Value-Centered R&D

William B. Rouse

January 14, 2013
Overview

• Value Philosophy
• Principles for Value-Centered R&D
  – Characterizing Value
  – Assessing Value
  – Managing Value
• Organizational (Re)Design
• Observations
Value Philosophy

- Value focuses on organizational outputs (or outcomes), rather than inputs.
- Value relates to benefits of outcomes, rather than outcomes themselves.
- Value implies relevant, usable, and useful outcomes.
Characterizing Value

1) Value is created in R&D organizations by providing “technology options” for meeting contingent needs of the enterprise.

2) R&D organizations provide a primary means for enterprises to manage uncertainty by generating options for addressing contingent needs.

3) A central challenge for R&D organizations is to create a portfolio of viable options; whether or not options are exercised is an enterprise challenge.
### Example Option-Based Valuations of Technology Investments

<table>
<thead>
<tr>
<th>Technology</th>
<th>Option Purchase</th>
<th>Option Exercise</th>
<th>Net Option Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft (manufacturing)</td>
<td>R&amp;D</td>
<td>Deploy Improvements</td>
<td>8</td>
</tr>
<tr>
<td>Aircraft (unmanned)</td>
<td>R&amp;D</td>
<td>Deploy System</td>
<td>137</td>
</tr>
<tr>
<td>Auto Radar</td>
<td>Run Business</td>
<td>Expand Offerings</td>
<td>133</td>
</tr>
<tr>
<td>Batteries (lithium ion)</td>
<td>R&amp;D</td>
<td>License Technology</td>
<td>215</td>
</tr>
<tr>
<td>Batteries (lithium polymer)</td>
<td>R&amp;D</td>
<td>Acquire Capacity</td>
<td>552</td>
</tr>
<tr>
<td>Optical Multiplexers</td>
<td>R&amp;D</td>
<td>Expand Capacity</td>
<td>488</td>
</tr>
<tr>
<td>Optical Switches</td>
<td>Run Business</td>
<td>Expand Offerings</td>
<td>619</td>
</tr>
<tr>
<td>Security Software</td>
<td>Run Business</td>
<td>Add Market Channels</td>
<td>267</td>
</tr>
<tr>
<td>Semiconductors (amplifiers)</td>
<td>Invest in Capacity</td>
<td>Expand Offerings</td>
<td>431</td>
</tr>
<tr>
<td>Semiconductors (graphics)</td>
<td>R&amp;D</td>
<td>Initiate Offering</td>
<td>99</td>
</tr>
<tr>
<td>Semiconductors (memory)</td>
<td>R&amp;D</td>
<td>Initiate Offering</td>
<td>546</td>
</tr>
<tr>
<td>Wireless LAN</td>
<td>Run Business</td>
<td>R&amp;D</td>
<td>191</td>
</tr>
</tbody>
</table>

**Total Net Option Value = $4.2 Billion**
4) Value streams, or value networks, provide a means for representing value flow and assessing the value of options created.

5) Valuation of R&D investments can be addressed by assessing the value of the options created in the value network.
Example Value Network
PROJECTING VALUE FLOW

• Projections based on baseline on market penetration and product life cycles
• Projections based on organizational simulations of healthcare delivery
• Projections based on user behaviors in interactive online games
Financial Information for Advanced Microp...
Ecosystem Level

Payment
- Capitated: 0.25
- Pay for Outcome: 0.75
- Capitated Payment: $300
- 400
- $3,000
- Healthcare Inflation Rate: 0%
- 7
- 20%
- Economy Inflation Rate: 0%
- 2
- Discount Rate: 0%
- 3
- 20%
- Cost Model:
  - ADA/AHA
  - Emory
- Termination Age:
  - 65
  - 80

Organization Level

Risk Threshold*** (8-year risk of DM)
- 0
- 0.25
- 0.5
- % Risk Reduction (Annual):
- 0%
- 55%
- 100%
- Program Length (per participant):
  - 1yr
  - 3
  - 10yrs
- Participant Growth (Annual):
  - 0%
  - 10%
  - 10%
- CAD/CHD** (10-year risk of CAD/CHD)
- 0
- 0.25
- 0.5
- % Risk Reduction (Annual):
- 0%
- 45%
- 100%
- Entering Age:
  - 25
  - 45
- Full Assessment Cost:
  - $300
  - $1000

* DM = Diabetes Mellitus
** CAD = Coronary Artery Disease, CHD = Coronary Heart Disease
*** If a participant’s risk is higher than the specified risk threshold, he/she will be classified as a high-risk participant.
HealthAdvisor

INFORMATION
REGISTRATION

EXIT
WAITING
ROOM
OFFICE

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CENTER FOR COMPLEX SYSTEMS AND ENTERPRISES
Multi-Stage R&D Management

- Multi-Stage Value Stream
- *R&D World* Organizational Simulation
- Multi-Attribute Decision Model
Multi-Stage Value Stream

Ideation & Concept Paper

Initial Project Decision

Exploratory Development Decision

Advanced Development Decision

Technology Transition Decision

Technology Transition & Innovation
**R&D World** for Forest Products

For 16 very reasonable allocation decision policies, profits range from ($254,000,000) to $1,720,616,000.

<table>
<thead>
<tr>
<th>Valuation</th>
<th>Volatility</th>
<th>Budget Allocation Across Stages</th>
<th>Delay Factor</th>
<th>Total Deployed Value</th>
<th># Proj</th>
<th>Total Expend.</th>
<th>Profit (TDV-TE)</th>
<th>Yield (TDV/TE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage-Gate</td>
<td>0.60</td>
<td>0.115 0.195 0.494 0.196</td>
<td>0.10 0.10</td>
<td>$1,788,389 232</td>
<td>$703,993</td>
<td>$1,084,396 2.54</td>
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<td></td>
</tr>
<tr>
<td>NPV</td>
<td>0.60</td>
<td>0.115 0.195 0.494 0.196</td>
<td>0.10 0.10</td>
<td>1,861,890 218</td>
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<td>1,194,091 2.79</td>
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<td>Options</td>
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<td>0.115 0.195 0.494 0.196</td>
<td>0.10 0.10</td>
<td>1,815,999 201</td>
<td>659,004</td>
<td>1,156,995 2.76</td>
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<tr>
<td>NPV</td>
<td>0.60</td>
<td>0.150 0.220 0.469 0.161</td>
<td>0.10 0.10</td>
<td>1,878,079 209</td>
<td>747,365</td>
<td>1,130,714 2.51</td>
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<tr>
<td>Stage-Gate</td>
<td>0.60</td>
<td>0.115 0.195 0.494 0.196</td>
<td>0.10 0.10</td>
<td>1,788,389 232</td>
<td>$703,993</td>
<td>$1,084,396 2.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage-Gate</td>
<td>0.60</td>
<td>0.200 0.400 0.300 0.100</td>
<td>0.10 0.10</td>
<td>1,394,330 114</td>
<td>695,761</td>
<td>698,569 2.00</td>
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<tr>
<td>Options</td>
<td>1.00</td>
<td>0.300 0.150 0.250 0.300</td>
<td>0.90 0.80</td>
<td>2,134,936 128</td>
<td>586,120</td>
<td>1,548,816 3.64</td>
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<tr>
<td>NPV</td>
<td>0.10</td>
<td>0.200 0.200 0.350 0.250</td>
<td>0.10 0.10</td>
<td>1,439,508 186</td>
<td>679,621</td>
<td>759,887 2.12</td>
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</tr>
<tr>
<td>Options</td>
<td>1.00</td>
<td>0.200 0.200 0.350 0.250</td>
<td>0.10 0.10</td>
<td>2,378,322 156</td>
<td>657,506</td>
<td>1,720,816 3.62</td>
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<tr>
<td>Stage-Gate</td>
<td>1.00</td>
<td>0.100 0.400 0.400 0.100</td>
<td>1.00 0.10</td>
<td>1,555,939 138</td>
<td>582,051</td>
<td>973,888 2.67</td>
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<tr>
<td>Options</td>
<td>0.90</td>
<td>0.400 0.400 0.050 0.150</td>
<td>0.50 0.70</td>
<td>353,437 22</td>
<td>607,469</td>
<td>(254,032) 0.58</td>
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<td></td>
</tr>
</tbody>
</table>
# Multi-Attribute Model

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic Fit</td>
<td>NA</td>
<td>Possible</td>
<td>Definite</td>
<td>Priority</td>
<td>Programmed</td>
<td></td>
</tr>
<tr>
<td>Payoff</td>
<td>NA</td>
<td>Imaginable</td>
<td>Articulated</td>
<td>Projected</td>
<td>Demonstrated</td>
<td></td>
</tr>
<tr>
<td>Schedule</td>
<td>NA</td>
<td>One-year deliverables</td>
<td>Multi-year sequence of deliverables</td>
<td>Multi-year sequence of demonstrations</td>
<td>Technology transition plan</td>
<td></td>
</tr>
<tr>
<td>Resources</td>
<td>No budget</td>
<td>Discretionary budget available</td>
<td>Budget scoped appropriately</td>
<td>Costs/benefits projected</td>
<td>Costs/benefits assessed</td>
<td></td>
</tr>
<tr>
<td>Technical Risk</td>
<td>NA</td>
<td>NA</td>
<td>Anticipated</td>
<td>Managed</td>
<td>Minimized</td>
<td></td>
</tr>
<tr>
<td>Application Risk</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Anticipated</td>
<td>Managed</td>
<td></td>
</tr>
<tr>
<td>Personnel</td>
<td>Interest &amp; commitment</td>
<td>Commitment &amp; credibility</td>
<td>Commitment &amp; credibility</td>
<td>Credibility &amp; availability</td>
<td>Credibility &amp; availability</td>
<td></td>
</tr>
<tr>
<td>Competencies</td>
<td>Desirable &amp; obtainable</td>
<td>Desirable &amp; developing</td>
<td>Available internally &amp; externally</td>
<td>Available internally &amp; externally</td>
<td>Demonstrated &amp; available</td>
<td></td>
</tr>
</tbody>
</table>
Managing Value

6) Decision making processes -- governance -- are central in managing the flow of value.

7) Organizational structure affects value flow, with significant differences between hierarchical vs. heterarchical structures.

8) Individual and team affiliations and identities affect value flow; dovetailing processes with disciplines is essential.
9) Champions play important, yet subtle, roles in value flow; supporting champions is necessary but not sufficient for success.

10) Incentives and rewards affect value flow; aligning these systems with value maximization is critical.
## Organizational (Re)Design

<table>
<thead>
<tr>
<th>Principle</th>
<th>Key Concept</th>
<th>“As Is”</th>
<th>“To Be”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Technology Options</td>
<td>Strengths, Weaknesses &amp; Deficiencies</td>
<td>Programs to Remediate Deficiencies</td>
</tr>
<tr>
<td>2</td>
<td>Uncertainty Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Portfolio of Options</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Value Stream/Networks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Option-Based Valuation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Decision Making Processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Organizational Structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Individuals &amp; Teams</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Champions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Incentives &amp; Rewards</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Observations Related to Healthcare Delivery

• There is an inherent conflict between payers and providers, especially when one organization pays and another organization receives the benefits.

• Alternative payment mechanisms -- fee for service, capitation, pay for outcomes – have enormous implications for how best to organize delivery.

• Appropriate framing of “the system” is critical to understanding sources of problems and improving outcomes – what seem to be exogenous variables may be sources of great leverage.
Summary

• Value Philosophy
• Principles for Value-Centered R&D
  – Characterizing Value
  – Assessing Value
  – Managing Value
• Organizational (Re)Design
• Observations