
R,D&E and Product Development Metrics

*John Hauser
and colleagues*



*MIT Center for Innovation in
Product Development*



Stream of metrics research

- Qualitative interviews (*RTM*)
- R,D&E metrics (by tiers) (*MS*)
- You are what you measure! (*EMJ*)
- Non-monetary compensation (*JMR, MKS*)
- “Engineer” agency theory (*internal notes*)
- Field measures to identify lean metrics



Roadmap for today.

- Qualitative ideas
- R,D & E metrics, measures at Draper
- Some concepts of agency theory
- “Engineered” theory
- Measures at Xerox, Ford



Qualitative ideas: Metrics have many uses

- Where am I, where am I going?
- In what should I invest?
- You are what you measure!
 - guide the allocation of effort
 - rewards and incentives, possibly non-monetary



Qualitative ideas: Counterproductive metrics

1. Delaying rewards (people vs. firm)
2. Using risky rewards (market-oriented?)
3. Making metrics hard to control
(firm's profit, vehicle-level, car door)
4. Losing sight of the goal (Steelcase)
5. Choosing metrics that are precisely wrong
(fast, efficient response vs. the right answers)
6. Assuming employees have no options
7. Thinking too narrowly (Intuit)



Seven steps toward lean, effective metrics

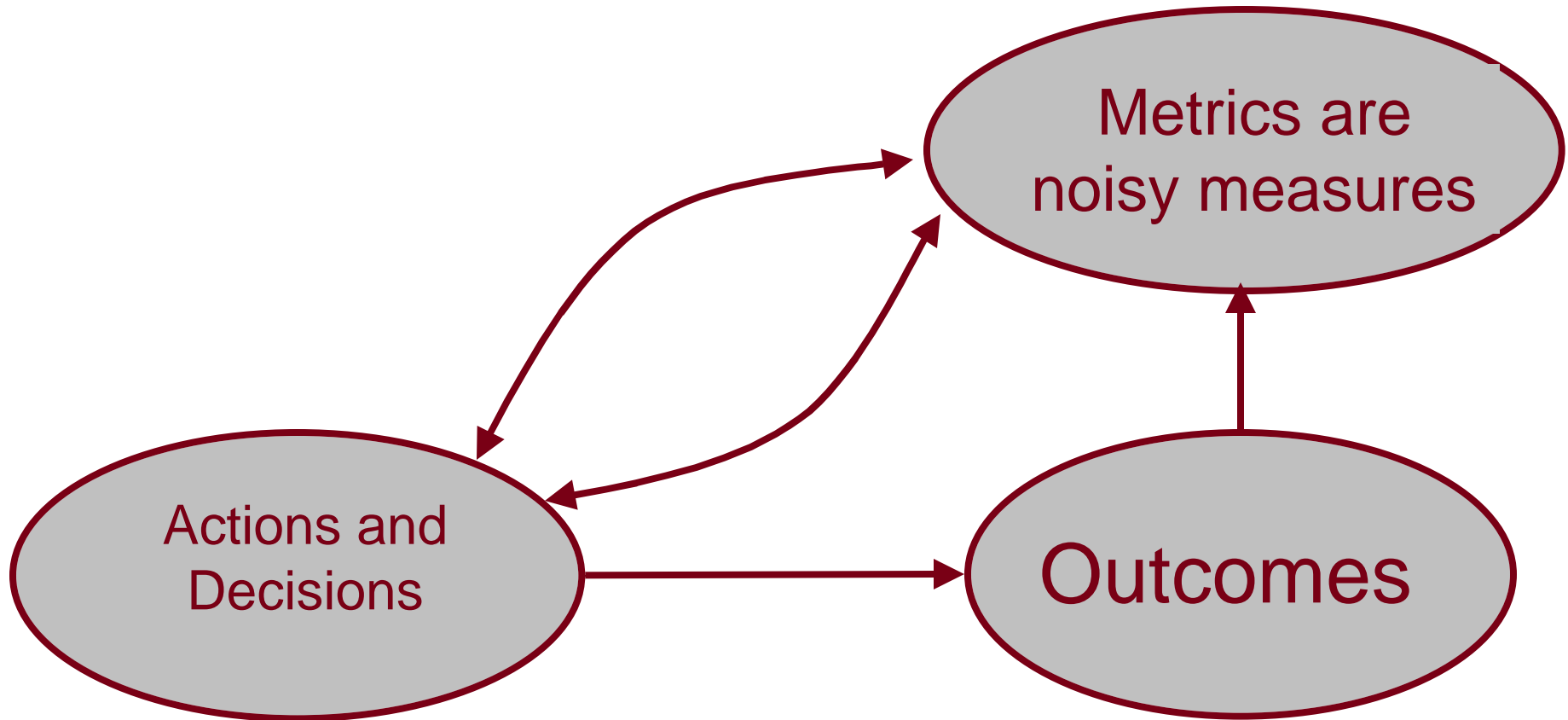
- Start by listening to the customer
- Understand the job
- Understand the interrelationships
- Understand the linkages
- Test the correlations and manager, employee reaction
- Involve managers and employees
- Seek new paradigms



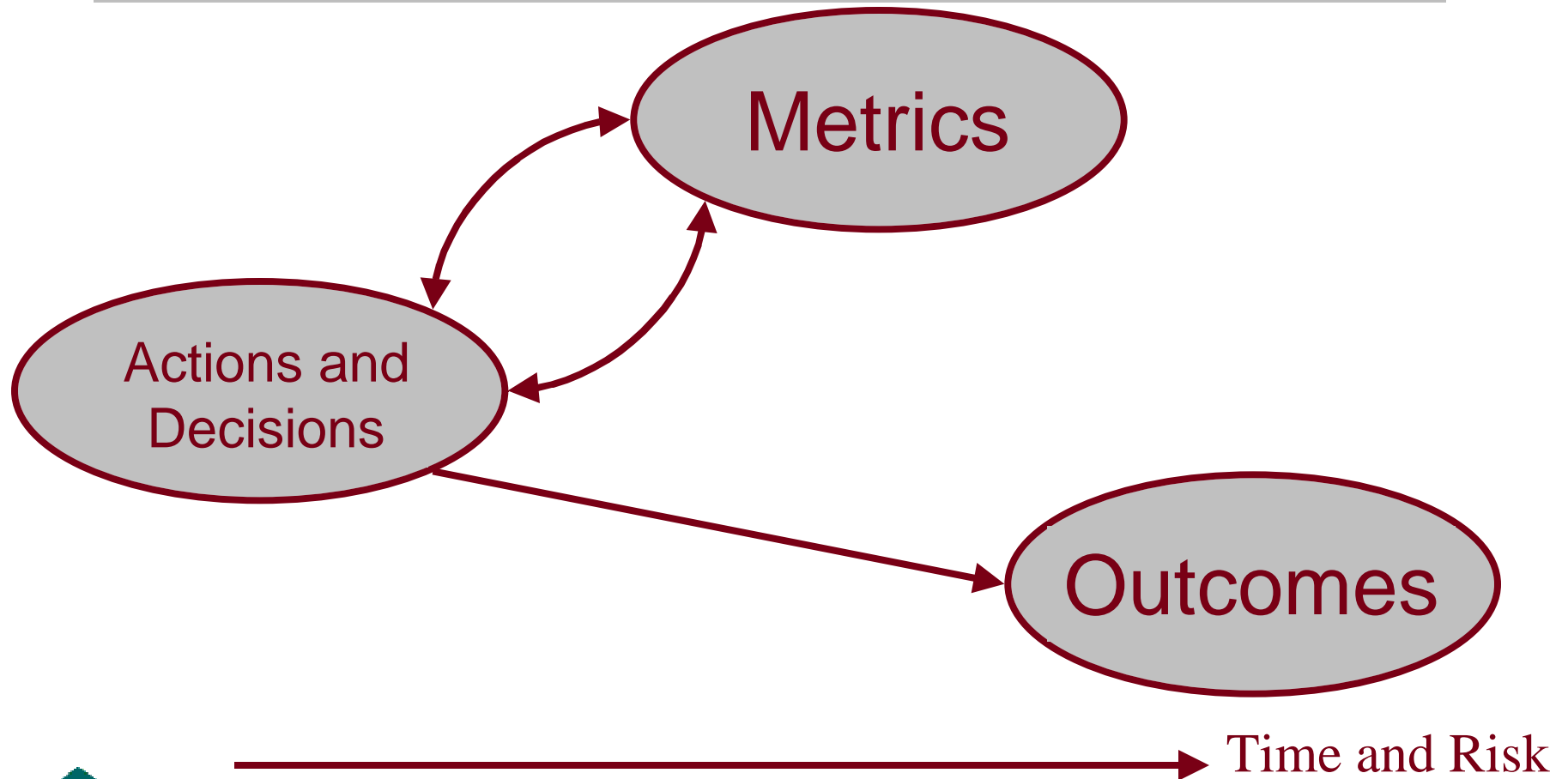
*MIT Center for Innovation in
Product Development*



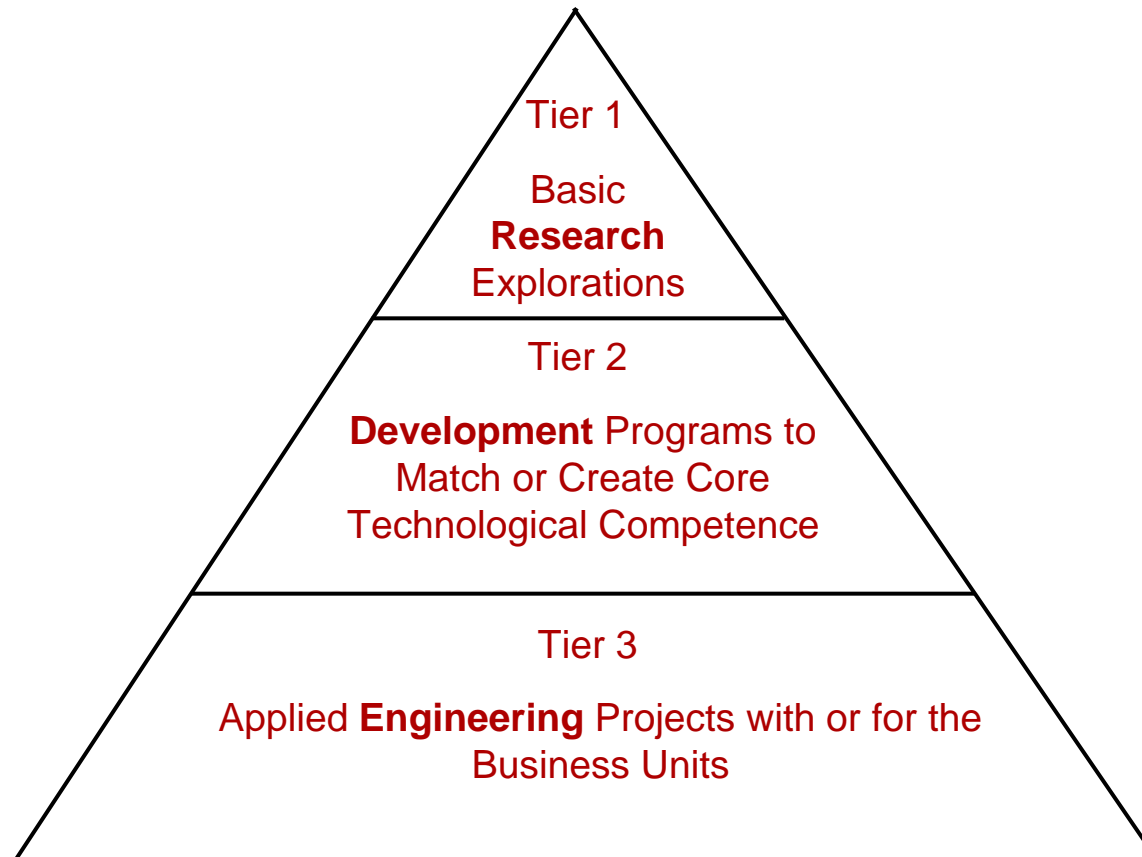
Qualitative ideas: Classical agency theory



Qualitative ideas: You are what you measure!



R,D&E metrics: A tier metaphor



*MIT Center for Innovation in
Product Development*



R,D&E metrics: Tier 3, applied engineering

- Firms use output metrics, but subsidize projects from central coffers
- Theory shows that subsidy adjusts for
 - risk
 - time preference
 - concentration of scope
- Option values (e.g., Black-Scholes)



R,D&E metrics: Tier 2, development

- Outcome metrics lead to severe false rejection (selection) of projects [*risk, time*]
- Once a project is selected, effort metrics (publications, etc.) are important motivators
- Optimal balance is
 - large weight on effort metrics
 - small weight on outcome metrics



R,D&E metrics: Tier 1, long-term research

- Extant systems emphasize identifying and rewarding idea generators
- “Not-invented-here” is a direct result of the metric system
- Many firms are beginning to reward “research tourism”



Lean metrics initiative: Draper Laboratories

Program	Management Score	Metric Score
Micromech. Sensors	45.0	42.3
Intelligent Sonobuoys	26.4	29.7
Program 3	24.3	25.9
Program 4	22.9	23.5
Program 5	27.9	27.6
Program 6	22.1	22.6
Program 7	26.4	22.9
Program 8	32.9	28.2

Correlation = 0.934



*MIT Center for Innovation in
Product Development*



Draper's metrics categories

- Personnel capabilities
- Technical capabilities
- Strategic fit
- Project management performance
- Match to customer needs
- Financial outcomes



*MIT Center for Innovation in
Product Development*



Tutorial review: Some concepts of agency theory

- Teams preference functions
 - rewards (risk and time discounts)
 - perceived costs of efforts
 - gaming
- Labor market (participation constraint)
- Incremental efforts, wages, profits



Tutorial review: Solution methods of agency theory

- Given the reward system, the team maximizes its own well-being.
- Firm chooses the reward system recognizing:
 - how the reward system affects the team
 - subject to labor market constraints



Tutorial review: It ain't all money!

Attribute	Raters	Ratees
Respect	\$13,700	\$2,900
Expectations	\$4,800	\$ 600
Special skills	\$2,200	\$1,300
Forego Assignments	\$2,600	\$5,700

Sample Size

61 managers

60 employees



*MIT Center for Innovation in
Product Development*



Engineering agency theory: Some issues

- PD teams rather than individuals
- Practically, the firm set priorities that apply to classes of projects
- Leverage varies project to project and is a hard-to-observe random variable
- Practical measures are necessary



Field research at Xerox (data on 20 projects)

Metric categories

- Understanding market and customers (4)
- Product designed for market needs (4)
- Relationship to other products (6)
- Rigor of design process (5)
- Appropriate technology selection (5)
- Coordination and communication (7)
- Relationships with suppliers, partners (7)
- Time to market
- Customer satisfaction

Covariates

- Product fits Xerox (3)
- Size of strategic opportunity (2)
- Size of financial opportunity (5)
- Resources available (3)
- Coordination difficulty of team (4)

Outcomes

- Actual profit in US
- Actual profit in Europe
- Judged overall success
- Profit later (estimates)



Status

- Pilot at Xerox (almost complete)
 - Metrics, covariates, outcomes
 - RDF, precision, judged importance
- Pilots beginning at Ford
- Instrumentation of variables (real challenge)
- Non-monetary compensation (web-based measures, efficient transfers)

1998-1999



*MIT Center for Innovation in
Product Development*

