



Knowledge as Inventory: Near-Optimizing Knowledge and Power Flows in Edge Organizations

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Agenda

- Motivation
- Conceptual Model
- Research Questions
- Inventory Theory
- Knowledge as a Perishable Good
- Agent Knowledge Metric
- C2 Applications
- Next Steps
- Theoretical Contributions



Motivation

- Edge Organization definition
 - ▶ No headquarters to rely upon
 - ▶ Requires: shared awareness / self synchronization
- Knowledge flow is especially critical for Edge Organizations
 - ▶ High levels of strategic & operational knowledge needed at nodes
 - ▶ Enables “agility” in an uncertain environment
 - ▶ Understanding knowledge growth & decay in Edge organizations - critical for optimizing performance
- Research Goals
 - ▶ Develop conceptual model of knowledge flows
 - ▶ Validate and embed in computational models for organizational simulations



Conceptual Model

- Consider inventory theory for perishable goods as a metaphor to inform knowledge and power flows in Edge Organizations
 - ▶ Inventory Theory
 - ▶ Knowledge Inventory

Research Questions

- Phase I:
 - ▶ How can MS Inventory Theory help to inform our understanding of knowledge flows in Edge Organizations?
- Phase II:
 - ▶ How can MS Inventory Theory, adapted to account for differences, extend current organizational design simulation models?

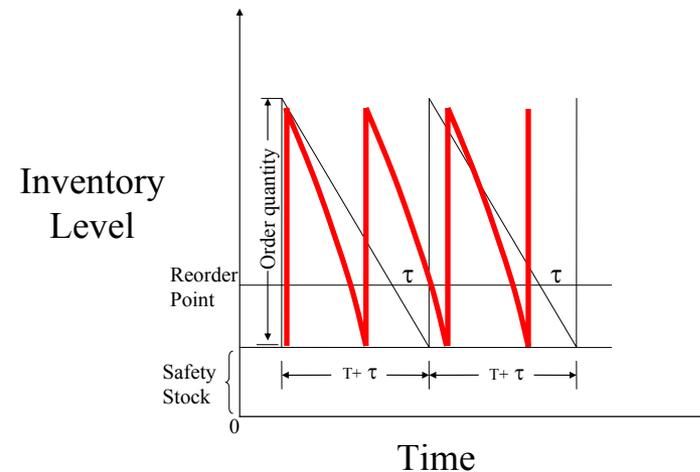
Inventory Theory: Analysis and Insights

Logistics Manager's Perspective

- For a supply chain of perishable goods, managers gain insights considering

- ▶ Economic Order Quantity (EOQ = Q^*)
- ▶ Reorder point
- ▶ Make vs. Buy decisions
- ▶ Inventory policies
 - Just-in-Time
 - Just-in-Case

$$Q^* = \sqrt{\frac{2K\lambda}{Ic}}$$





Perishable Goods in a Supply Chain vs. Knowledge in an Organization

■ Similarities

- ▶ Knowledge is a critical resource
- ▶ Knowledge demand is difficult to forecast
- ▶ Knowledge stores can be increased
- ▶ Knowledge stores can be decreased
- ▶ Knowledge can be distributed



Perishable Goods in a Supply Chain vs. Knowledge in an Organization

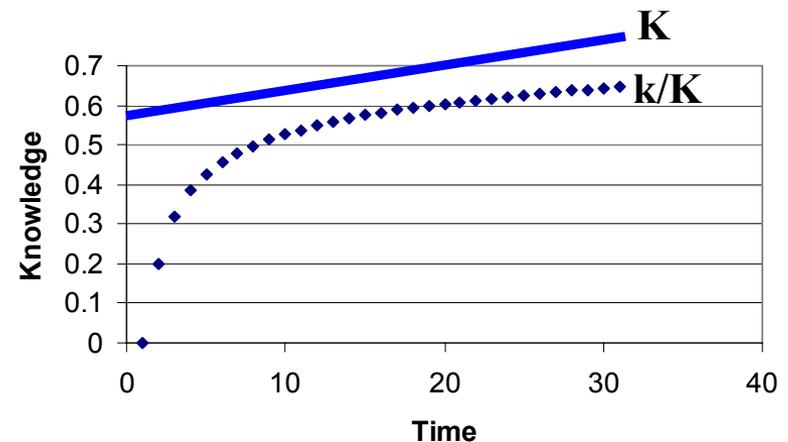
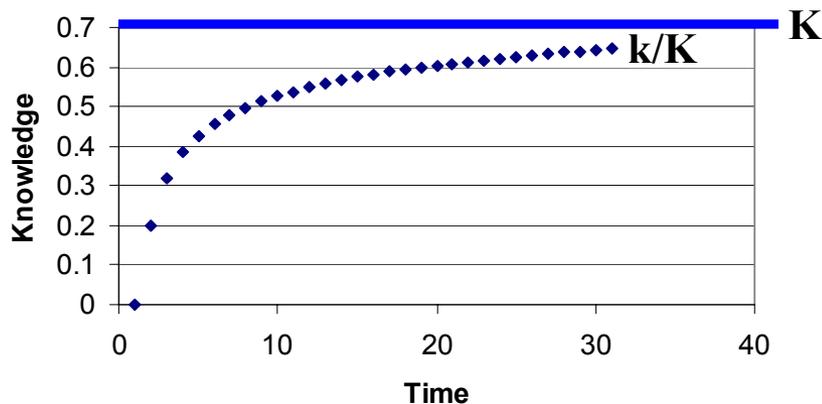
■ Differences

- ▶ Knowledge is a collective (public) good—vs. produce
- ▶ Knowledge when demanded creates more knowledge
- ▶ Knowledge “holding costs”
 - Individually may be negligible—vs. security, refrigeration, rent
 - Underutilized experts however may be very expensive
- ▶ Knowledge is difficult to quantify—vs. produce



Agent Knowledge Metric (k/K)

- Fraction of relevant knowledge possessed by agent (k) versus the knowledge available in a certain field (K).
- Metric changes
 - ▶ Type, amount, recency of learning (OJT, mentoring, etc.) — $\uparrow k$
 - ▶ Knowledge obsolescence (environment) — $\uparrow K$
 - ▶ Decay (time, interference) — $\downarrow k$





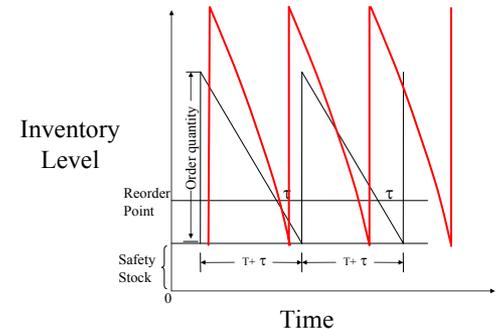
C2 Application

- Knowledge as inventory provides framework
- Example: Watchstander training (deployment preparation)

- ▶ Consider EOQ model

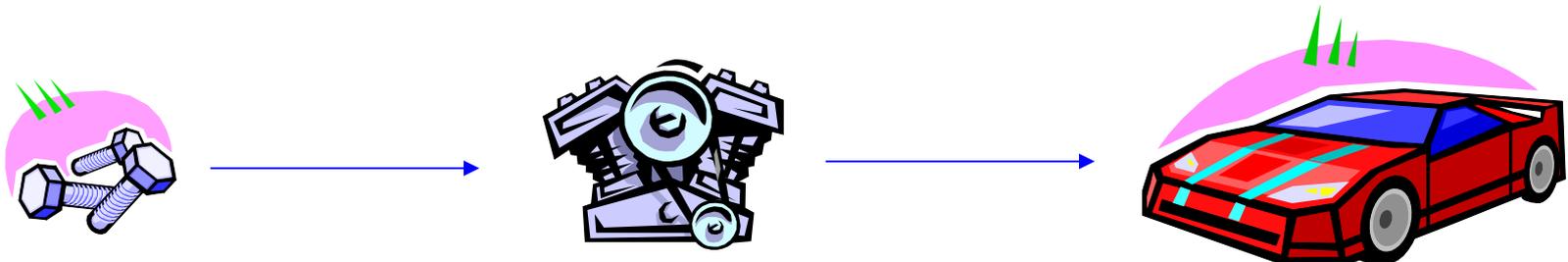
- Increased subtractions ($\downarrow k$)
- Decreased additions ($\downarrow k$)
- Uncertain environment ($\uparrow K$)
- Safety stock
- Less time for training requires a longer lead time
- Frequency and magnitude of “reordering” increases to maintain proficiency

$$Q^* = \sqrt{\frac{2K\lambda}{Ic}}$$



C2 Application Insights

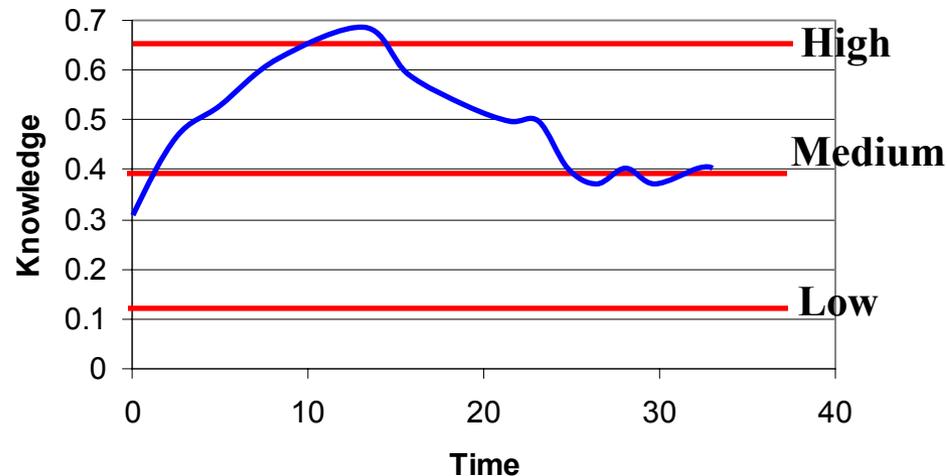
- JIT vs. JIC
 - ▶ Specialist
 - Longer lead time, but knowledgeable
 - ▶ Generalist
 - Shorter lead time, but not an expert
- Material Resource Planning (MRP)
 - ▶ Building upon earlier training
 - Basic to advanced
 - OJT to mentoring





Next Steps

- Proposed Extensions to POW-ER Computational Modeling Framework
- Develop framework to account for agent knowledge
- Develop fine-grained agent knowledge metric (k/K)
- Provide for dynamic knowledge over time





Theoretical Contributions

- Phase I
 - ▶ New knowledge concerning how inventory theory can inform knowledge flows in Edge organizations
 - ▶ Development of Knowledge Metric ($\sim\% k/K$)
 - ▶ Exploration of “Knowledge Chain Management” principles (\sim Supply Chain Management)
- Phase II
 - ▶ Extend the capability of computational modeling to reflect optimally contingent knowledge flow in Edge and other organizations



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