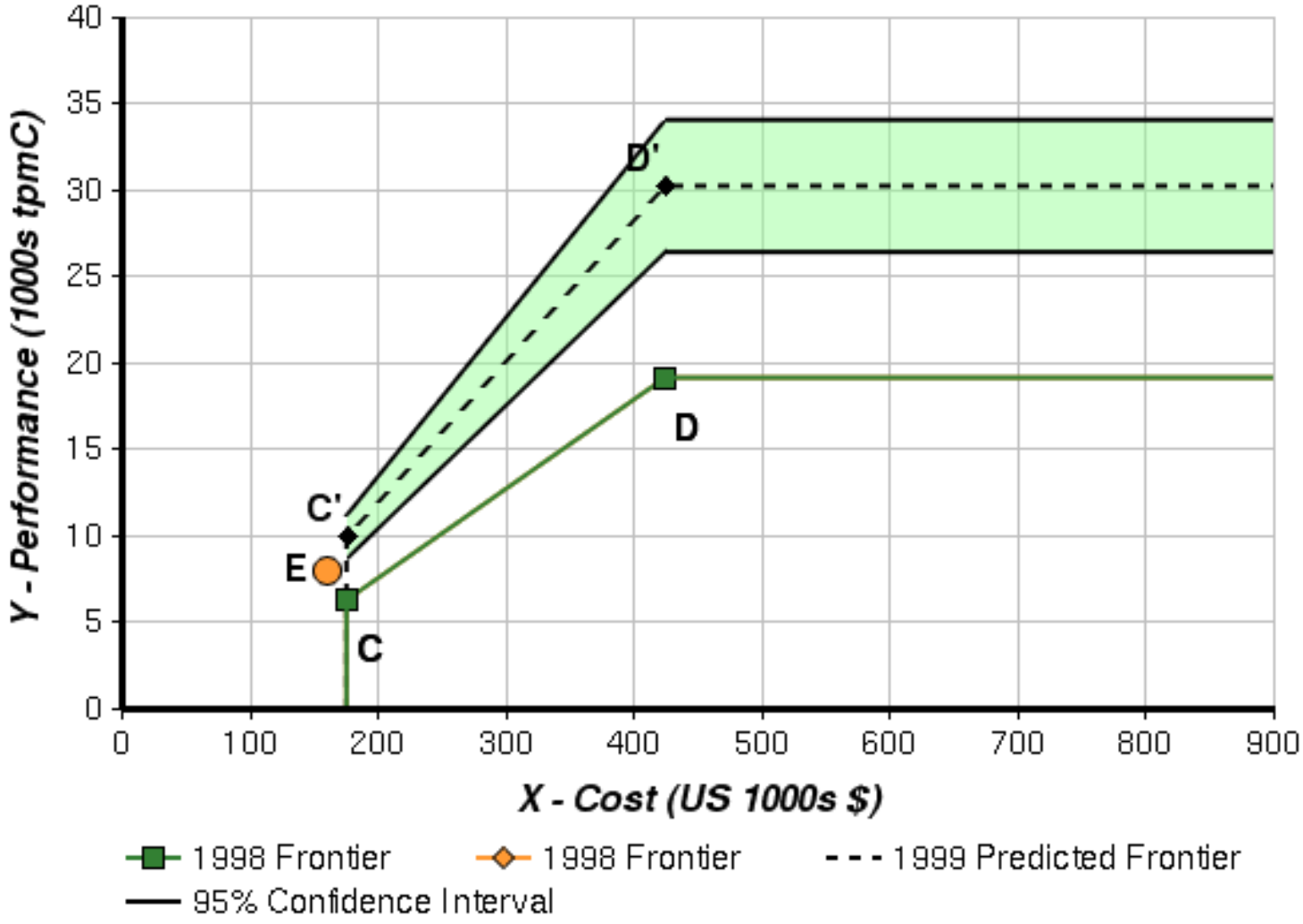
- *Use the β determined earlier:*

$$\phi^t = (\beta)^t \cdot \phi^0$$

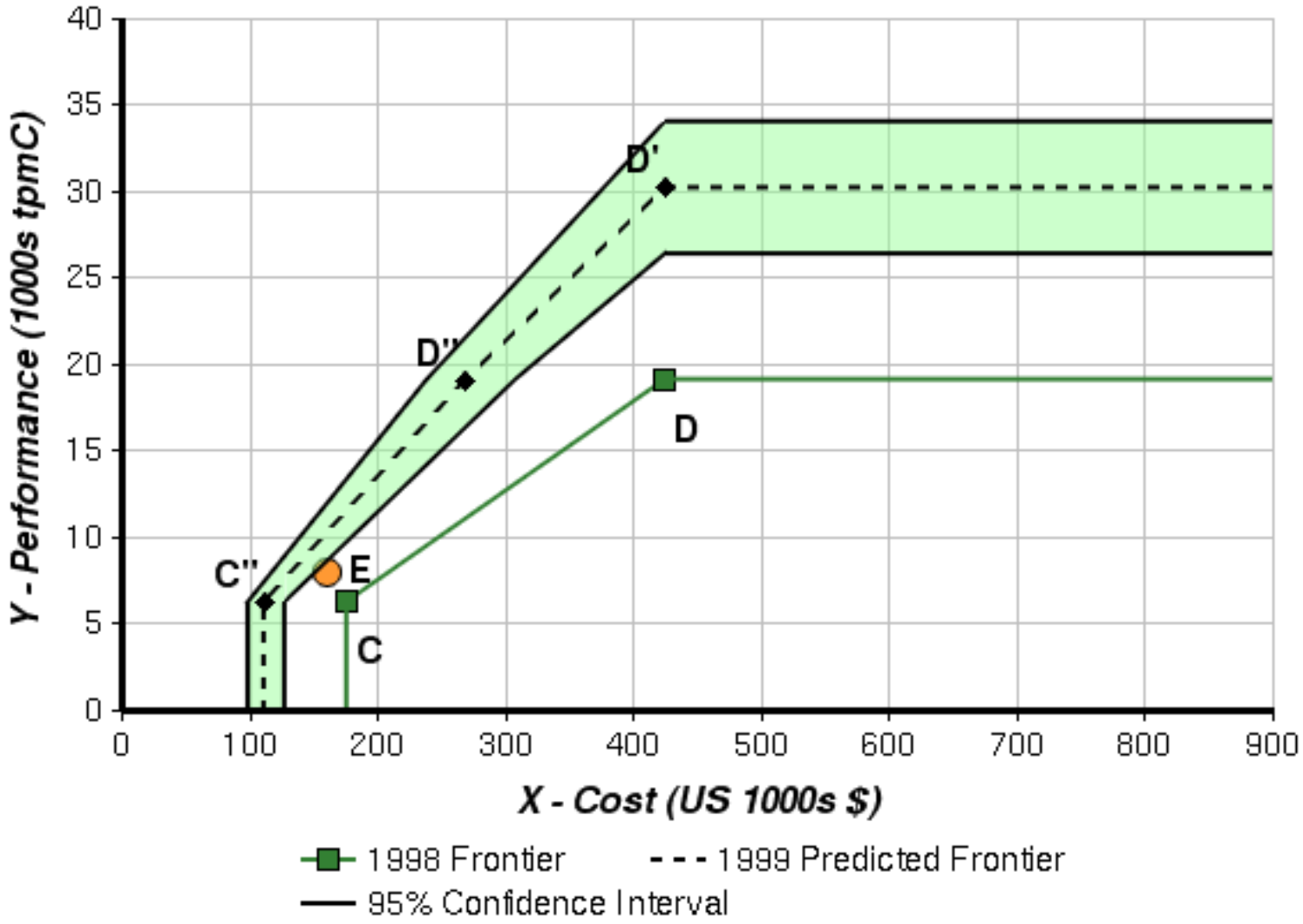
$$y_r^t = \beta^{\Delta t} \cdot y_r^0 \forall\, r \in \{1 \ldots m\}$$

- *Translation: new outputs can be multiplied by the old outputs*

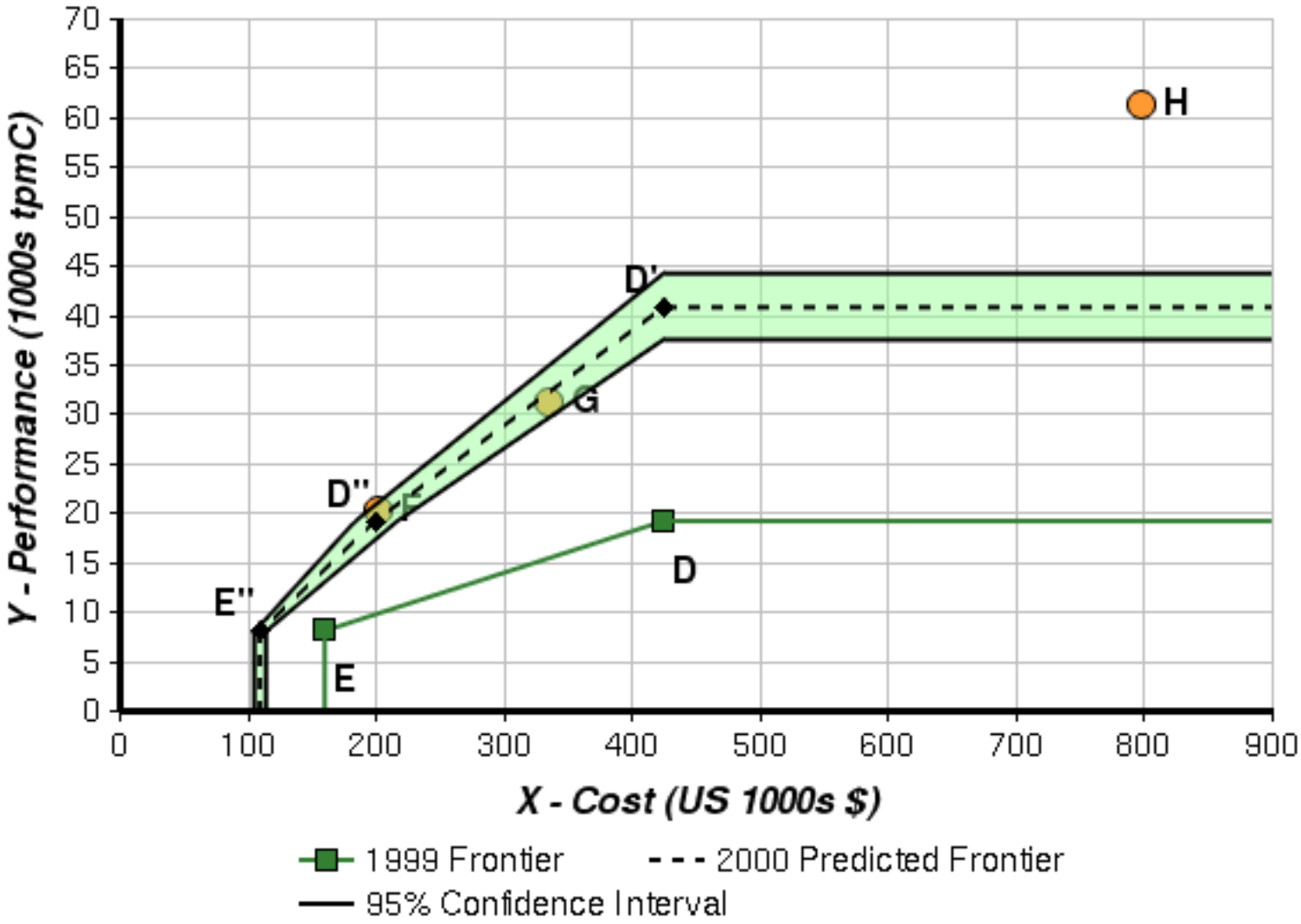
Forecasting the Future



Forecasting the Future



Forecasting the Future



Applications:

TPC Results

Output-Oriented TFDEA

Predicted Range	541	42.77%
ROC Predicts Lower Bound Only	220	17.39%
ROC Predicts Upper Bound Only	241	19.05%
ROC Did not Predict SOA	263	20.79%
Total	1265	100.00%

IO-OO Output-Oriented TFDEA

Predicted Range	797	63.00%
ROC Predicts Lower Bound Only	130	10.27%
ROC Predicts Upper Bound Only	338	26.71%
ROC Did not Predict SOA	0	0.00%
Total	1265	100.00%

TPC Results

Product	*Date Available*	Φ_{lower}	Φ_{upper}	*Status*
IBM eServer xSeries 365 4P c/s	2004-03-31	1.23	1.30	Low
HP Integrity Superdome	2004-04-14	0.95	1.02	Target
HP rx8620	2004-04-15	1.04	1.07	Low
Unisys ES7000 Aries 420 Enterprise Server	2004-04-20	1.20	1.24	Low
HP Integrity rx5670 Cluster 64P	2004-04-30	0.82	0.89	RISK
PRIMEPOWER 2500	2004-04-30	1.64	1.77	Low
IBM eServer pSeries 690 Model 7040-681	2004-08-16	1.08	1.21	Low
IBM eServer Xseries 445 8P c/s	2004-08-31	1.44	1.59	Low

*HP Integrity made its debut – but it used RedHat Linux for its Operating System.

TPC - Conclusions

- Method provides a good estimate of future trends.
- IO-OO offers additional insight.
- Still prone to disruptive technologies