CSE 405
Software Engineering Economics

Introduction to SEE

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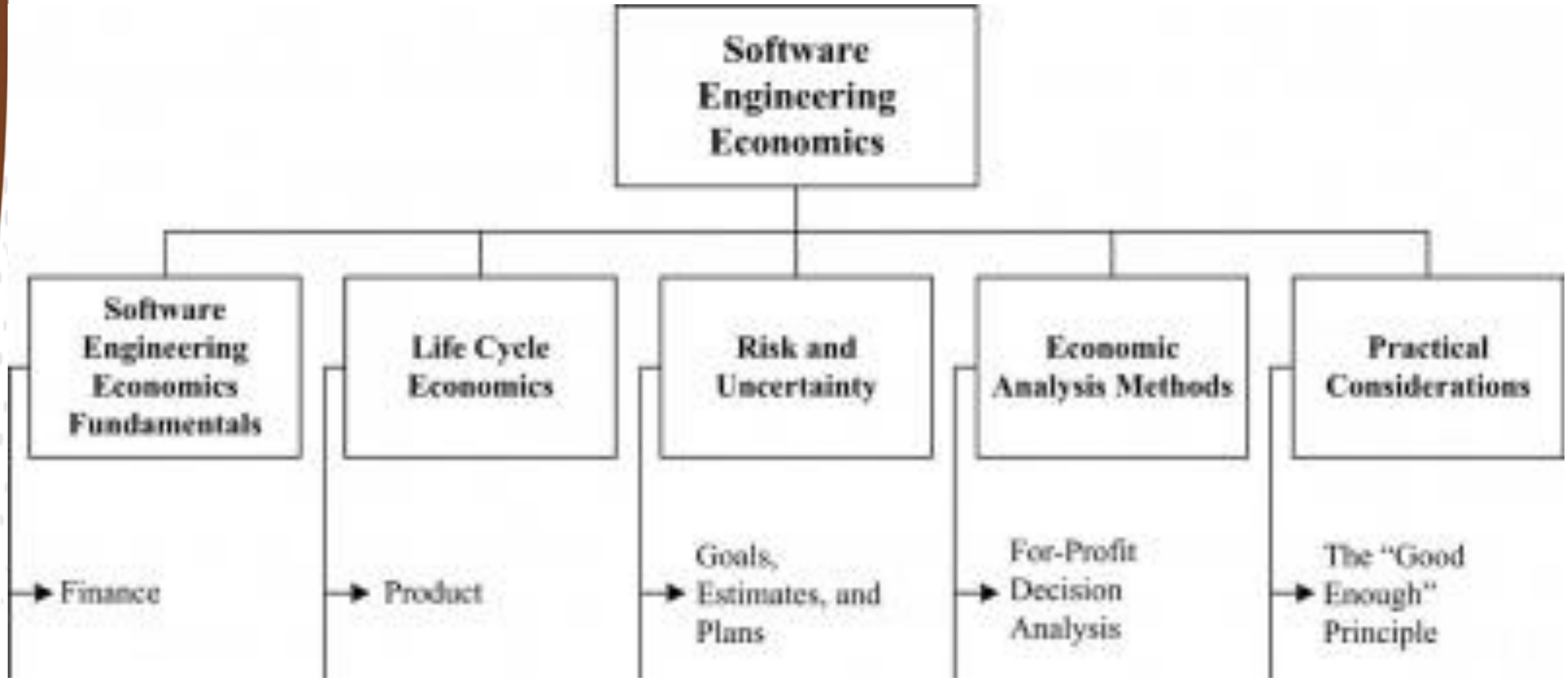
Objective

- To enable students understand the fundamental **principles of software management and economics**
- To provide an empirical view of **where the effort and money goes** when we build large software systems.
- To suggest ways of **reducing and controlling software development costs**.
- To analyze software cost/schedule **tradeoff issues** via to software metrics, software **cost estimation** tools and microeconomic techniques
- To apply the principles and techniques to practical situations. A special focus will be on a **critical success factor for Software Engineering projects**, and etc.

Course Contents



Course Administration

- Recommended Textbooks
  - Software Engineering Economics by Boehm, Prentice Hall, 1981.ISBN-10: 0138221227.
  - Estimating Software Costs: Bringing Realism to Estimating by Capers Jones, McGraw-Hill Osborne Media; 2nd Edition (April 19, 2007).ISBN-10: 0071483004
  - Software Cost Estimation with COCOMO II by Barry W. Boehm, Chris Abts, A. Winsor Brown and Sunita Chulani, Prentice Hall (August 11, 2000). ISBN-10: 0130266922.
  - Software Cost Estimation and Sizing Methods, Issues, and Guidelines by Shari Lawrence Pfleeger, Rand Publishing (September 13, 2005). ISBN-10: 0833037137.
  - Software Engineering Economics and Declining Budgets by Pamela T. Geriner, Thomas R. Gulledge, William P. Hutzler, Springer London, Limited, (31-Jul-2012)
- Assessment
  - The course shall be comprised of various assignments and quizzes that shall be spread through out the course.
  - Final Exams.
  - The final grade shall depend on your performance in EACH of the above mentioned KPIs.

What is Economics & Why its Important?

- Economics is the branch of social science that deals with the production, distribution, and consumption of goods and services and their **management**.
- Society has scarce/limited resources, therefore, society cannot produce all the goods & services people wish to have. Economics is the study of how society manages its scarce resources.
- Economics is the science of reasoned choice & decision-making despite limited resources OR the **systematic evaluation** of the **economic merits** of proposed **solutions**, at least as it applies to engineering.
    - Who will work?
    - What goods and how many of them should be produced?
    - What resources should be used in production?
    - At what price should the goods be sold?

What is Economics & Why its Important?

- **Macroeconomics:** This is the branch of economics that focuses on the analysis of broad trends in a country's economy, such as inflation, unemployment, industrial production, tax rates, interest rates etc.

OR

- **The study of how people make decisions in resource-limited situations on a national or global scale.**

- **Microeconomics:** This is the branch of economics concerned with the decisions made by individuals, households, and firms and how these decisions interact to form the prices of goods and services and the factors of production.

OR

- **The study of how people make decisions in resource-limited situations on a more personal scale.**

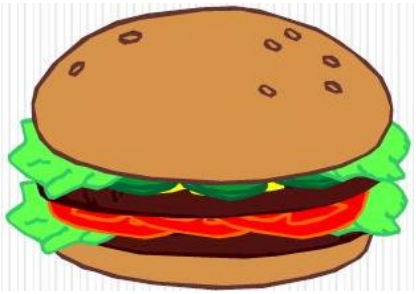
Economics & Software Engineering

- Software Economics is the field that seeks to enable significant **improvements in software design** and engineering **through economic reasoning** about product, process, program, and policy issues.
- Software engineering economics is concerned with aligning software **technical decisions** with the **business goals** of the organization.
- **The study of how scarce project resources are allocated for software projects.**
- Throughout the **SDLC**, there are many decision situations involving limited resources in which software engineering economics techniques provide useful assistance.

Economics & Software Engineering

- **Feasibility phase:** **How much should we invest** in information system analysis (user questionnaires, interviews, current-system analysis, workload, etc.) in order to meet the concept of operation for the system we plan to implement?
- **Requirements phases:** **How thoroughly should we specify requirements?** How much should we invest in requirements validation activities before proceeding to design and develop a software system?
- **Design phase:** **Should we organize the software** to make it possible to use a complex piece of existing software that generally but not completely meets our requirements?
- **Programming phase:** Given a choice b/w three data storage and retrieval schemes that are primarily execution-time efficient, storage efficient, and easy to modify, respectively, **which these should we choose to implement?**
- **Integration and Test phase:** **How much testing** and formal verification should we perform on a product before releasing it to users?
- **Maintenance phase:** Given an extensive list of suggested product improvements, **which one should we implement first?**
- **Phase-out:** Given an aging, hard-to-modify software product, **should we replace it with a new product, restructure it, or leave it alone?**

10 Principles of Economics



1. People face tradeoffs.
   - **There is no such thing as a free lunch!**
   - To get one thing, we usually have to give up another thing.
   - Making decisions requires trading off one goal against another

     (Fast vs Cheap vs Good)

2. The cost of something is what you give up to get it.
   - Decisions require comparing costs and benefits of alternatives.
   - **Whether to go to college or to work?**
   - Whether to study or go out to play game?
   - Whether to go to class or sleep in?

10 Principles of Economics

3. Rational people think at the margin.
   - Marginal changes are small, incremental adjustments to an existing plan of action
   - **People make decisions by comparing costs and benefits at the margin.**

4. People respond to incentives.
   - Marginal changes in costs or benefits motivate people to respond.
   - The decision to choose on alternative over another occurs when that alternative's marginal benefits exceed its marginal costs!
   - LA Lakers basketball star **Kobe Bryant** choose to **skip college** and go straight to the NBA from high school when **offered a $10 million contract**.

10 Principles of Economics

5. Trade can make everyone better off.
   - People gain from their ability to trade with one another
   - **Trade allows people to specialize in what they do best**

6. Markets are usually a good way to organize economic activity.
   - In a market economy, households decide **what to buy and who to work for**.
   - Firms decide **who to hire and what to produce**.

7. Governments can sometimes improve market outcomes.
   - When the market fails (break down) government can intervene to **promote efficiency and equity**.
   - Market failure may be caused by market power, which is the ability of a single **person or firm to unduly influence market prices**

10 Principles of Economics

8. The standard of living depends on a country's production.
   - The standard of living is usually measure by comparing **personal incomes** or total market **value of a nation's production**.
   - Productivity is the amount of goods and services produced in each hour of the worker's time

9. Prices rise when the government prints too much money.
   - **Inflation** is an **increase** in the overall level of **prices** in the economy.

10. Society faces a short-run tradeoff between inflation and unemployment.
   - If policymakers **expand aggregate demand**, they can **lower unemployment**, but only at the cost of **higher inflation**.
   - If they **contract aggregate demand**, they can **lower inflation**, but at the cost of temporarily **higher unemployment**.

Why S.E.E is Important?

- The Standish study also showed that for projects that do deliver software, the average one is 45% over budget, **63% over schedule**, and delivers only 67% of the originally planned features and functions. Tracy Kidder reports that about 40% of the commercial applications of computers have proven uneconomical.

- Assuming the Standish and Kidder data can be combined, the resulting statistics are rather grim. If 23% of all software projects are **cancelled** without delivering anything, and 40% of the projects that do deliver software are **net money losers**, then about 54% of all software projects are **counterproductive** in the business sense.

- A sizeable amount of money is being wasted every year—around **$63 billion** in cancelled software projects alone. The money wasted annually could be as much as **$149 billion** if projects not showing a positive return on their investment are included.

Software Engineering Economics Fundamentals

1. Finance: This is the branch of economics concerned with issues such as allocation, management, acquisition, and investment of resources.

- Finance is an element of every organization, including software engineering organizations.
- The field of finance deals with the concepts of time, money, risk, and how they are interrelated.
- It also deals with how **money is spent and budgeted**.

2. Accounting: Accounting is part of finance. It allows people whose money is being used to run an organization to know the results of their investment: did they get the profit they were expecting?

- The primary role of accounting is to **measure** the organization's actual **financial performance** and to communicate **financial information** about a business entity to stakeholders, such as shareholders, financial auditors, and investors.

Software Engineering Economics Fundamentals

3. Controlling: Controlling is an element of finance and accounting that It ensures that an organization's objectives and plans are accomplished.

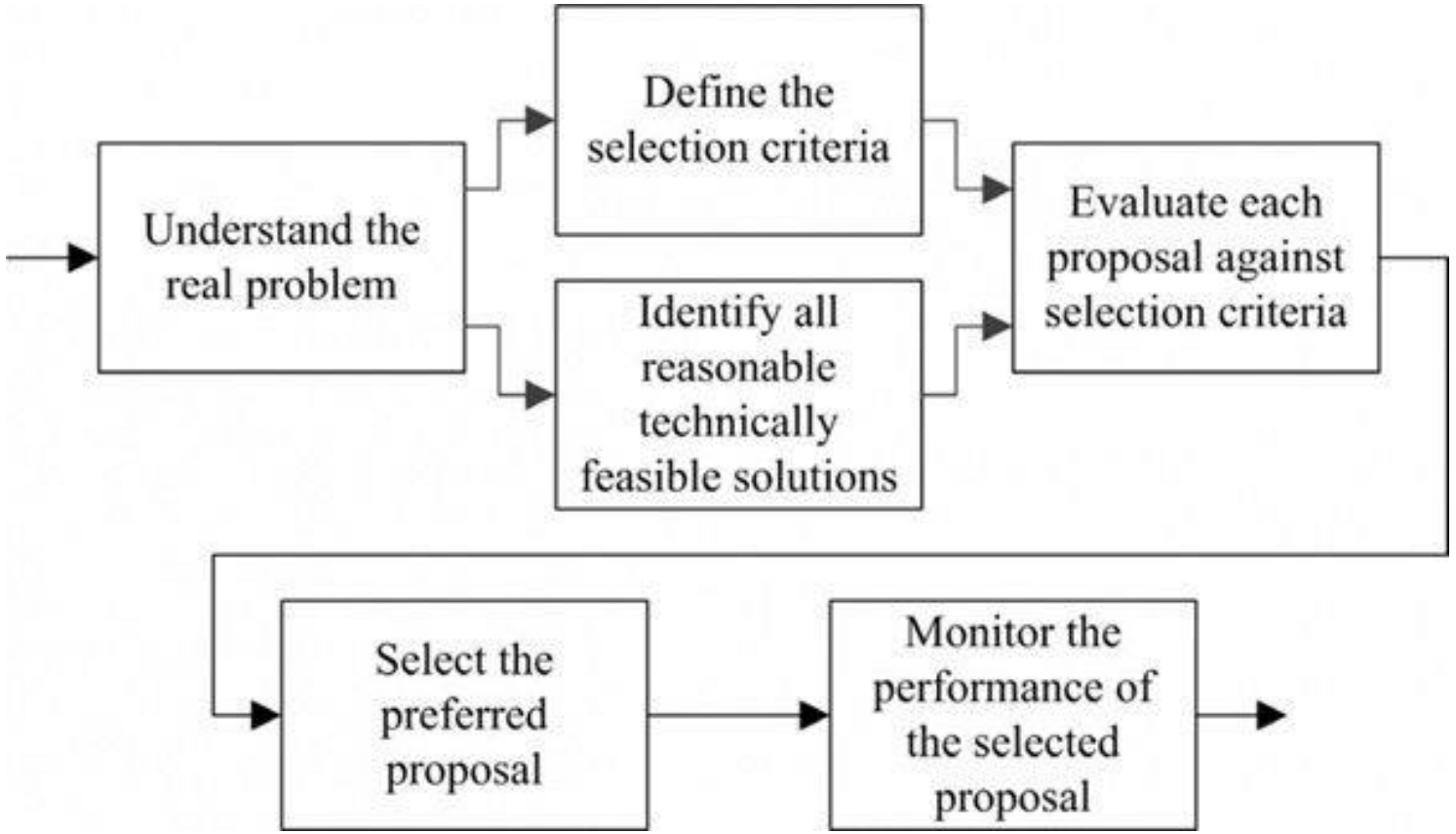
- Controlling involves **measuring and correcting** the performance of **finance** and **accounting**.
- Controlling cost is a specialized branch of controlling used to detect variances of actual costs from planned costs.

4. Cash Flow: Cash flow is the movement of money into or out of a business, project, or financial product over a given period.

- The sales income from product X in the 11th month after market launch is an example of an incoming cash flow instance.

Software Engineering Economics Fundamentals

5. Decision Making Process: If we assume that candidate solutions (off-the-shelf or homegrown) solve a given technical problem equally well, why should the organization care which one is chosen?



Software Engineering Economics Fundamentals

6. Time Value of Money: This is one of the most fundamental concepts in finance and business decisions.

- **Money has time-value and the value changes over time (e.g. Naira to Doller)**.
- A specific amount of money right now almost always has a different value than the same amount of money at some other time.

7. Efficiency: Economic efficiency of a process, activity, or task is the ratio of resources **actually** consumed to resources **expected** to be consumed or desired to be consumed in accomplishing the process, activity, or task.

- Efficiency means **"doing things right"**
- Factors that may affect efficiency in software engineering include product complexity, quality requirements, time pressure, process capability, team distribution, interrupts, tools, and programming language.

Software Engineering Economics Fundamentals

8. Effectiveness: Effectiveness is about having impact.

- It is the relationship between **achieved** objectives to **defined** objectives.
- Effectiveness means **"doing the right things."**
- Effectiveness looks only at whether defined objectives are reached—not at how they are reached

9. Productivity: Productivity is the **ratio of output over input** from an economic perspective.

- Output is the **value delivered**. Input covers all **resources** (e.g., effort) spent to generate the output.
- Productivity combines efficiency and effectiveness from a value oriented perspective
- Maximizing productivity is about generating highest value with lowest resource consumption.

Summary

- Introduction to CSE 405-SEE
- What is Economics & Why its Important?
- Economics & Software Engineering
- Why S.E.E is Important?
- 10 Principles of Economics
- Software Engineering Economics Fundamentals

Q & A

Any Question?