ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ

Ψηφιακή Οικονομία

Διάλεξη 4η: Supply Chains

Μαρίνα Μπιτσάκη
Τμήμα Επιστήμης Υπολογιστών

Course Outline

- **Part I: Service Science**
  - Introduction
  - Basics of Network Economics
    - **Supply Chains**
    - Service Value Networks
  - Tools
    - Vensim

What is a Supply Chain

- Supply chain: consists of all parties involved in fulfilling a customer request
  - **Entities**: suppliers, manufacturer, transporters, warehouses, retailers, customers
  - **Functions**: product development, marketing, operations, distributions, finance, customer service

- Dynamic
  - Constant flow of information, product, funds between different stages
  - Supply network: many players involved at a stage (e.g. receive material from several suppliers)

Source: Supply Chain Management: Strategy, Planning and Operation, S. Chopra, P. Meindl

Objective of a Supply Chain

- Maximize the overall value generated

  Supply chain value = value of final product – costs incurred

  ↓

  Supply chain profitability = revenues generated from customers – overall cost across the supply chain

- Supply chain profitability is the **total** profit to be shared across all supply chain and intermediaries
  - Profitability at an individual stage may lead to a reduction in overall supply chain profits

Decision Phases in a Supply Chain

- Supply chain decisions play a significant role in the success or failure of a firm
- Decision phases
  - Design
  - Planning
  - Operation

Decision Phases in a Supply Chain

1. **Design** (long term decisions)
   - Structure of the supply chain
   - Resource allocation
   - What processes each stage will perform
   - Outsourcing
   - Location and capacities of production
   - Warehousing facilities
   - Modes of transportation
   - Type of information system

Take into account uncertainty in market conditions over the next years

Decision Phases in a Supply Chain

2. **Planning** (short term decisions)

- **Forecast** of demand in different markets
- Which markets will be supplied from which locations
- Inventory policies
- Marketing
- Pricing

3. **Operation** (daily time horizon)

- Handle incoming customer orders (date for an order to be filled, shipping modes, delivery schedules, …)

Less uncertainty about demand information

Supply Chain Performance

- A **company's** competitive strategy: the set of customer needs that it seeks to satisfy through its products and services
- A **company's** value chain strategy: the functional strategies within the company

New product development -> Marketing and sales -> Operations -> Distribution -> Service

  - Finance, accounting, information technology, human resources facilitate the functioning of the value chain

Supply Chain Performance

- **Strategic fit**: for a company to be successful both the competitive and supply chain strategies must have aligned goals
  - Consistency between customer priorities and supply chain capabilities
  - To achieve strategic fit, a company must understand:
    - Customer needs and uncertainty of the supply chain
    - Supply chain's capabilities in terms of responsiveness and efficiency

Supply Chain Performance

- Supply chain uncertainty
  - Unpredictability of demand, supply uncertainty
- Supply chain responsiveness
  - Respond to wide ranges of quantities demanded
  - Meet short lead times (delay between the initiation and execution of a process)
  - Handle a large variety of products
  - Build highly innovative products
  - Meet a high service level
  - Handle supply uncertainty
- Supply chain efficiency: the inverse of the cost of making and delivering a product
- HIGH RESPONSIVENESS -> INCREASED COSTS -> LOW EFFICIENCY

Supply Chain Performance

- Achieving strategic fit
  - Ensure that the degree of supply chain responsiveness is consistent with the implied uncertainty
    - Target high responsiveness for a supply chain facing high implied uncertainty
    - Target efficiency for a supply chain facing low implied uncertainty

Supply Chain Performance

- Scope of strategic fit: functions within the firm and stages across the supply chain that devise an integrated strategy
- When the scope of strategic fit is narrow, companies optimize their own performance resulting in conflicting actions that reduce supply chain profit

Drivers of Supply Chain Performance

1. Facilities
   - Physical locations where product is stored assembled or fabricated
   - Manufacture and store in one location increases efficiency at the expense of responsiveness
2. Inventory
   - Exists because of mismatch between demand and supply
   - A high level of inventory (high responsiveness) increases holding costs (low efficiency)
3. Transportation
   - Moves product between different stages in a supply chain
   - Faster transportation increases responsiveness but reduces efficiency

Drivers of Supply Chain Performance

4. Information
   - Consists of data and analysis concerning facilities, inventories, transportation, costs, prices, customers
   - Serves as the connection between various stages
   - Main components
     - Information sharing
     - Forecasting
5. Sourcing
   - The set of business processes required to purchase goods and services
   - Key sourcing decision: whether to perform a task in-house or outsource it to a third party
6. Pricing
   - How much a firm will charge for goods and services

Designing the Supply Chain Network

- Decisions to be taken:

1. Distribution Network (How to move and store a product from the supplier stage to a customer stage)
    - Service factors: response time, product variety, product availability, customer experience, time to market, order divisibility, returnability
    - Cost factors
2. Facility Role (What processes are performed at each facility)
3. Facility Location (where should facilities be located)
4. Capacity allocation (how much capacity should be allocated to each facility)
5. Market and supply allocation (what markets should each facility serve – which supply sources should feed each facility)

Designing the Supply Chain Network

- Impact of e-business on customer service
  - Longer response time for physical products
  - Larger selection of products
  - Improved product availability
  - Increases the ease with which customers buy products
  - Faster time to market
  - Enable order visibility
  - Harder returnability

Designing the Supply Chain Network

- Impact of e-business on cost
  - Requires less inventory
  - Reduced network facility costs
  - Higher transportation costs for non digital goods
  - Improved coordination by shared information
  - Additional information costs for the IT infrastructure for e-business

Network design in an Uncertain Environment

- Uncertainties that influence supply chain performance and network design:
  - Supply
  - Demand
  - Financial (price, exchange rates, competitive environment)
- Methodologies to **evaluate supply chain** design decisions under uncertainty
  - Discounted cash flow analysis
  - Models that can be used to represent uncertainty in factors such as demand, price, … (binomial representation of uncertainty, …)
  - Decision trees

Discounted Cash Flow Analysis (DCF)

- DCF Analysis evaluates the present value of any stream of future cash flows
- Supply chain decisions take place by comparing two streams of cash flows in terms of their financial value
- DCF Analysis is based on the premise that "a euro today is worth more than a euro tomorrow"
  - invest and earn a return according to a **discount rate k**

Discounted Cash Flow Analysis (DCF)

- Discount factor = 1/(1+k)
  - If 1 euro is invested today it will result in 1+k euros in the next period
  - Thus 1 euro in the next period is discounted by 1/(1+k) to obtain its present value: 1/(1+k) + k/(1+k) = 1
- Given a stream of cash flows C_0, C_1, …, C_T over the next T periods, and rate of return k, the **net present value** is given by

$$NPV = C_0 + \sum_{t=1}^{T} \left(\frac{1}{1+k}\right)^t C_t$$

- The net present value of different options should be compared when making supply chain decisions

Representation of Uncertainty

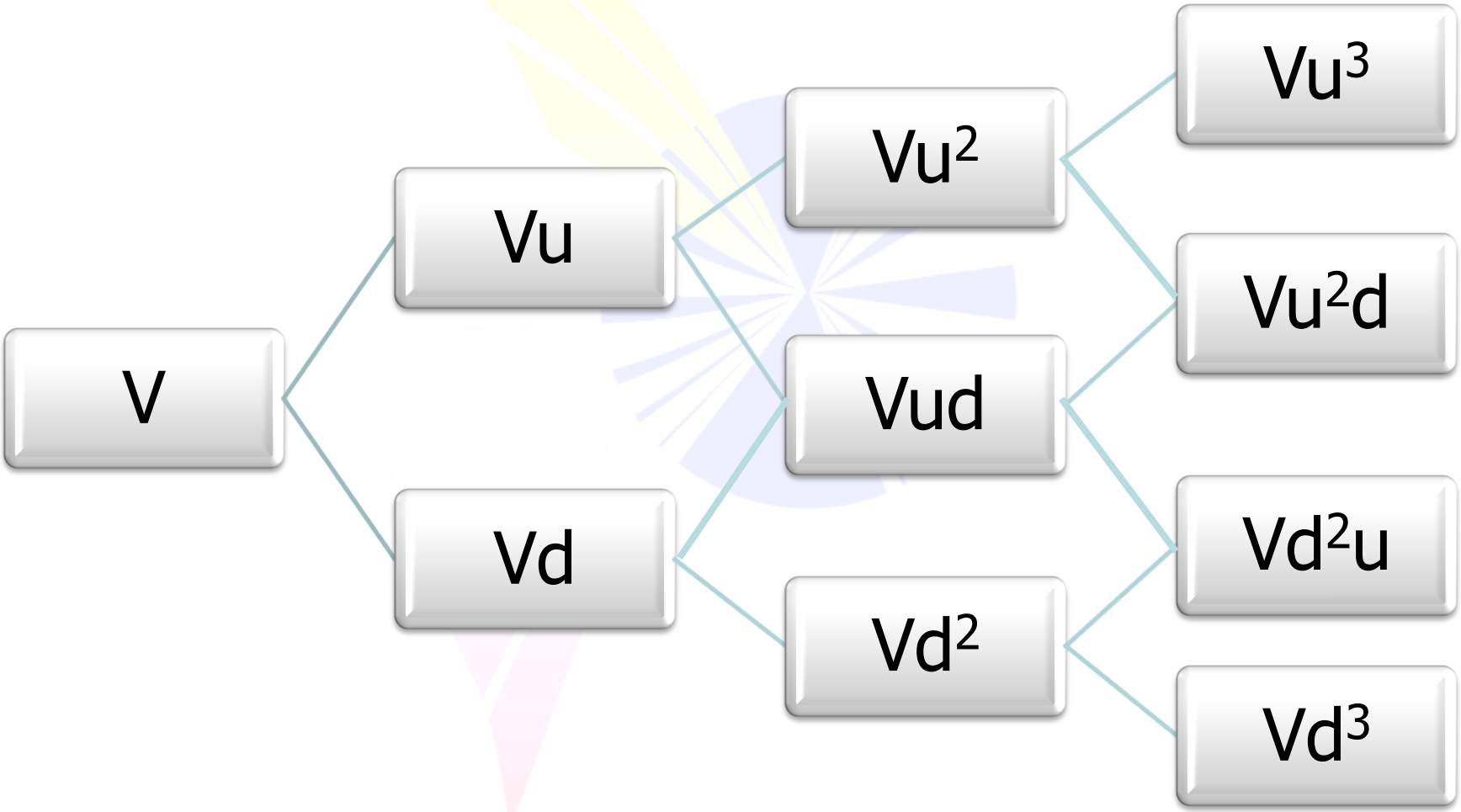
- A company experiences fluctuations in factors such as demand, prices, exchange rates, competitive environment
- **Binomial representation** of uncertainty
  - Consider that we want to represent the uncertainty of factor A
  - Assume that when moving from one period to the next, factor A has **only two possible outcomes**: up or down
  - Let V be the value of factor A in period 0

Binomial Representation of Uncertainty

- Multiplicative binomial
  - Value of A moves up by a factor $u > 1$ with probability p
  - Value of A moves down by a factor $d < 1$ with probability $1-p$
    - Value in Period 0: V
    - Possible values in Period 1: Vu, Vd
    - Possible values in Period 2: Vu^2, Vud, Vd^2
    - Possible values in Period 3: Vu^3, Vu^2d, Vud^2, Vd^3
  - In general, period T has the following possible outcomes:

$$Vu^t d^{(T-t)},\ t=0,1,\ldots,T$$

Multiplicative Binomial Tree

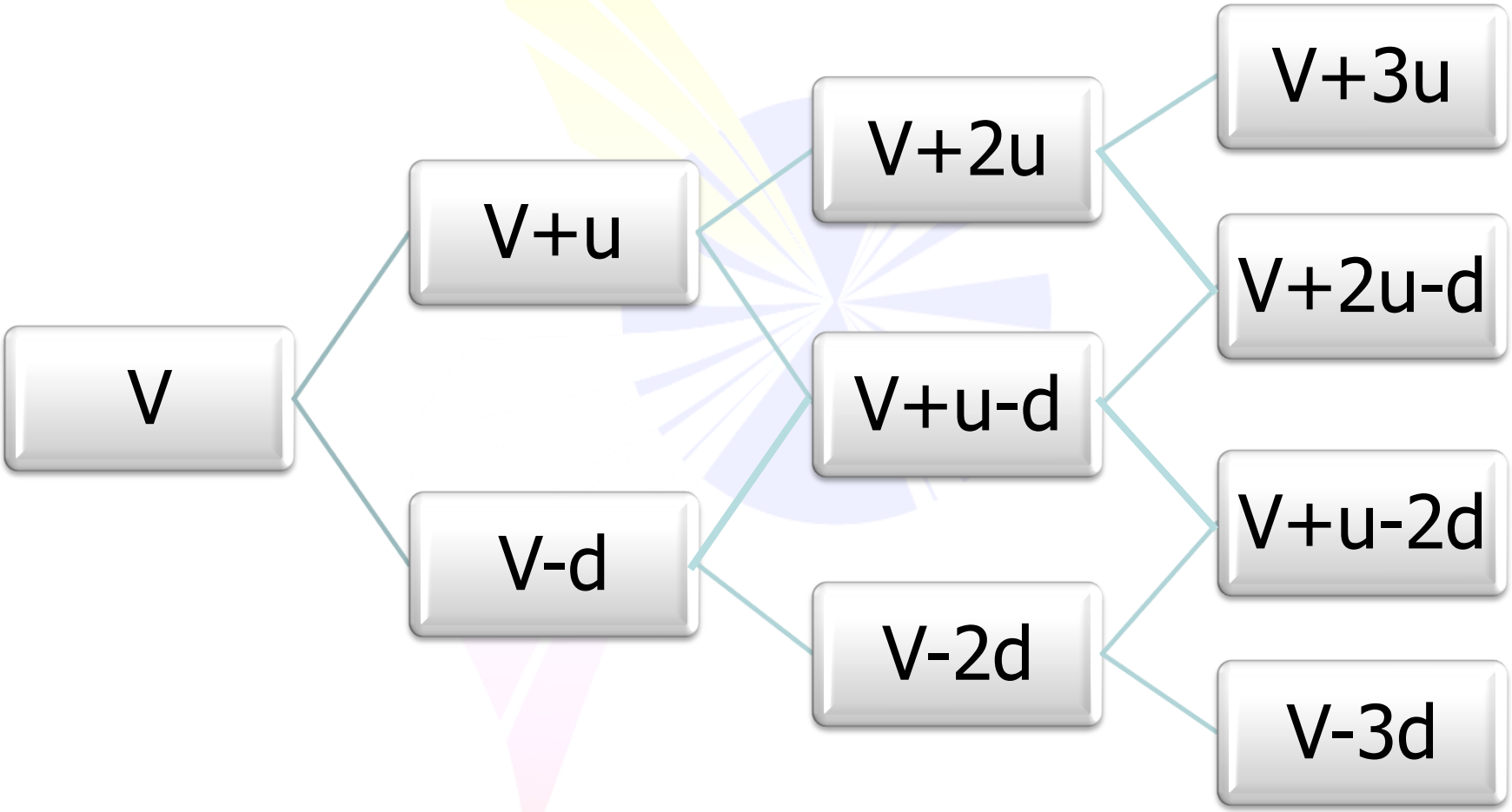


Binomial Representation of Uncertainty

- Additive binomial
  - Value of A increases by $u>0$ with probability p
  - Value of A decreases by a factor $d>0$ with probability $1-p$
    - Value in Period 0: V
    - Possible values in Period 1: V+u, V-d
    - Possible values in Period 2: V+2u, V+u-d, V-2d
    - Possible values in Period 3: V+3u, V+2u-d, V+u-2d, V-3d
  - In general: period T has the following possible outcomes:

$$V+tu-(T-t)d,\ t=0,1,\ldots,T$$

Additive Binomial Tree



Decision Tree Analysis

- Methodology used to evaluate decisions under uncertainty
- Decision tree: a graphic device used to evaluate decisions under uncertainty
- Evaluation of the decision tree is based on *Bellman's principle*:

  For any choice of strategy in a given state, the optimal strategy in the next period is the one that is selected if the analysis is assumed to begin in the next period

- Treeplan: tool to solve decision trees

Decision Tree Analysis

Steps:

1. Identify the duration of each period and the number of periods T over which the decision is to be evaluated
2. Identify factors whose fluctuation will be considered
3. Determine what distribution to use to model the uncertainty
4. Identify the discount rate k for each period
5. Represent the decision tree which contains the present and T future periods
6. Starting at period T, work back to period 0 identifying the optimal decision and the expected cash flows at each step (Bellman's principle)

Τέλος Ενότητας

Χρηματοδότηση

•Το παρόν εκπαιδευτικό υλικό έχει αναπτυχθεί στα πλαίσια του εκπαιδευτικού έργου του διδάσκοντα.

•Το έργο «**Ανοικτά Ακαδημαϊκά Μαθήματα στο Πανεπιστήμιο Κρήτης**» έχει χρηματοδοτήσει μόνο τη αναδιαμόρφωση του εκπαιδευτικού υλικού.

•Το έργο υλοποιείται στο πλαίσιο του Επιχειρησιακού Προγράμματος «Εκπαίδευση και Δια Βίου Μάθηση» και συγχρηματοδοτείται από την Ευρωπαϊκή Ένωση (Ευρωπαϊκό Κοινωνικό Ταμείο) και από εθνικούς πόρους.

Ευρωπαϊκή Ένωση
Ευρωπαϊκό Κοινωνικό Ταμείο

ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
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ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΩΝΙΚΟ ΤΑΜΕΙΟ

Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

Σημειώματα

Σημείωμα αδειοδότησης

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Σημείωμα Αναφοράς