

# Optimizing Enterprise-Wide Capital Resource Allocation in Hospitals and Health Systems

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# Presentation Overview

- About Strata Decision Technology
- Capital budgeting in hospitals and healthcare systems
- Tools for supporting capital allocation
  - Multiobjective decision analysis
  - Optimization
- Implementation challenges, solutions, and outcomes

# Strata Decision Technology LLC



- Founded 1996 by Catherine Kleinmuntz and Don Kleinmuntz
- Software for better strategic planning and financial decision making
- Market leader among not-for-profit hospital providers
  - Around 1,000 hospitals
  - More than 1,400 healthcare businesses of all types

# Strata Decision Technology LLC



- Champaign Office
  - Located in University of Illinois Research Park
  - $\frac{1}{3}$  of staff
    - Corporate Administration
    - Marketing
    - Data Center
    - Software R&D
  - 7,500 sf
- Chicago Office
  - Aon Center 49th Floor
  - $\frac{2}{3}$  of staff
    - Consulting & Technical Services
    - Software R&D
    - Training Center (soon)
    - Additional Data Center (soon)
  - 33,000 sf

# Selected Healthcare Customers

- Health Systems [5 to 60 hospitals]
  - Ascension Health (MO)
  - Banner Health (AZ)
  - Bon Secours (MD)
  - Baptist Health (FL)
  - Baptist Memorial (TN)
  - Catholic Health System (NY)
  - Catholic Healthcare West (AZ/CA)
  - CHRISTUS Health (TX)
  - Continuum Health (NY)
  - Henry Ford Health System (MI)
  - Intermountain Health Care (UT)
  - Jefferson Health System (PA)
  - Orlando Regional Healthcare (FL)
  - Parkview Health (IN)
  - Providence Health & Services (WA)
  - Trinity Health (MI)
  - University Hospitals (OH)
- Healthcare Practices at Financial / Professional Service Firms
  - Navigant Consulting
  - Ponder & Co.
  - Ziegler Capital Markets
  - Various regional firms
- Major Medical Centers
  - Children's Hospital of Philadelphia
  - Cleveland Clinic
  - Dartmouth-Hitchcock Alliance
  - Duke U Health System
  - Johns Hopkins Hospital & Health
  - Mt. Sinai School of Med (NY)
  - New York Presbyterian Healthcare System
  - New York U Medical Center
  - Northwestern Memorial (IL)
  - Rush U (IL)
  - SUNY Upstate Medical U
  - Temple U Health System
  - Tufts-New England Medical Center
  - U of Arizona
  - U of California Davis Health System
  - U of Illinois Medical Center
  - U of Iowa
  - U of Tennessee
  - U of Texas Medical Branch
  - U of Virginia
  - U of Wisconsin
  - Yale-New Haven Health

# Products and Services

## Software Product Line

- Capital budgeting & resource allocation
  - StrataCap® (first release: 1997)
- Capital project tracking
  - StrataTrak® (first release: 2000)
- Long-term forecasting and planning
  - StrataCast® (first release: 1999)
- Market demand forecasting & analysis
  - StrataPlan™ (first release: 2006)
- Budgeting, integrated planning, and collaboration
  - StrataJazz™ (first release: 2007)

## Service Offerings

- Software implementation
  - Management consulting
  - Technical consulting
- Technical support
- Application hosting
- Data integration
  - ERP & financial systems
  - Third-party data sources

# “OR Inside”

Application	Techniques
Capital allocation	Optimization, decision analysis
Financial planning & budgeting	Monte Carlo simulation
Market demand forecasting	Data mining, econometrics

- What we tell our customers:
  - Our software uses state-of-the-art information technology and advanced analytics to support better planning and decision making
- What we don't tell our customers:
  - Our software uses “OR”



# Capital Allocation Challenges in Not-for-Profit Hospitals

- Diverse projects and requirements
  - Information technology, medical technology, facility and infrastructure, business development
- Highly constrained capital
  - Financial pressures (shrinking reimbursements, labor shortages, competitive threats, hostile regulators, etc.)
  - Limited access to funds (municipal debt markets)
- Current choices impact future opportunities
  - Bad decisions divert scarce funds now and drain more resources



# What Did Administrators Say About Their Capital Budgeting Process?

- It is too difficult to plan for the long term...things are changing too quickly
- Planning takes too long and uses too much staff time
- Senior management lacks the information they need
- After the fact, no one understands how or why the decisions got made.
- No one feels good about the outcomes.
- All too often, the process is contentious.

*(Apart from all that, it is fine...)*

# Capital Allocation in Hospitals

- Performing sound financial analysis is harder than it looks
  - Too many projects to analyze each in depth
  - Difficulties getting reliable information on project costs and impact on revenues and expenses
- Discounted cash flow analysis is only PART of the story...Impact on:
  - Quality?
  - Customer satisfaction?
  - Organizational capabilities (staffing, infrastructure)?
  - Strategic market position?
  - Critical mission-related strategies?

# Multiobjective Analysis & Portfolio Selection

- Process focused on multiple objectives:
  - Financial value
  - Long-run drivers of financial value
  - Mission-related objectives
- Process is focused on selecting the best portfolio of projects in light of ALL objectives

# Multi-Criteria Evaluation Process

- Score proposals for benefits on specific criteria
  - Financial criteria assessed by finance staff
  - Top-level management group scores proposals on individual criteria
- Assess importance weights for criteria
  - CEO only, Executive Committee, or others
- Compute weighted additive value scores
  - Combine weights and scaled project scores

$$B_i = \sum_i w_i \cdot v_i(s_i)$$

# Capital Evaluation Attributes: “Standard” Definitions

<i>Objective</i>	<i>Attribute</i>	<i>Definition</i>
Financial	NPV	Net present value of projected future cash flows (dollars)
Quality	Clinical Impact	Improves clinical experience in terms of health outcomes, patient safety, waiting times, throughput times, and general comfort (rating from 0 to 100)
	Infrastructure	Improves or maintains quality of hospital, outside facilities, and equipment, including expenditures to comply with safety, code, and accreditation standards (rating from 0 to 100)
	Staff/Physician Relationships	Improves ability of employees and medical staff to work effectively and productively (rating from 0 to 100)
Strategy	Market Share	Enhances market share by increasing the number of patients seen and/or increasing ability to attract new patients (rating from 0 to 100)

# Project Portfolio Selection Methods

- Goal:  
Select projects that provide the highest cumulative benefit, subject to limited budget and other constraints
- Method 1 (fast, simple, easy to explain):
  - Compute Benefit / Cost ratio
  - Sort projects based on “bang for the buck”
- Method 2:
  - Optimization using integer linear programming
  - Easily formulated as a “knapsack” problem

# Optimization

- Project portfolio optimization as a binary integer linear programming problem
  - Objective: Maximize total benefit
  - Constraints:
    - Budget (one or multiple years)
    - Financial performance targets
    - Project exclusivity / dependency
  - Solve using standard optimization tools

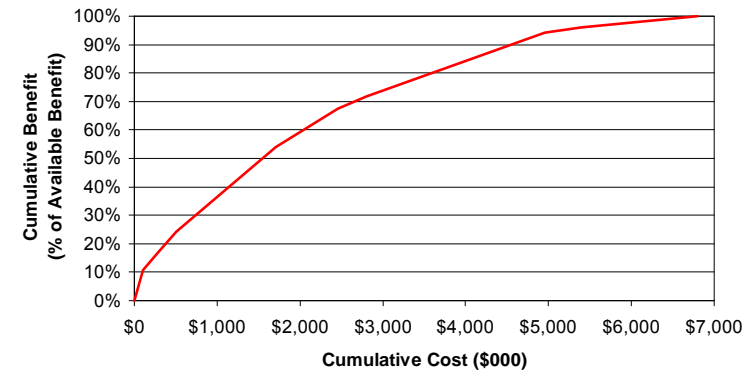


# StrataCap<sup>®</sup> Optimization Output

Analysis		0 Selected					2006 Requested: \$0		Total Requested: \$0		Total NPV: \$0	
Constraints	View	Inc	Non Disc	Appr	Original	Last	Proposal Name	Weighted Average Rating ▼	Quantity	2006 Requested	Total Requested	
<b>Analysis of Capital</b>												
Constraint	2006											
Non-Disc	\$8,900,000											
Approved as Funded	\$2,000,000											
<b>Available for Disc</b>	<b>\$0</b>											
Disc Requests	\$6,900,000											
Disc Funded	\$13,530,278											
<b>Surplus (Shortfall)</b>	<b>\$6,805,938</b>											
<b>Financial Return</b>												
Cost of Capital	5.0%											
Required Return	12.5%											
<b>Actual Return</b>	<b>13.19%</b>											
<b>Total Funded NPV</b>	<b>\$4,901,221</b>											
<input checked="" type="checkbox"/> Enforce Financial Constraint												
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Radiation - Accelerator Linear, COM, IMRT	81.5	1.0	\$2,010,000	\$2,010,000	
2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		MRI, COM	75.5	1.0	\$835,000	\$835,000	
3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Camera Nuclear, COM, Dual Head Nuclear Medicine Camera	69.6	1.0	\$650,000	\$650,000	
4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Camera Nuclear, COM, Nuc. Card Paynesville/JV	53.2	1.0	\$253,000	\$253,000	
5	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Camera Nuclear, COM, Nuclear Service for SCMG	45.6	1.0	\$386,000	\$386,000	
6	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Meter Noninvasive Dose-KV, COM, EECF	42.5	1.0	\$175,000	\$175,000	
7	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Machine Ultrasound, COM, Cardiac Ultrasound	42.2	1.0	\$170,263	\$170,263	
8	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Equipment Dictation, COM, Dictation System Upgrades	39.7	3.0	\$267,100	\$304,300	
9	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Machine Ultrasound, COM, Cardiac Ultrasound Upgrades	39.1	4.0	\$252,800	\$252,800	
10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Scanner CT, COM, 64 Slice - North Wing	38.2	1.0	\$1,785,000	\$1,785,000	
11	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	System Heart Lung, COM, Heart Lung Perfusion System	37.2	1.0	\$109,549	\$218,549	
12	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Analyzer Chemistry, COM	37.0	1.0	\$211,475	\$211,475	
13	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	MRI, COM, 3T Magnet	32.5	1.0	\$1,760,000	\$1,760,000	
14	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Machine Ultrasound, COM, Digital Ultrasound System	31.5	1.0	\$196,300	\$196,300	
15	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	System Imaging Ultrasound, COM, Ultrasound Targeting and Guid	30.2	1.0	\$170,000	\$170,000	
16	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	C-arm Surgical, COM	29.7	1.0	\$159,000	\$159,000	
17	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Monitor System, COM, Video Monitors/Cameras/Telescopes	28.2	1.0	\$266,539	\$266,539	
18	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Construction General, COM, Radiologists Reading Room	27.2	1.0	\$184,500	\$184,500	
19	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	C-arm Surgical, COM, Vascular	27.2	1.0	\$209,000	\$209,000	
20	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Laser, COM, Retinal Surgery Laser	26.3	1.0	\$116,159	\$116,159	
21	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Hardware General, COM, Wireless Network on 6th Avenue	25.9	200.0	\$160,000	\$160,000	
22	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	System Telephone, COM, SpectraLink Phone System	25.3	1.0	\$1,250,000	\$1,250,000	
23	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Server Network, COM	24.7	36.0	\$126,000	\$126,000	
24	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Software General, COM, Lawson eRecruiting Software	21.8	1.0	\$199,000	\$199,000	
25	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Server Network, COM, Disaster Recovery - TeraBeam	21.4	2.0	\$125,000	\$125,000	
26	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Server, COM, NT File Servers	20.9	17.0	\$136,000	\$136,000	
27	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Software General, COM, 1	20.3	1.0	\$257,000	\$257,000	
28	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Unit Mammography, COM, Mobile	17.2	2.0	\$160,000	\$160,000	
29	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Software General, COM, Clinical Documentation	13.1	1.0	\$2,000,000	\$3,900,000	
30	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Construction General, COM, Move Net Result of Neuro-Rehab-Rec	11.9	1.0	\$950,593	\$950,593	

# Sensitivity Analyses

- Impact of adding to budget constraint
- Analyze project alternatives
  - Variations in sizing, timing, financing options
- Reconsider project benefits and/or strategic priorities (weights)
- “Force” project in or out of budget



# Implementation Timeline for Single Hospital

- Advance preparation and communication [1 week]
  - Define goals, objectives, capital request forms, review process
- Training [1 week]
  - How to write and review high-quality requests
- Enter capital requests [4 weeks]
  - Create business plans, justify needs
  - Analyze incremental financial impact on existing operations
- Review and discussion [4 weeks]
  - Senior managers and functional experts review
  - Return for clarification or more information
  - Sign-off prior to evaluation
- Prioritize capital requests [1 day]
  - Executive-level managers, including physician leadership
  - Focused discussion of proposals
  - Score proposals
  - Establish trade-off weights
  - Prioritize requests using optimization tool
  - Arrive at consensus on selected pool

# Improving Implementation: IT to Support Efficient Process

## Ten years later:

- Analytical framework still follows original design
- IT infrastructure has evolved considerably

- Improving proposal quality
  - External links to technology assessment databases
  - Internal review of proposals and projections
- Workflow and communication
  - Integration with Email
  - Integration to other systems (accounting, supply chain)
- More robust evaluation processes
  - Optimization to provide more robust analytical results
  - Budget constraints over multiple years
  - Required financial return targets

# Implementation Challenges: Many Projects

- A typical hospital may have to evaluate and prioritize hundreds of proposed expenditures
- A typical healthcare system must handle thousands of proposed expenditures
- Required: Project management system
  - Database to handle thousands of proposals
  - Workflow management (review, tracking)
  - Collaboration and coordination
  - Budget implementation tracking
- Desirable: Data/system interfaces
  - Interface to accounting & ERP systems
  - Links to external technology assessment data

# Implementation Issue: Many Projects with Negative NPV

- Projects with negative NPV are the norm
  - Designed to achieve other goals (mission)
- For any one project, this is fine
  - But if the aggregate portfolio has negative return...  
**NO MONEY = NO MISSION!**
- Putting more weight on NPV doesn't help!
  - Violation of additivity and preference independence assumptions
- Solutions:
  - Nonlinear optimization (messy!)
  - Introduce minimum financial performance constraint

# Implementation Insurance: Senior Management Involvement

- C-Level support is critical
- CFO, COO, CEO
- Focus on what they want:
  - Improve management discipline
  - Strengthen physician relations
  - Control operating costs
  - Create a strategic focus
  - Build consensus around the final plans



# How Do We Know This Works?

- Continued use:  
Almost every organization that implements the process uses it for three or more years
- Most common feedback:  
Praise for open, collaborative nature of process  
Sense that everyone is “on a level playing field”

“Sitting on a hill, you can see everything clearly...”



# Resources

- Recent book chapter:
  - Kleinmuntz (2007). Resource allocation decisions. In Edwards, Miles, & von Winterfeldt (Eds.), *Advances in Decision Analysis*. Cambridge University Press.
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