

Multiple Criteria Analysis for Evaluation of Information System Risk

David L. Olson

University of Nebraska

Desheng Wu

University of Toronto

Information Systems Risk

- **Physical**
 - Flood, fire, etc.
- **Intrusion**
 - Hackers, malicious invasion, disgruntled employees
- **Function**
 - Inaccurate data
 - Not providing needed data
- **ERM contributions**
 - More anticipatory; Focus on potential risks, solutions
 - COSO process framework

IT & ERM

- Enterprise Risk Management
 - IT perspectives
 - Enterprise Risk Management, Olson & Wu, World Scientific (2008)
 - New Frontiers in Enterprise Risk Management, Olson & Wu, eds. (contributions from 27 others)
 - Includes three addressing IT
 - » Sarbanes-Oxley impact – Chang, Choy, Cooper, Lin
 - » IT outsourcing evaluation – Cao & Leggio
 - » IT outsourcing risk in China – Wu, Olson, Wu
 - Enterprise Systems a major IT focus

History of ERP

- Extension of **materials resource planning, accounting**
- **Integrate** a firm's computing for reporting, planning, & control – common architecture
 - Multifunctional, Integrated, Modular
- In 1990 industry about \$1 billion
 - SAP, Baan, PeopleSoft, JDEdwards, Oracle, others
- Rapid growth in late 1990s
 - Some relation to Y2K fears, but not the main reason
- Mergers in early 2000s
 - Peoplesoft bought JDEdwards;
 - Oracle bought Peoplesoft



History of ERP

- **SAP**: All-comprehensive in theory, apply **best-practices**
 - Very **intrusive**, very **expensive**, require massive changes in operations
 - **If changes a core business competency, don't;**
- While theory centralized, many implementations modular
 - **PeopleSoft** – human resources
 - Finance & Accounting a common first module



Reasons for Implementing ERP

measured on 1-5 scale (5 best)

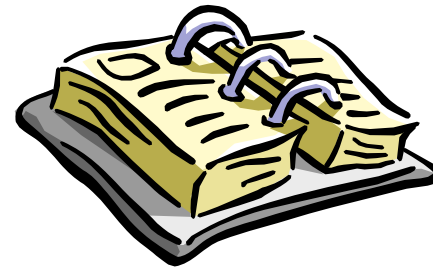
Mabert, Soni & Venkataramanan, *Production Inventory Management Journal* 41:20, (2000) 52-58

<i>Most important</i>	Avg	Small	Large	Sig.
Replace legacy systems	4.06	87%	90%	
Simplify & standardize	3.85	72%	95%	***
Improve interactions-suppliers & customers	3.55	71%	76%	
Gain strategic advantage	3.46	70%	92%	**

Implementation Time Required

Mabert et al. (2000)

- 6 months or less 9%
- 7 to 12 months 25%
- 13 to 18 months 24%
- 19 to 24 months 21%
- 25 to 36 months 11%
- 37 to 48 months 6%
- Over 48 months 2%



Rate of technology change makes 18 month IT projects dubious

although ERP a major system, longer times appropriate

System Cost

Mabert et al. (2000)

		≈ 6% annual revenue (less for larger; up to 50% for smaller)
<\$5 million	42.3%	<\$50 mill revenue
\$5 to \$25 mill	33.0%	\$251 to \$750 mill revenue
\$26 to \$50 mill	10.4%	Widespread
\$51 to \$100 mill	7.2%	\$1.5 bill to \$5 bill revenue
>\$100 million	7.1%	Over \$5 billion revenue

Cost Component

% of total implementation

Mabert et al. (2000)

	Survey	Interviews	Range	Small	Large
Software	30.2%	15%	10% to 20%	35%	23%
Consulting	24.1%	30%	20% to 60%	24%	25%
Hardware	17.8%	25%	0% to 50%	21%	14%
Impl. Team	13.6%	15%	5% to 20%	11%	23%
Training	10.9%	15%	10% to 20%	10%	12%

Cost Impact

Mabert et al. (2000)

- Also affects operations
 - Intent was to lower operations cost
 - Initially, often the reverse
- Often use data warehouse system
 - Very efficient data storage
 - Very expensive

Alternative ERP Options

Olson [2007]

FORM	ADVANTAGES	DISADVANTAGES
In-house	Organizational fit	Most difficult, most expensive, slowest
In-house+vendor	Blend proven features with organizational fit	Difficult to develop, Slow, costly
Best-of-Breed	Theoretically ideal	Hard to link, slow
Customize Vendor system	Proven features modified to fit organization	Slower, usually more expensive
Select Vendor modules	Less risk, fast, less cost	Expansion inefficient, leading to greater cost
Full vendor system	Fast, efficient	Inflexible
ASP	Fastest, least implementation risk	High risk of ASP failure

Outsourcing Risk

Bryson & Sullivan, *Business Process Management Journal* 9:6,
(2003), 705-721

Benefits of Outsourcing	Problems with Outsourcing
Can access well-developed software at very low rates	Low rates may easily rise if successful
Opportunities to gain market share	Risk of ASP bankruptcy
Aid cash flow	ASP vulnerable to attacks such as hacking
Can let ASP take on the risk of vendor upgrading	

ERP System Risk Assessment

McCarthy, *Financial Executive* 17:4 (2001), 45-48

- Total life cycle costs
 - Software upgrades (including hardware impact)
 - Integration, implementation, testing, maintenance
 - Providing users functionality, technical support
 - Hardware (servers)
 - Disaster recovery
 - Electrical service (including building modifications)
 - STAFFING

Multiple Criteria Analysis

measure value v_j of alternative j

- identify **what is important** (hierarchy)
- identify **RELATIVE** importance (weights w_k)
- identify **how well each alternative does** on each criterion (score s_{jk})

- can be linear

$$v_j = \sum w_k s_{jk}$$

- or nonlinear

$$v_j = \{\prod(1 + Kk_j s_{jk}) - 1\}/K$$

Total Costs of Alternatives

	Vendor A	A custom	Vendor B	Vendor C	Best-of-B	ASP
Software	15	13	12	2	16	3
Consultants	6	8	9	2	12	1
Hardware	6	6	6	4	6	0
Implement	5	10	6	4	9	2
Train	8	2	9	3	11	8
TOTAL COST	40	39	42	15	54	14

Relative Scores by Criteria

could be objectively, subjectively based

	Vendor A	A custom	Vendor B	Vendor C	Best-of-B	ASP
Customer service	0.6	1	0.9	0.5	0.7	0.3
Reliability availability scalability	1	0.8	0.9	0.5	0.4	0
Integration	0.8	0.9	1	0.6	0.3	0.3
Cost	0.6	0.7	0.5	0.9	0.2	1
Security	1	0.9	0.7	0.8	0.6	0
Service level	0.8	0.7	1	0.6	0.2	1
Image	0.9	0.7	0.8	0.5	1	0.2

Worst & Best Measures by Criteria

Criteria	Worst Measure	Best Measure
Customer service	0.3 – ASP	1 – A customized
Reliability, availability, scalability	0 – ASP	1 – Vendor A
Integration	0.3 – B-of-B, ASP	1 – Vendor B
Cost	0.2 – B-of-B	1 – ASP
Security	0 – ASP	1 – Vendor A
Service level	0.2 – B-of-B	1 – Vendor B, ASP
Image	0.2 - ASP	1 – B-of-B

Criterion Weight Development

First sort; Second give best 100; Third give worst 10

Criteria	Based on Best		Based on Worst		Compromise
Customer service	100 / 268	0.373	300 / 820	0.366	0.37
Reliability Availability Scalability	80 / 268	0.299	250 / 820	0.305	0.30
Integration	50 / 268	0.187	150 / 820	0.183	0.19
Cost	20 / 268	0.075	60 / 820	0.073	0.07
Security	10 / 268	0.037	30 / 820	0.037	0.04
Service level	5 / 268	0.019	20 / 820	0.024	0.02
Image	3 / 268	0.011	10 / 820	0.012	0.01

Value Calculation

Criteria	Wgt	Vendor A	A custom	Vendor B	Vendor C	Best-of-B	ASP
Customer service	0.37	× 0.6 = 0.222	× 1 = 0.370	× 0.9 = 0.333	× 0.5 = 0.185	× 0.7 = 0.259	× 0.3 = 0.111
Reliability avail.scal.	0.30	× 1 = 0.300	× 0.8 = 0.240	× 0.9 = 0.270	× 0.5 = 0.150	× 0.4 = 0.120	× 0 = 0.000
Integration	0.19	× 0.8 = 0.152	× 0.9 = 0.171	× 1 = 0.190	× 0.6 = 0.114	× 0.3 = 0.057	× 0.3 = 0.057
Cost	0.07	× 0.6 = 0.042	× 0.7 = 0.049	× 0.5 = 0.035	× 0.9 = 0.063	× 0.2 = 0.014	× 1 = 0.070
Security	0.04	× 1 = 0.040	× 0.9 = 0.036	× 0.7 = 0.028	× 0.8 = 0.032	× 0.6 = 0.024	× 0 = 0.000
Service level	0.02	× 0.8 = 0.016	× 0.7 = 0.014	× 1 = 0.002	× 0.6 = 0.012	× 0.2 = 0.004	× 1 = 0.020
Image	0.01	× 0.9 = 0.009	× 0.7 = 0.007	× 0.8 = 0.008	× 0.5 = 0.005	× 1 = 0.010	× 0.2 = 0.002
TOTALS	1.00	0.781	0.887	0.866	0.561	0.488	0.260

Conclusions

- ERM has become a paramount topic
- IT risk is important
 - ERP is the most costly, recently most common form of IT
- We have reviewed some of the salient risks
 - In IT
 - In ERP
- Reviewed a methodology to select among options