

Business Process Expansion to Exploit Optimization Models For Supply Chain Planning

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**The Role of Optimization in Supply Chain Management
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The Overselling of Supply Chain Planning Suites

– 60 Manufacturers Speak Up

AMR Research, August 2001

- **Overselling collaboration, Supply Chain Planning (SCP) product suites fail to deliver on bold promises of synchronizing the supply chain**
- **Users are crediting SCP automation for performance improvement...but overall score of C+ reflects... frustration about long implementation cycles and exaggerated vendor claims**
- **SCP systems deliver results in inventory management and customer service**
- **Success is more dependent on **effective change management** than it is on technology**

Agenda

- **Transactional IT vs. Analytical IT**
- **Constructing the supply chain decision database from an ERP database**
- **Behavioral realities underlying organizational decision-making**
- **Harmonizing exploration and exploitation**
- **Business process expansion for tactical supply chain planning based on optimization models**
- **Conclusions**

**To effectively apply IT
in managing its supply chain,
a company must distinguish
between the form
and function of
Transactional IT
and
Analytical IT**

Transactional IT

Concerned with acquiring, processing and communicating raw data about the company's past and current supply chain operations

e.g., POS systems, general ledger systems, quarterly sales reports, ERP and e-commerce systems

Analytical IT

Concerned with developing and applying systems for evaluating and disseminating decisions based on models constructed from **supply chain decision databases**

e.g., production scheduling systems, forecasting systems, supply chain network optimization systems

Differences between **Transactional IT** and **Analytical IT** can be contrasted across six aspects:

Aspect: Time frame addressed

Transactional IT: Past and present

Analytical IT: Future

Aspect: Purpose

Transactional IT: Reporting

Analytical IT: Forecasting and decision-making

Aspect: Business scope

Transactional IT: Myopic

Analytical IT: Hierarchical and longitudinal

Aspect: Nature of databases

Transactional IT: Raw and lightly transformed objective data

Analytical IT: Raw, moderately and heavily transformed data that is both objective and judgmental

Aspect: Response time for queries

Transactional IT: Real-time

Analytical IT: Real-time and batch processing

Aspect: Implications to business process re-engineering

Transactional IT: Substitute for, or eliminate, inefficient human effort

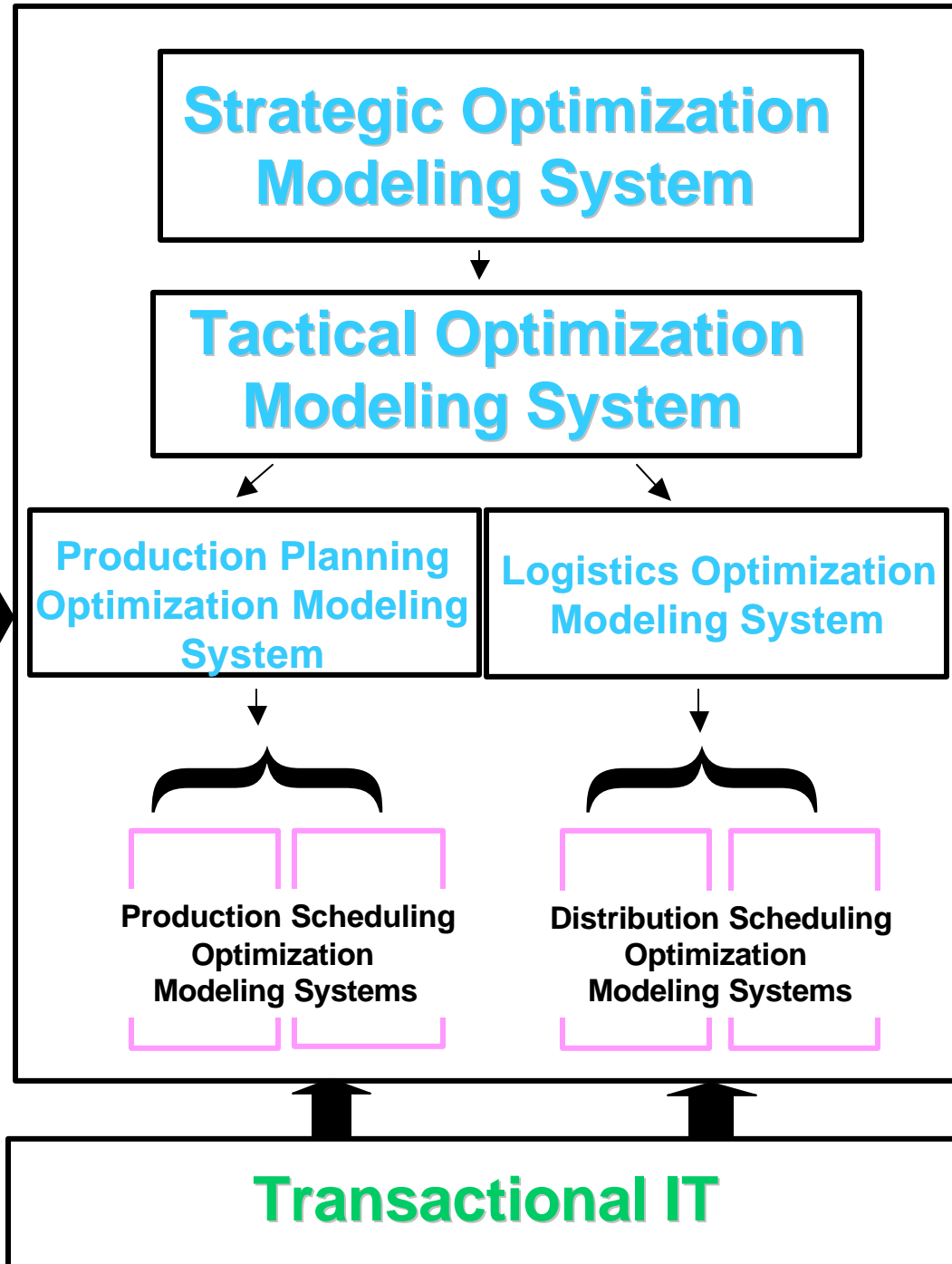
Analytical IT: Improve managerial decision-making

Models for Integrated Supply Chain Management

- **Descriptive modeling** - forecasting, data mining, activity-based costing, performance metrics, simulation, systems dynamics
- **Prescriptive modeling** - optimization models (mathematical programming combined with heuristic methods)

**Supply Chain
Modeling System
Hierarchy
Top-Down View**

**Demand
Forecasting
and Order
Management
System**



Scope

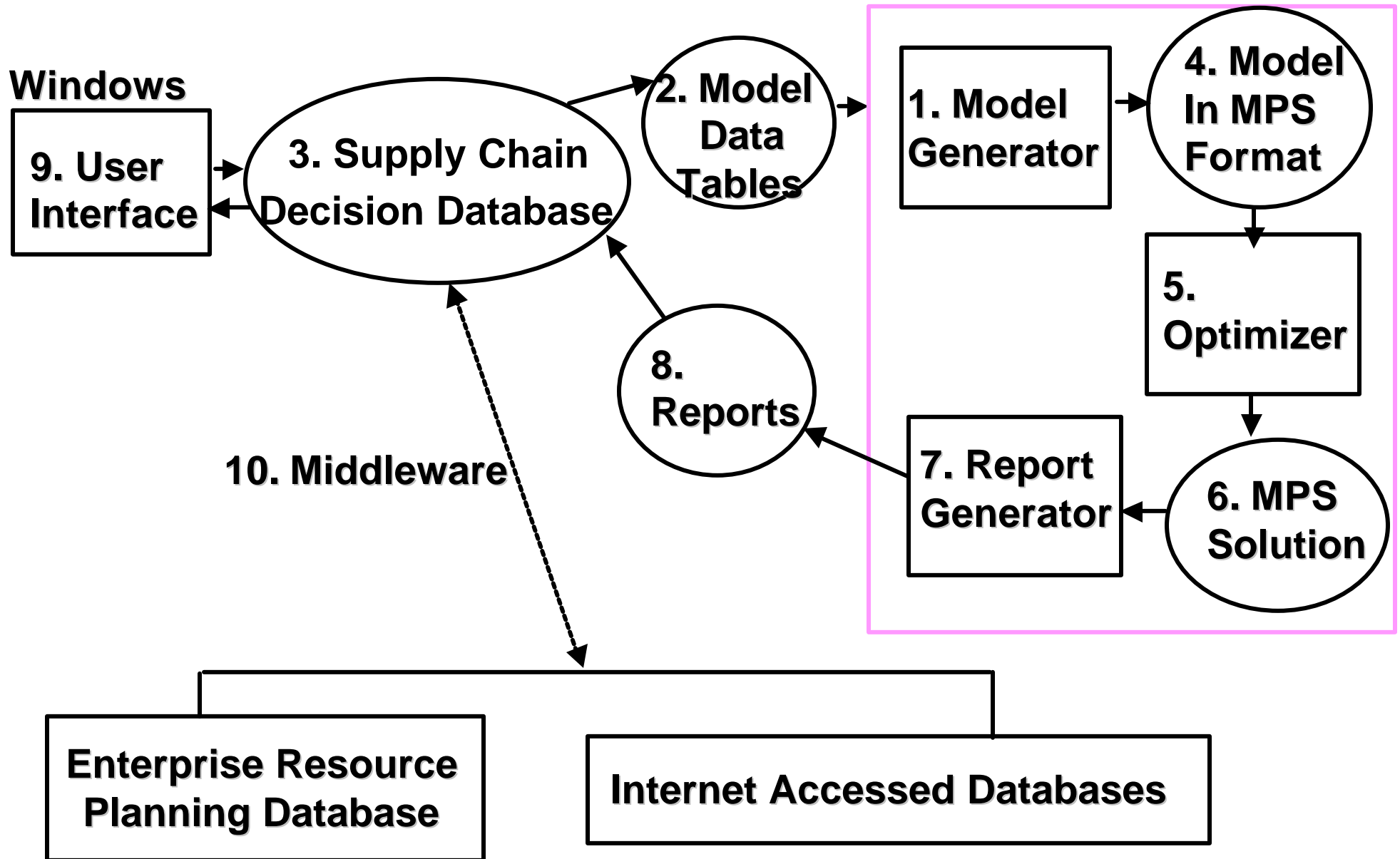
**Strategic
Analysis**

**Long-Term
Tactical
Analysis**

**Short-term
Tactical
Analysis**

**Operational
Analysis**

Transactional IT

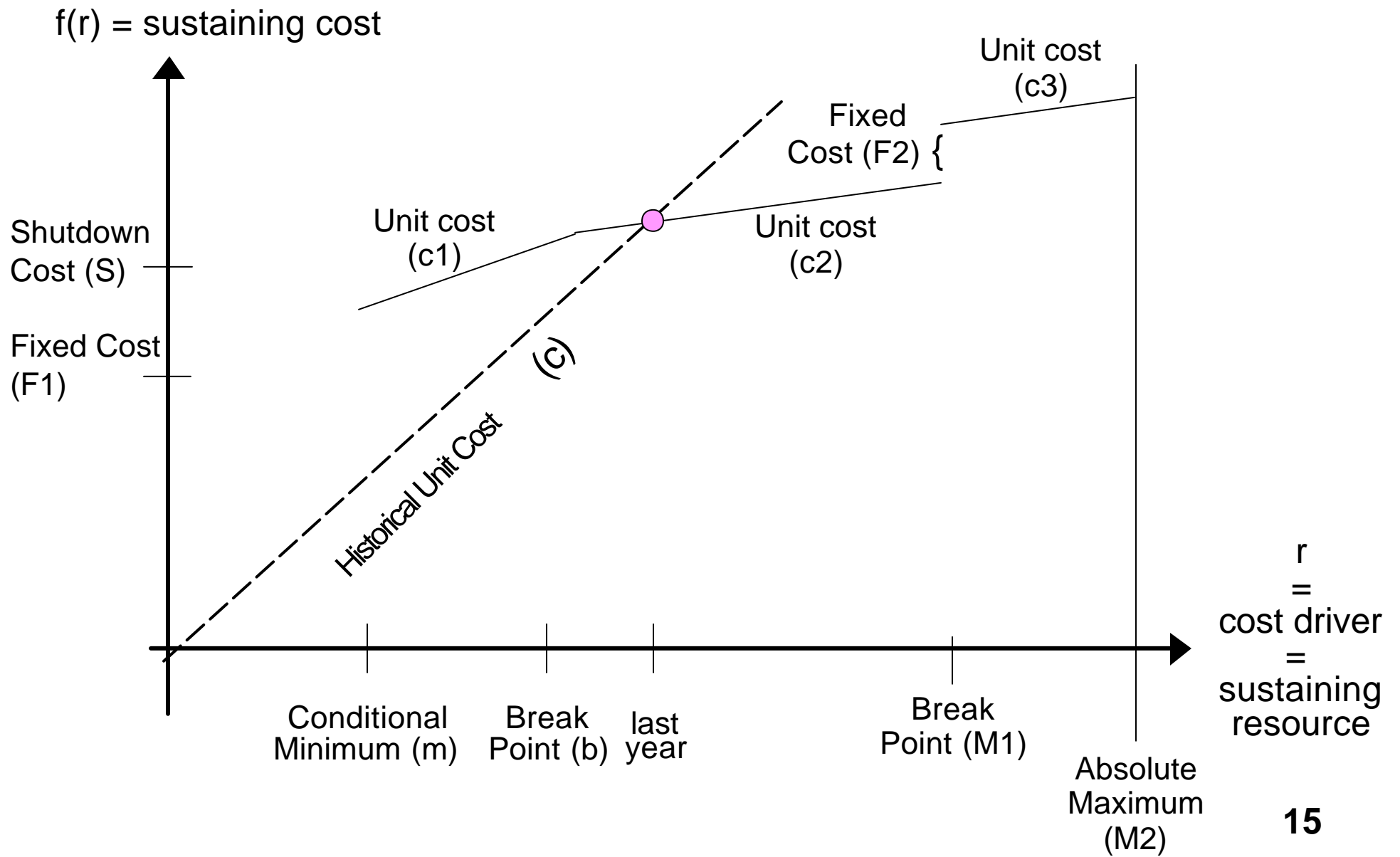


Modeling System Schematic

Supply Chain Decision Database for Strategic and Tactical Planning

- **Derived from, but different than, transactional database**
- **Implied by optimization models**
- **Combines structural and numerical elements**
- **Based on aggregations of product families, customers into markets, vendors into suppliers**

- Contains **managerial accounting** representations of manufacturing and distribution costs
 - Requires **cost relationships**
 - Close links with **activity-based costing** (push/pull relationship with optimization models)
 - Compute **optimal transfer prices**



- Contains **process, recipe** and **resource** descriptions of manufacturing and distribution activities at facilities
- Contains approximate **inventory cost** relationships
- Contains extensive databases describing **transportation networks** (inbound, inter-facility, out-bound)
 - Rates, distances, capacities, modes, customer service limitations
- Contains **demand data** for finished products (suitably aggregated) extracted from order entry system and/or forecasting model

- Contains **business policy** data
- Integrates input data with output (optimization) results to compute **performance metrics**
- Linked to GIS for **graphical mapping** displays of supply chain inputs and strategies
- Multiple scenarios of input and output data require multi-dimensional reporting and data graphing

A Primer on Decision Making

James March [1994]

“As ideas from (many) disciplines are woven into the story of decision making, new forms of old issues are encountered: issues of reason and ignorance, of intentionality or fate, of coherence and conflict, of institutions, identities, and rules, of learning and selection, of meaning and interpretation, of preferences and obligations”

Economic Theory of Rational Decision Making

Rational decision making involves answering:

- i. The question of **alternatives**: What actions are possible?
- ii. The question of **expectations**: What future consequences might follow from each alternative? How likely is each possible consequence, assuming that alternative is chosen?
- iii. The question of **preferences**: How valuable (to the decision-maker) are the consequences associated with each of the alternatives?
- iv. The question of **the decision rule**: How is a choice to be made from among the alternatives in terms of the values of their consequences?

Limited Rationality

Decision makers still intend to be rational, but they are limited by their mental capacities and accuracy and completeness of available information:

- i. limitations in attention**
- ii. limitations in memory**
- iii. limitations in comprehension**
- iv. limitations in communication**

- **By contrast to theories of (limited) rationality, behavioral theories of decision making are concerned with how decisions actually happen rather than how they ought to happen**
- **Four issues persistently divide students of decision-making**

The **first issue** is whether decisions are to be viewed as **choice-based** or **rule-based**

- Do decision makers pursue **a logic of consequence**, making choices among alternatives by evaluating their consequences in terms of prior preferences?
- Or do they pursue **a logic of appropriateness**, fulfilling identities or roles by recognizing situations and following rules that match appropriate behavior to the situation they encounter?

The **second issue** is whether decision making is typified more by **clarity and consistency** or by **ambiguity and inconsistency**

- **Are decisions occasions in which individuals and institutions achieve coherence and reduce equivocality?**
- **Or are they occasions in which inconsistency and ambiguity are exhibited, exploited, and expanded?**

The **third issue** is whether decision making is an **instrumental activity** or an **interpretive activity**

- Are decisions to be understood primarily in terms of the way they fit into a problem solving, adaptive calculus?
- Or are they to be understood primarily in terms of the way they fit into efforts to establish individual and social meaning?

The **fourth issue** is whether outcomes of decision processes are seen as primarily attributable to the **actions of autonomous actors** or to the **systemic properties of an interacting ecology**

- Is it possible to describe decisions as resulting from the intentions, identities, and interests of independent actors?
- Or is it necessary to emphasize the ways in which individual actors, organizations, and societies fit together?

Exploration vs. Exploitation

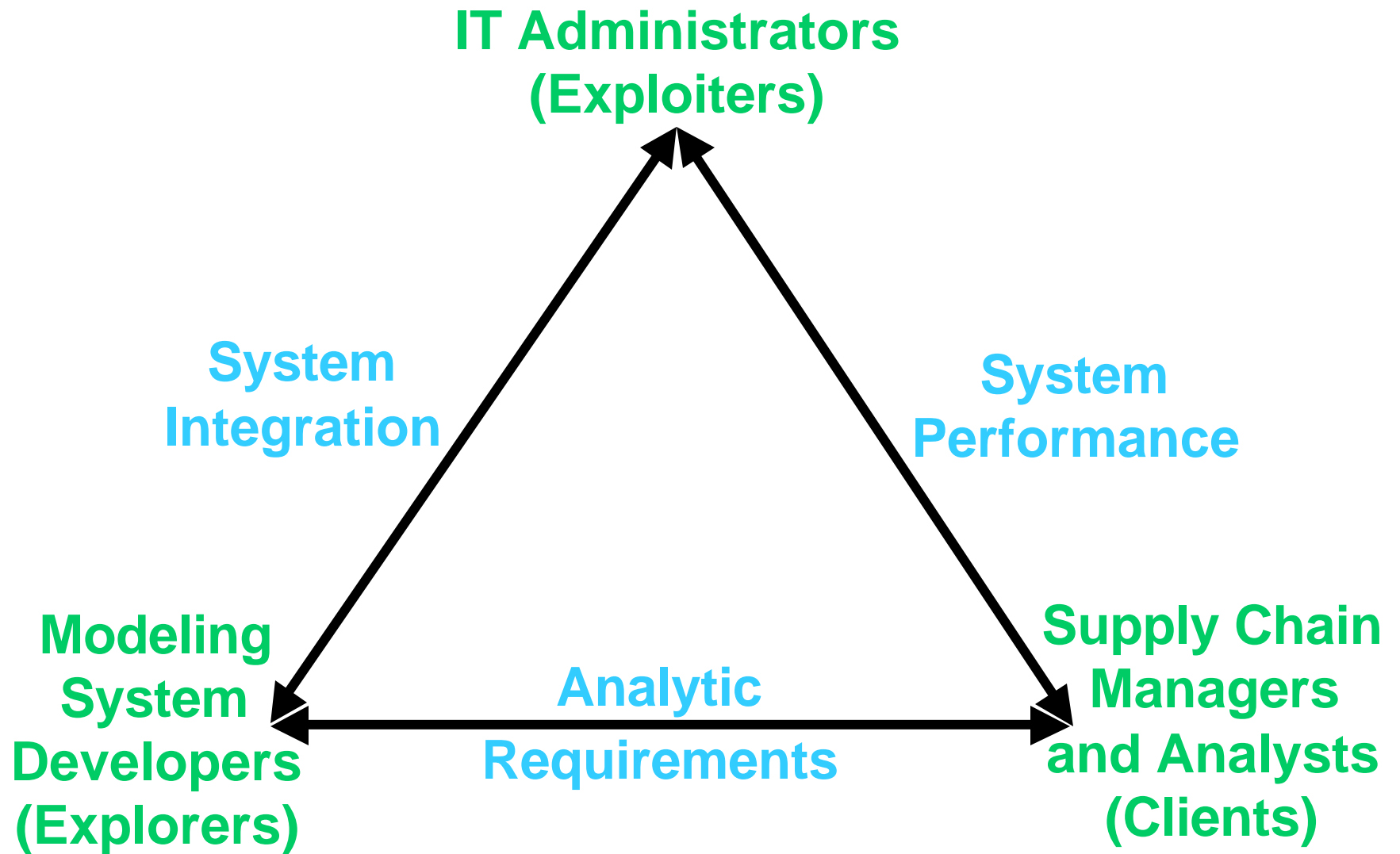
“Organizational behaviorists have studied the relationship between **exploration** of new possibilities and **exploitation** of old certainties in describing how organizations adapt to a changing world” (March [1991])

Exploration includes activities described as search, risk taking, experimentation, discovery, learning and innovation.

Exploitation includes activities described as refinement, production, efficiency, implementation and execution.

Exploratory Learning for Improved Supply Chain Management

- **Learning about the meaning of data**
- **Learning about which models to use in representing the company's supply chain problems**
- **Learning about the best, acceptable plans for supply chain planning problems**



Exploration vs. Exploitation of Modeling Systems₂₈

Organizational Adaptation to Routine Use of Supply Chain Modeling Systems for Tactical Planning

- Create **supply chain coordination team** of IT personnel and supply chain analysts to implement and support modeling system, database and system infrastructure
- Validate **optimization model** and **supply chain decision database**, and determine **planning cycle** (e.g., once a month) and form of **multiple period model** (e.g., 6 months)
- Expand model to incorporate demand management decisions (e.g., product mix, pricing of products or orders)

Monthly Supply Chain Review

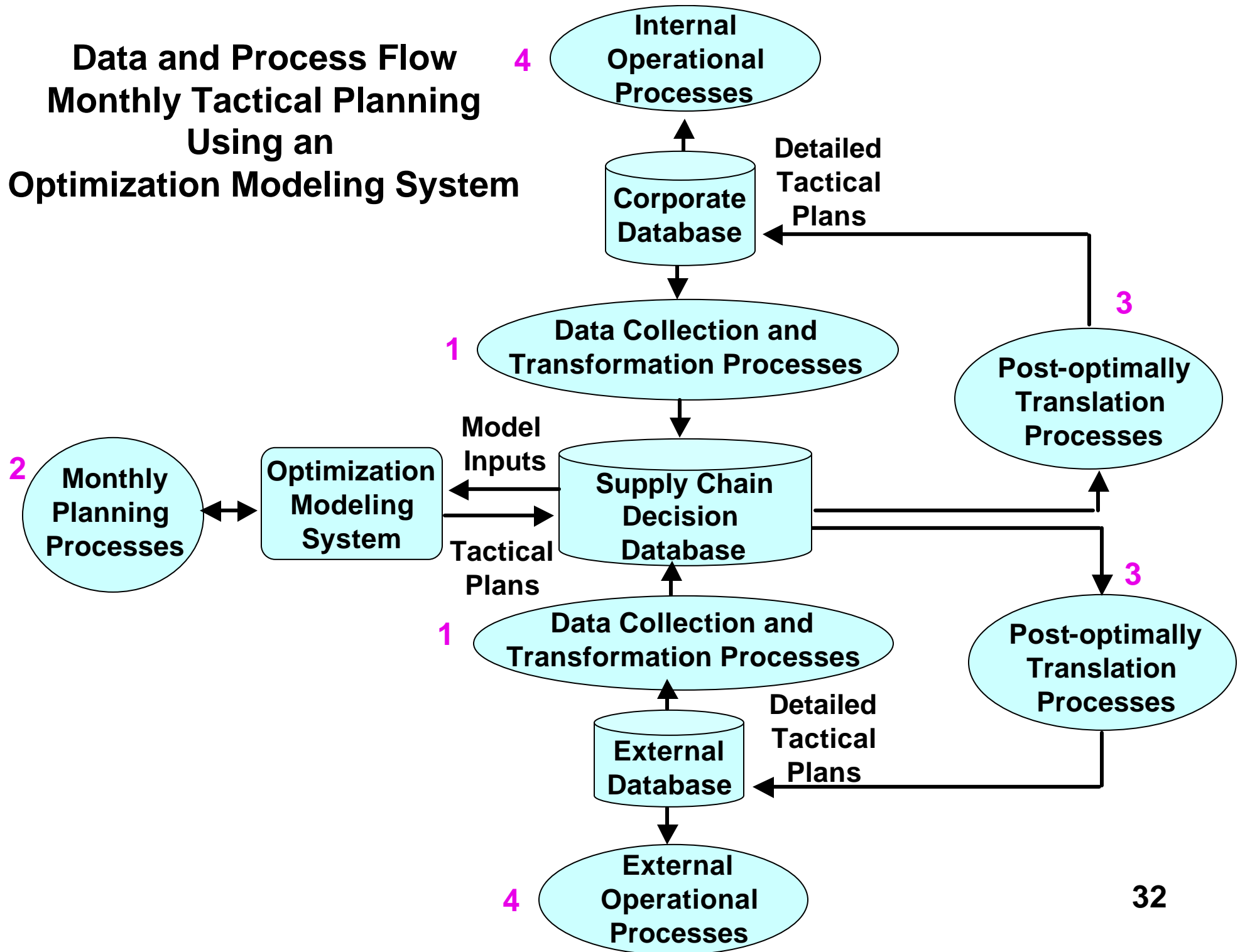
- Monthly exercise carried out by **supply chain coordination team**
- Multiple period model optimized on **rolling horizon basis**
 - fine tune next month's plan
 - prepare likely plan for month two
 - analyze and resolve conflicts for months three, four, five and six
- Review may also be used in emergencies
- Develop and implement **managerial incentives** that reflect global supply chain optimization

Supply Chain Review

Invokes Business Process Expansion

- **New processes for data collection and transformation**
- **New processes for determining supply chain plan**
- **New processes for negotiating and disseminating the plan**
- **New processes for executing the plan**

Data and Process Flow Monthly Tactical Planning Using an Optimization Modeling System



Conclusions

- **Managerial understanding, acceptance and application of optimization models to supply chain management are still in their early days**
 - **provide education of modeling concepts and benefits**
 - **demonstrate value**
 - **seek value pricing of optimization modeling studies and systems**
- **Basic and applied research is needed to discover new concepts and to construct new systems for harmonizing human judgment with modeling analysis**
 - **combine heuristics with rigorous models and methods**
 - **perform cognitive research**
 - **devise new managerial incentive schemes**

- **Business process expansion is needed to overcome human and organizational barriers to (limited) rational decision making based on data, models, and modeling systems**
- **Success of optimization models for supply chain management will lead to wider applications across entire enterprises**