Class 4

Models – The Second Prerequisite
The Processing Network Paradigm (BPR)
Why Queues – via DS-PERT/CPM (Project Management)
Flanders: The intelligent influential skeptic.
Larson: (part of the) production of Justic; DS-Networks

The Processing Network Paradigm (BPR)

- On ReEngineering;
- Building Blocks: customers (jobs), activities, resources, processes (routes);
- Project Management: dynamic stochastic (process) view.

Why (operational) queues?
A systematic answer via Dynamic Stochastic PERT/CPM (Handout)

- Defining Capacity of a service station, hence resource utilization.
  1. Can we do it? capacity analysis;
  2. How long will it take? response-time analysis;
  3. Can we do better? parametric and sensitivity (what-if)analysis;
  4. How much better can we do? optimization/approximations.
- What is prevalent in practice (Critical Chain Method), and what is better/best? some alternative controls.
- Brief survey on Fork-Join queues/networks (as time permits):
  - Bounding average project time by max of iid exponentials;
  - Resource-queues dominate (linear effect)
  - synchronization-queues (log);

Recitation 4: Processing Networks, PERT.

HW 4:, "A Processing Network Model of a Service System".
(The assignment and class-lectures include examples of homeworks.)

From Robert **Kaplan** (Accounting) and Michael **Porter** (Strategy), HBR, September 2011

Question (Title): "**How to Solve the Cost Crisis in Health Care**"

Answer: Does not require medical science breakthroughs or new governmental regulation. It simply requires a new way (**TDABC** = Time-Driven Activity-Based Costing) to accurately measure costs and compare them to outcomes.

Indeed, accurately measuring costs and outcomes is the single most powerful lever we have today for transforming the economics of healthcare.

A TDABC budgeting process starts by predicting the volume and types of patients the provider expects.

The new approach engages physicians, clinical teams, administrative staff and financial professionals in creating process maps and estimating the resource costs involved in treating patients over their care cycle.

Introduction:

Goal of Heath care delivery system: Improve the **value** delivered to patients.

Value = measured in terms of **outcome** achieved per dollar expended (**cost**).

Medical outcome: has enjoyed growing attention.

Cost to deliver outcomes: received much less attention - the **FOCUS** here.

Opportunities to Improve Value:

- **Eliminate** unnecessary **process variations** and processes that don't add value.
- **Improve resource capacity utilization.**
- Deliver the right processes at the right location.
- Match clinical skills to the process.
- **Speed up cycle time.**
- **Optimize** over the full cycle of care.

The Challenge of Health Care Costing:

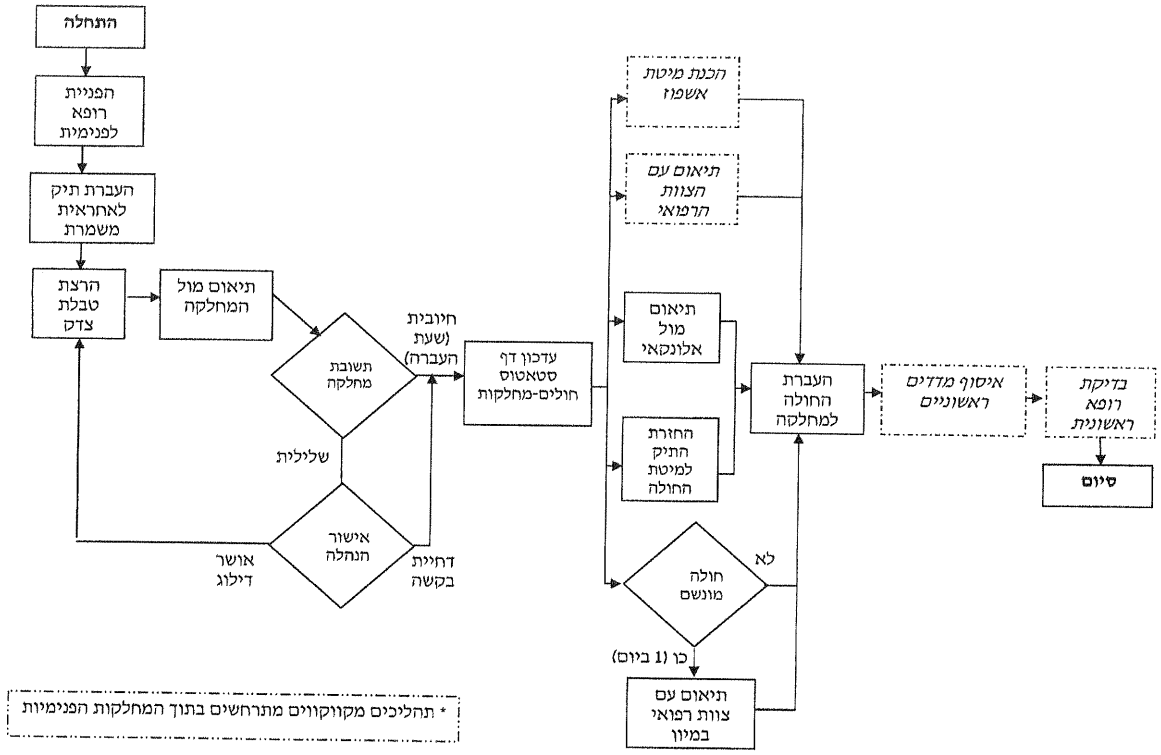
- Heath care today is a **highly customized job shop**
- Any accurate costing system must, at a fundamental level, account for the **total costs of all the resources used** by a patient as she or he traverses the system. That means **tracking** the **sequence** of and **duration** of **clinical** and **administrative** processes used by **individual** patients – something the most hospital **information systems** today are **unable** to do. (In the future: RFID etc.)
- With **good estimates of the typical path an individual patient takes** for a medical condition, providers can use the **Time-Driven Activity-Base Costing** (TDABC) to assign costs accurately and relatively easily to each process step along the path.
- Requires that **providers estimate only two parameters at each process step: the cost of each resource used in the process and the quantity of time the patient spends with each resource.**

The Cost Measurement Process:

- Select the medical condition
- Define the care delivery value chain (CDVC), which charts the principal activities involved in a patient's care for a medical condition along with their location.
- **Develop process maps** of each activity in patient care delivery.
- **Obtain time estimates** for each process.
- Estimate the cost of supplying patient care resources.
- Estimate the capacity of each resource and calculate the capacity cost rate.
- Calculate the total cost of patient care.

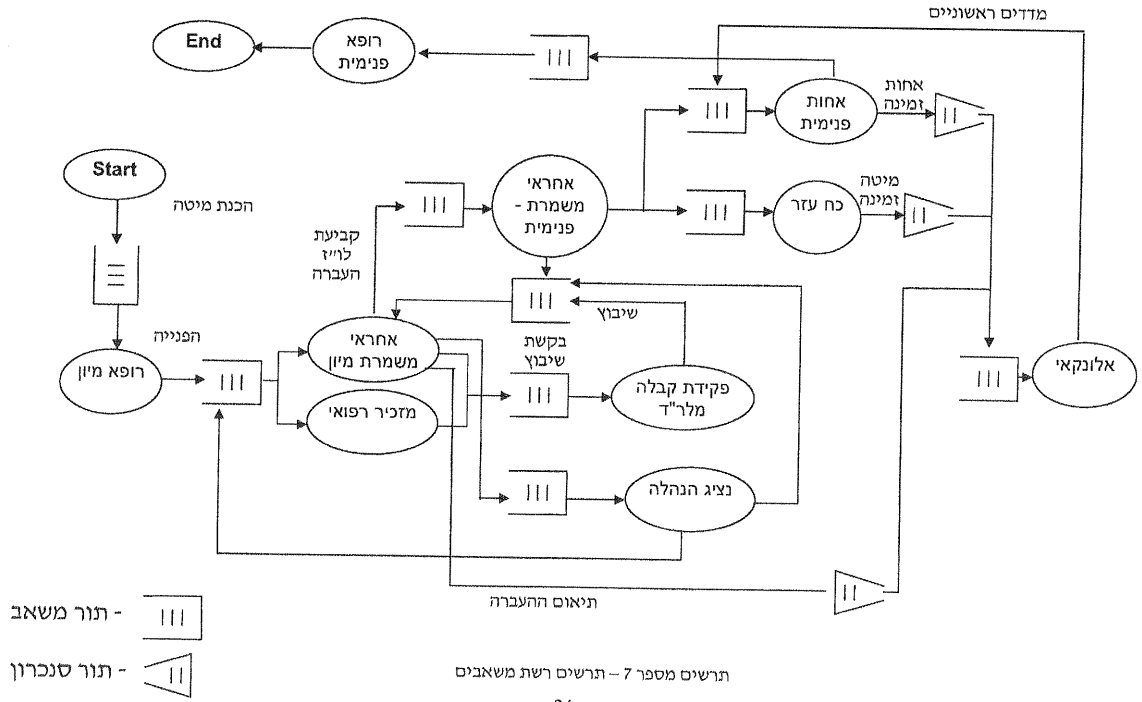
Reinventing Reimbursement: Abandon the current complex fee-for-service payment schedule. Instead, payors should introduce value-based reimbursement, such as bundled payment, that covers the full care cycle and included care for complications and comorbidities.

נספח ח' – תרשים פעילויות וקדימויות



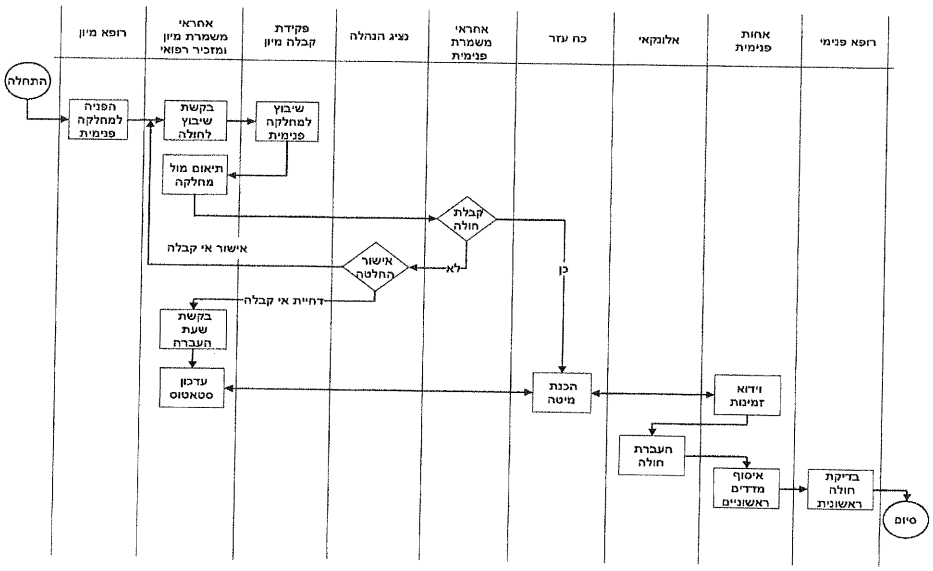
תרשים מספר 6 – תרשים פעילויות וקדימויות

נספח ט' – תרשים רשת משאבים



תרשים מספר 7 – תרשים רשת משאבים

נספח י' – תרשים תהליך משולב



תרשים מספר 8 – תרשים תהליך משולב

Service Engineering

Why Queues ?
via Dynamic Stochastic PERT/CPM Networks

- Product/Service development
- Project management

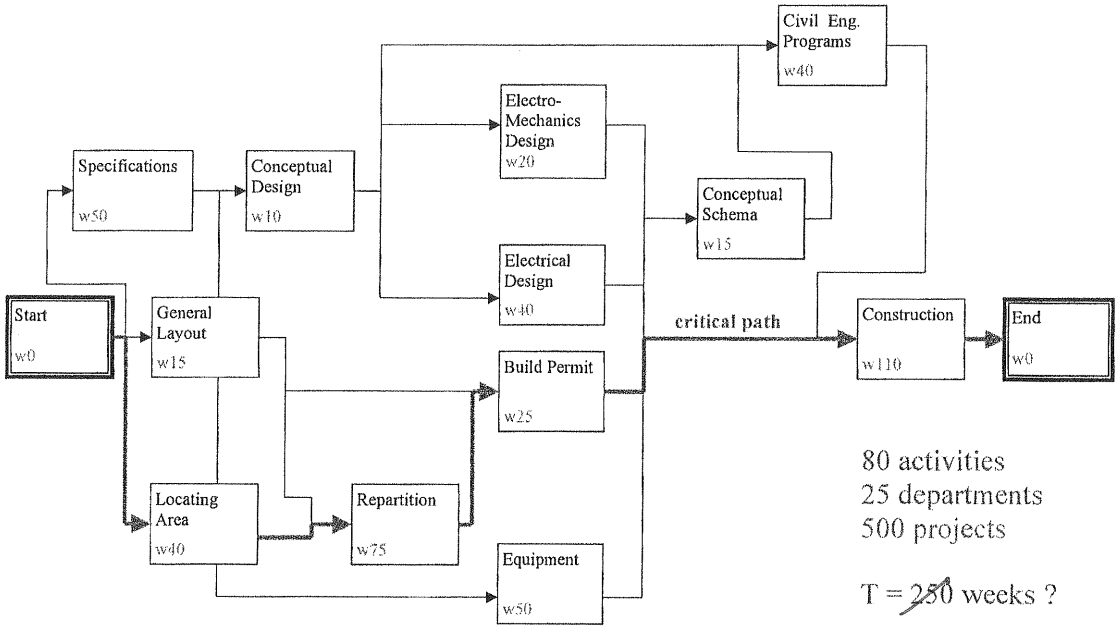
Both "enjoy":

- Stochastic environment
- Multi-projects
- Scarce resources

4

Traditional PERT/CPM Representation

Project View

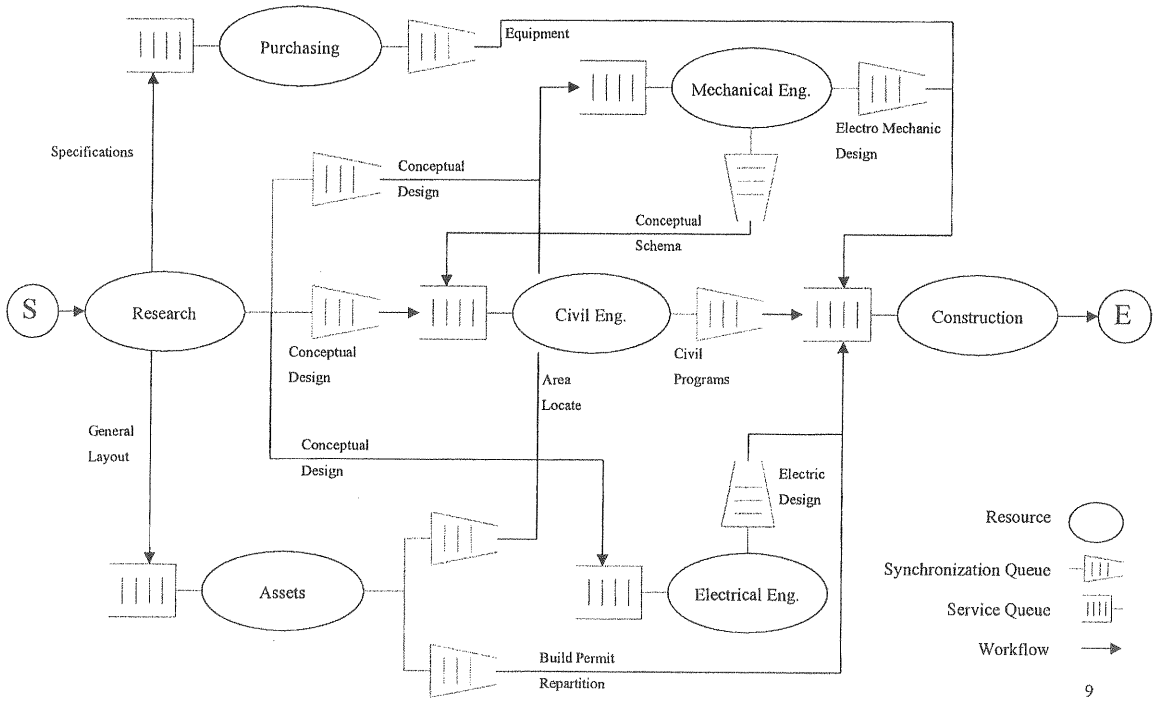


80 activities
25 departments
500 projects

T = ~~250~~ weeks ?

265 = 50 + 10 + 40 + 15 + 40 + 110

Processing Network Representation

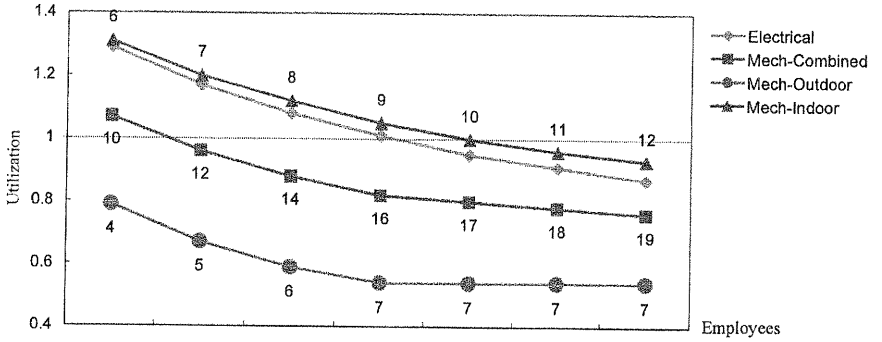


Can We Do It ?

Capacity Analysis -
[= Fluid-view (first moments)]

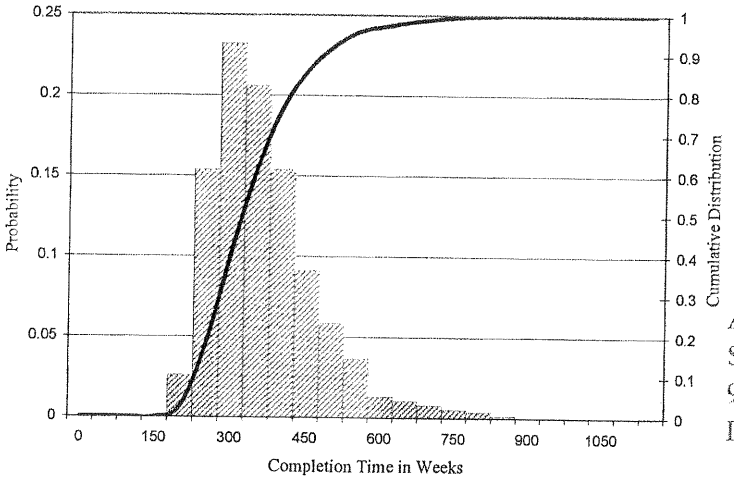
Utilization as a function
of the number of employees:

Electrical		Electro-Mechanic Combined		Electro-Mechanic Outdoor		Electro-Mechanic Indoor	
Employees	Utilization	Employees	Utilization	Employees	Utilization	Employees	Utilization
6	129%	10	107%	4	79%	6	131%
7	147%	12	96%	5	67%	7	120%
8	168%	14	88%	6	59%	8	112%
9	191%	16	82%	7	54%	9	105%
10	92%	17	80%	7	54%	10	100%
11	91%	18	78%	7	54%	11	96%
12	87%	19	76%	7	54%	12	93%



How long Will It Take ?

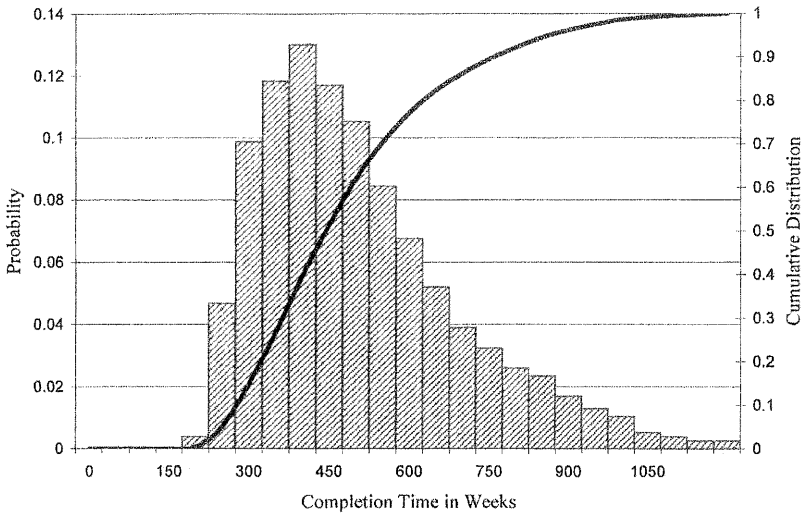
Stochastic static model (single project):



Avg. 338 weeks
Std. 100
90% 475
Det. 250

How Long Will It Take ?

Stochastic dynamic model:



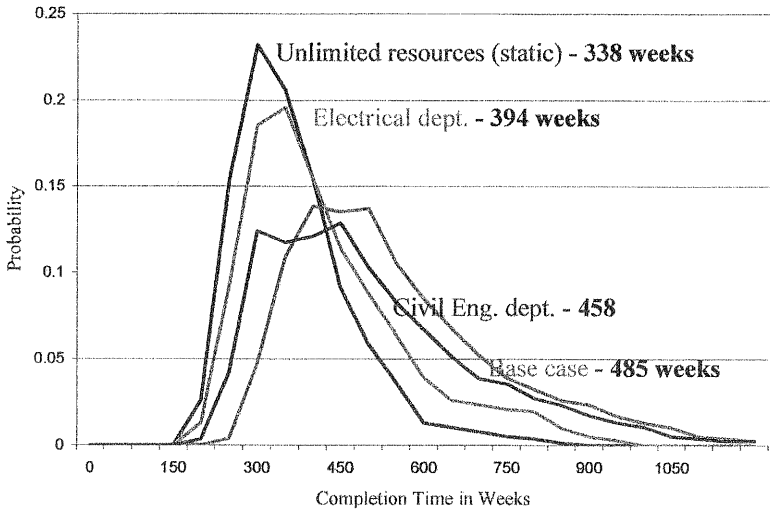
4 Types:

Type	Per year
New sub-station	3.27
New switching stations	0.6
Improvements	3.4
Additional capacity	1.9

Avg. 485 weeks
Std. 199
90% 770
Det. 250

Can We Do Better ?

Relieving bottlenecks:



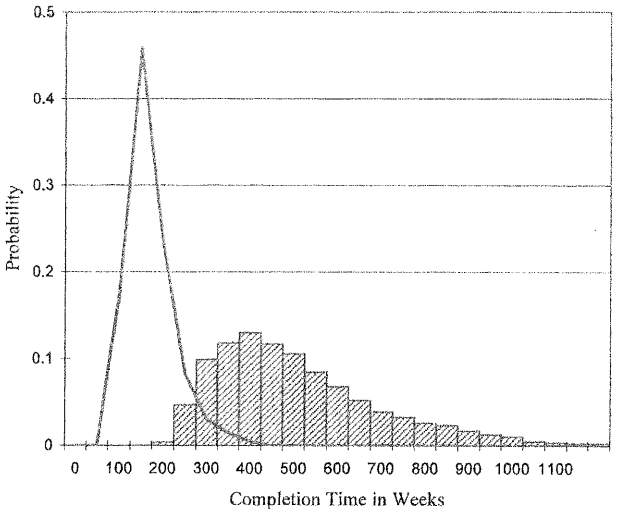
Unlimited resources:
(= Stochastic static)
Avg. 6 years.
10% over 9 years.

6 years avg. too long.
=> Resources NOT the problem !

(Infinite-server models are important).

Can We Do Better ?

New location management and standardization:



	Base	New
New location mgt:		
	40 weeks,	8 weeks
	0.5 prob. of repeat	0.8 prob.
Standardization:		
	8000 hrs. planning,	2000
	repeats,	none
	long execution times	↓25%
Avg.	485 weeks	189
Std.	199	55
90%	770	294

Summary

	E	σ	90%
Deterministic	~~251~~ 265 weeks	0	~~251~~ 265
Stochastic Static Single-Project	338	100	475
Stochastic Dynamic Multi-Projects	485	200	770 (14 years)
Infinite Resources	338	...	...
Re-Engineering	189	55	294