Multiskillness and health care process types

Frits van Merode, Jyoti R.Munavalli, Shyam Vasudevarao

Symposium CHOIR in Practice
UTWENTE, 22 november 2013

Maastricht UMC+

academisch ziekenhuis Maastricht azM | Maastricht University

Multiskillness in health care: Observations

- Jobs in health care become more and more specialized.
- Often efficiency arguments for specialization do not appear true.
- Flexibility of work force decreases.
- Complexity of planning increases.

Multiskillness:

- Staff can be allocated to various tasks requiring different skills.

Multiskillness is an important issue because:

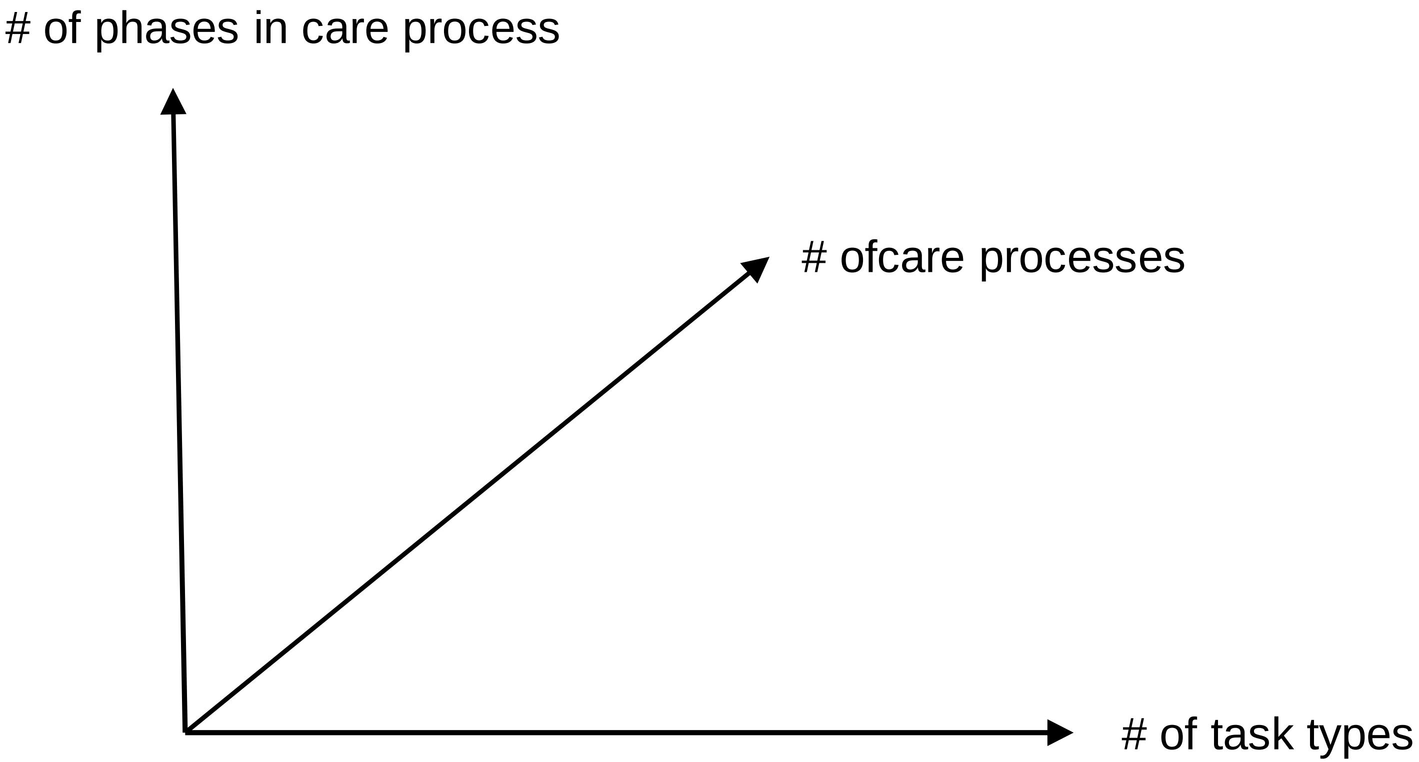
- There is always a labour shortage issue.
- There is a trend towards hierachical as well as horizontal differentiation in jobs and jobs requirements
- Often staff is underutilized, flexibility can increase efficiency.

Multiskillness:

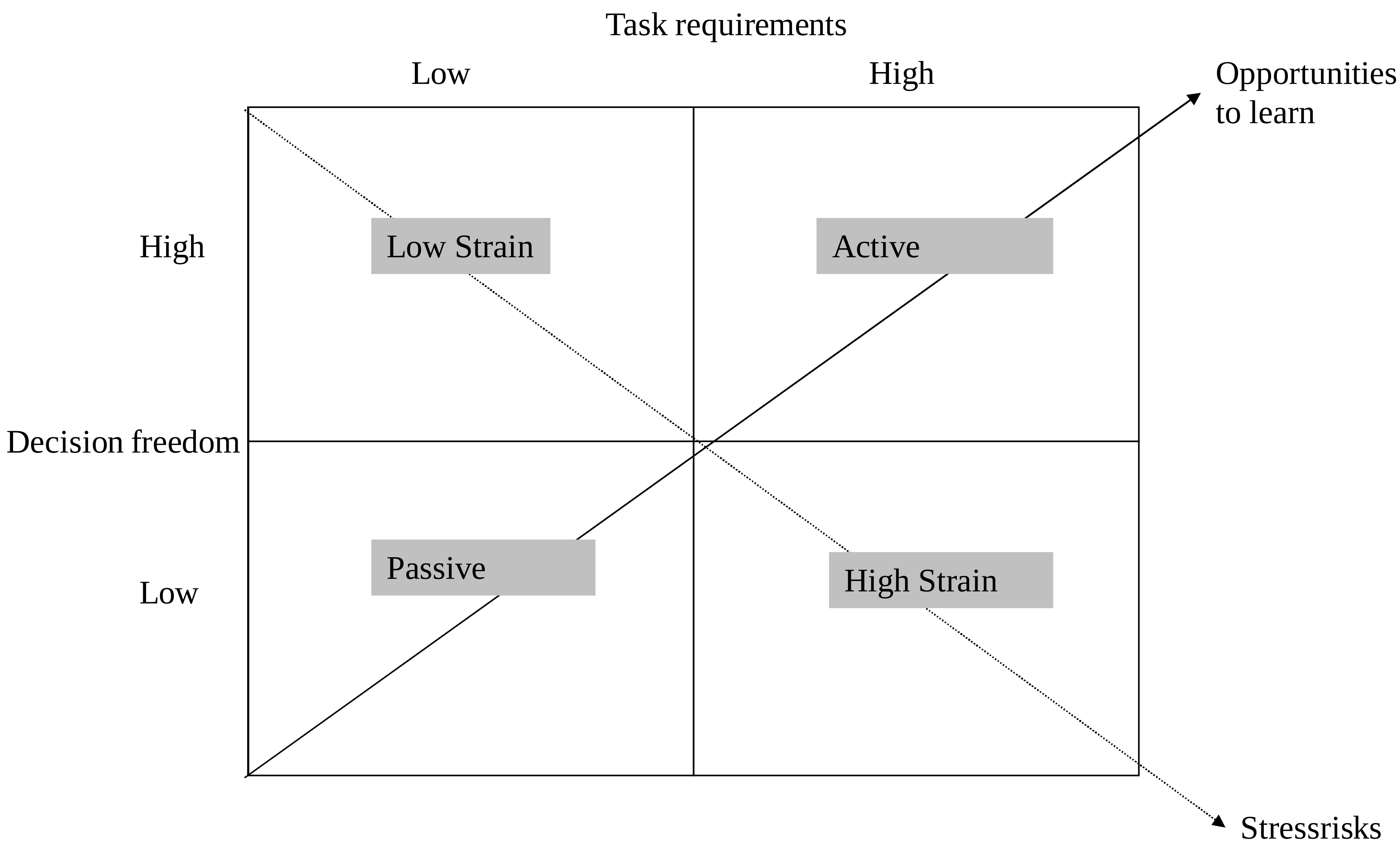
- Staff can be allocated to various tasks.

- Staff work on different types of tasks, and/or
- Staff is involved in different care processes, and/of
- Staff is involved in different phases of care processes.

Dimensions of multiskillness:

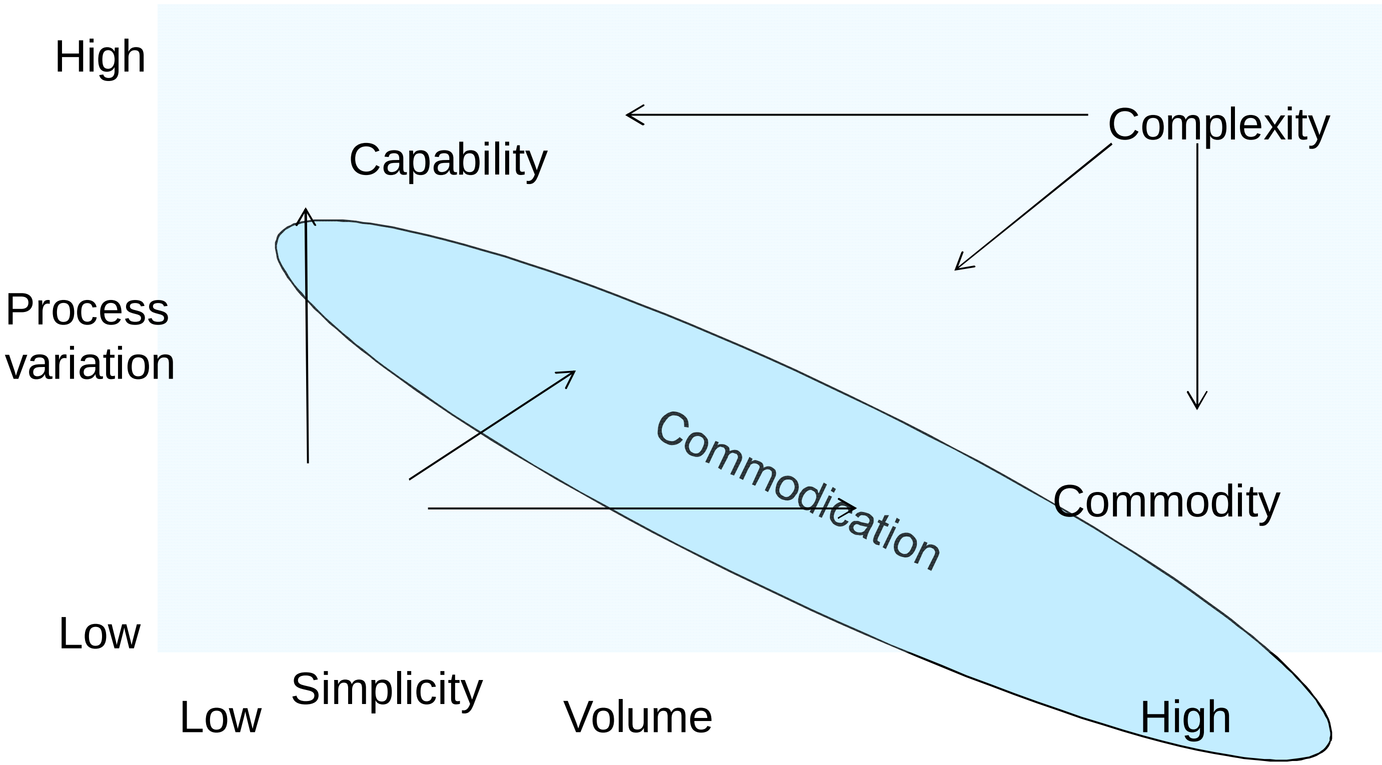


Karaseks model (1979, 1990)



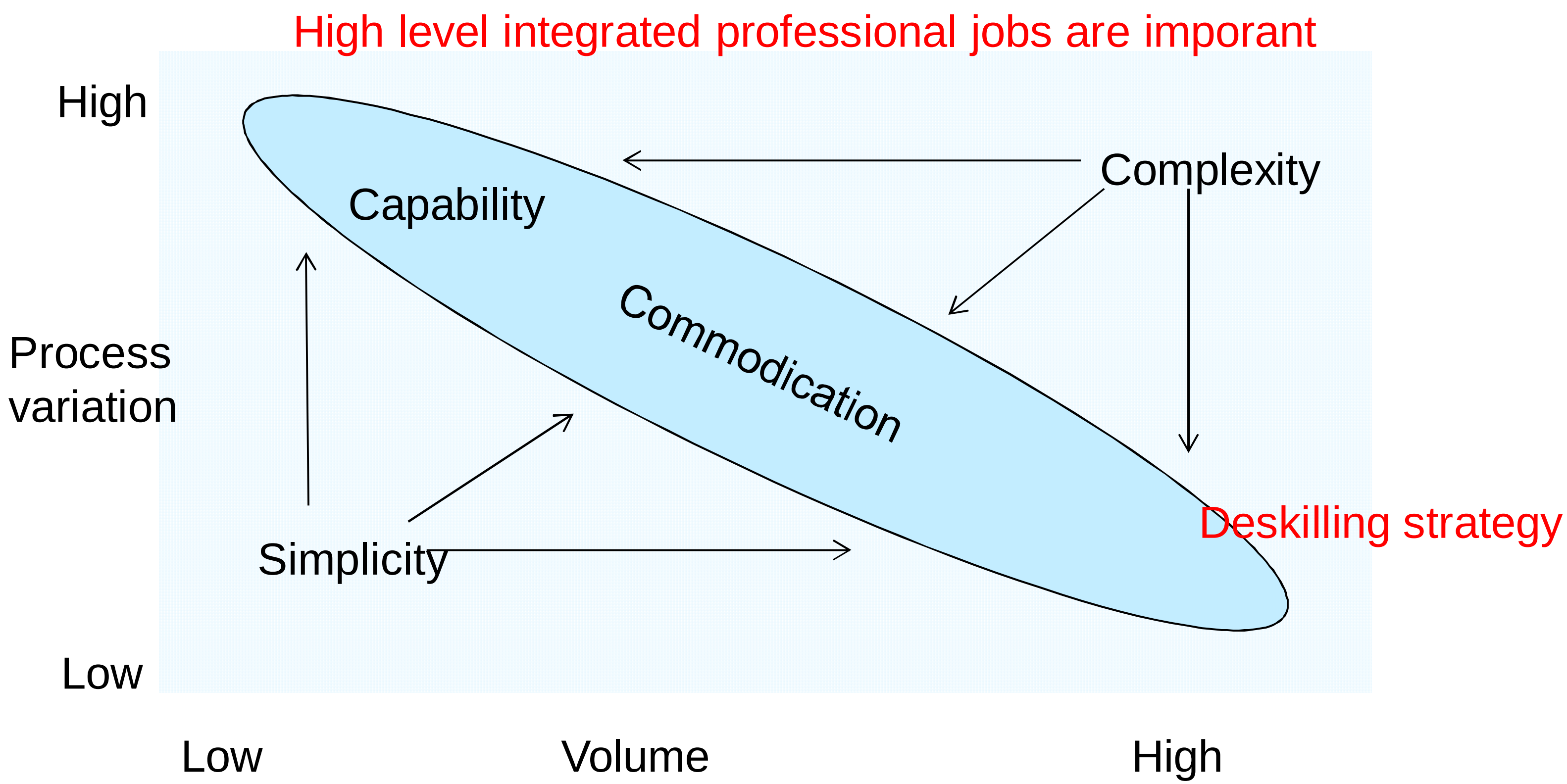
Job and process design are interrelated

Process variation versus volume



Bron: Johnston, R., G. Clark, and M. Shulver, *Service Operations Management: Improving Service Delivery* 2012, Harlow, Essex: Pearson.

Process variation versus volume

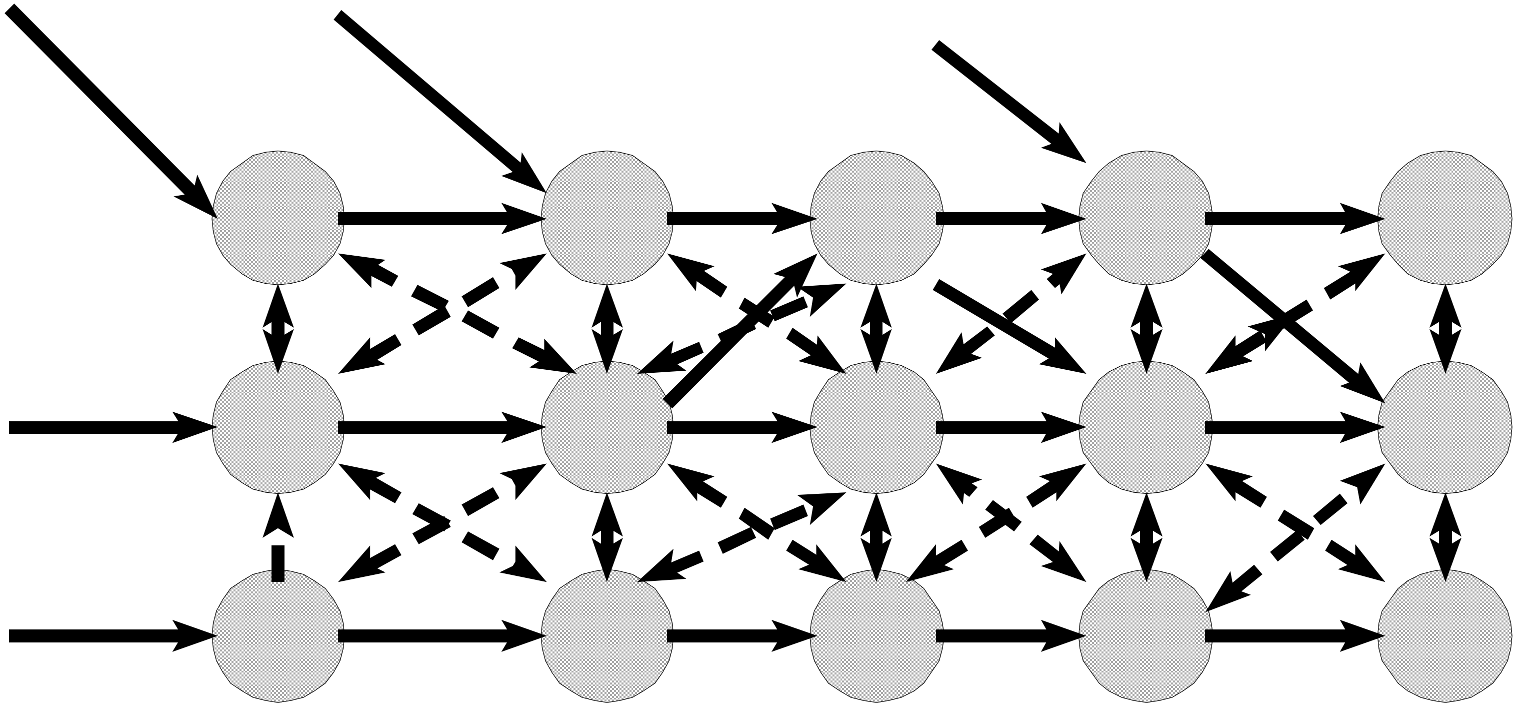


Apart from volument there is ‘uncertainty’

- Processing uncertainty
- Arrival uncertainty
- Intervention uncertainty

- How to keep the hospital synchronized?

Lack of synchronization leads to waiting times for patients and underutilization of capacity



The way to synchronization.

- Case study 1: What is the optimal structure of a large clinical laboratory with multiskillness?
- Case study 2: Real time scheduling of staf and patients in a large eye hospital with a deskilling strategy.
- Case study 3: Automating health care, avoiding the skill issue.

The way to synchronization.

- Case study 1: What is the optimal structure of a large clinical laboratory with multiskillness

Case study 1: large clinical laboratory

- Standardized processes.
- Departments with job shop structure and with production line structure.
- Short turn-around times required.
- Variable arrival times and product mix characteristics.

- How can we optimize turn around times?
- What is de optimal combination of cross-skillness and the composition of departments: what are optimal teams?

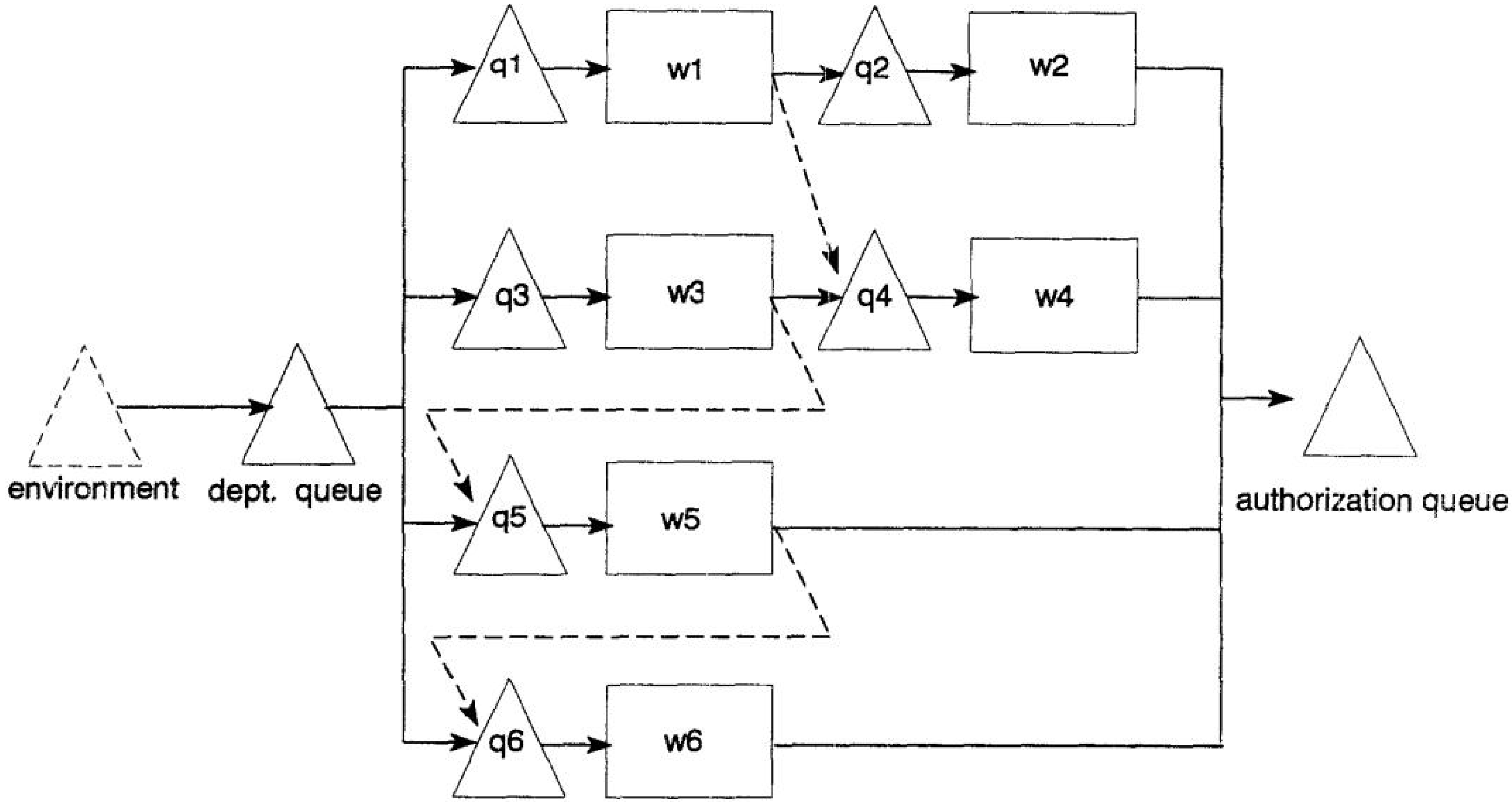


Fig. 1. Example of a layout of a laboratory department. Triangles indicate queues of samples. Boxes indicate workstations. Sample streams are represented by solid lines. Dashed lines indicate the possibility that samples flow from a particular workstation to another workstation.

van Merode, G.G., et al., *Advanced management facilities for clinical laboratories.* Computer Methods and Programs in Biomedicine, 1996. **50**(2): p. 195-205.

Data of processes for optimisation model

No	Workstation	Volume	Minimum (min)	mean (min)
1	Bulk chemical analyser	445	0.5	1
2	Specific test analyser	150	1.5	2.5
3	Specific test analyser	195	1.5	2.5
4	Glucose and chloride analyser	200	0.5	2
5	Bulk haematological analyser	425	0.5	1.5
6	Small size haematological analyser	95	1	2
7	Eye blood cell differential	55	2	2.5
8	Erythrocytes sedimentation rate (ESR)	125	1	2
9	Coagulation analyser	102	2	4
10	Urine stick analyser	102	2	4
11	Eye urine differential	43	1.5	2
12	Metabolic diseases screening tests	2	10	20
13	Metabolic diseases specific tests	2	10	20
14	Chromatography	90	4	8
15	Blood gas analyser	75	3	5
16	Manual techniques	25	60	60
17	Manual screening	150	2	3
18	Radio-immuno assays	70	5	10
19	Immuno assays	250	5	10
20	Reception area out-patient samples	600	1	1.5
21	Reception area in-patient samples	455	1	1.5

van Merode, G.G., et al., *Optimisation of the structure of the clinical laboratory.* European Journal of Operational Research, 1998. **105**(2): p. 308-316.

Approach:

1. Determine skill matrixes and their degrees of freedom.
2. Determine a covariance matrix with arrival patterns.
3. Use portfolio optimization (similar to the Markowitz model) to find the optimal # of departments.

Solution for scenarios for the optimisation model

Scenario		Minimum process time 17 technicians available			Mean process time 24 technicians available		
# job shops	Max # technicians	#technicians total per period	Max idle time	Total idle time (min)	#technicians total per period	Max. idle time	Total idle time (min)
3	5	57	16.27	90.40	–	–	–
3	8	57	10.11	90.49	92	56.50	220.00
4	5	57	13.00	90.49	–	–	–
4	8	57	27.00	90.49	92	16.00	220.00
5	5	58	46.00	225.49	92	29.00	298.50
5	8	58	46.00	225.49	92	18.00	220.00

van Merode, G.G., et al., *Optimisation of the structure of the clinical laboratory.* European Journal of Operational Research, 1998. **105**(2): p. 308-316.

Results of portfolio - optimization:

- Multiskillness has a large effect.
- Switching and set up costs do have a large effect to.
- Portfolio optimization is effective to design departments, but investing in flexibility of staff and processes has a larger effect.

The way to synchronization.

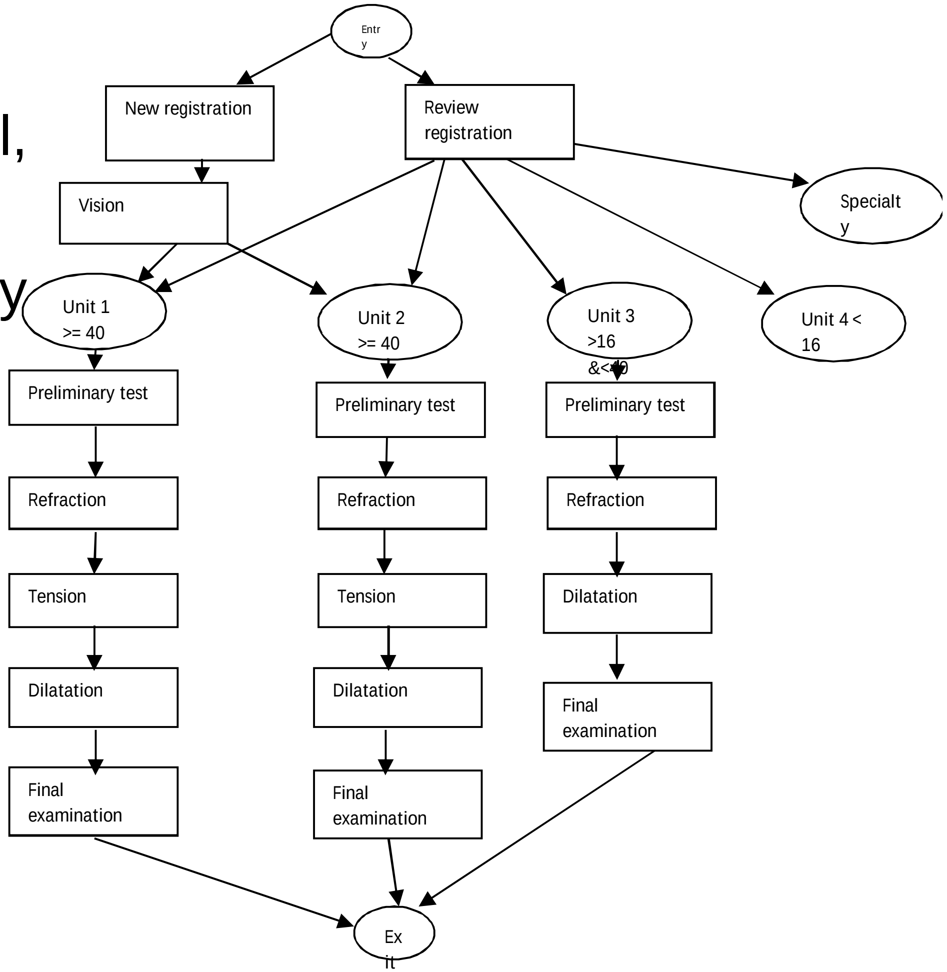
- Case study 2: Real time scheduling of staff and patients in a large eye hospital with a deskilling strategy.

Example 2: Real time scheduling

Example 2.
Real time schedulingPull systems in Aravind Eye Clinic, Madurai, India.

Case Study

- ❖Aravind Eye Care Hospital, Madurai, South India
- ❖General and super specialty clinics
- ❖Out-Patients/day
  - ❖ 1433 (on average)
  - ❖ 2300 (peak season)



Objectives of Research

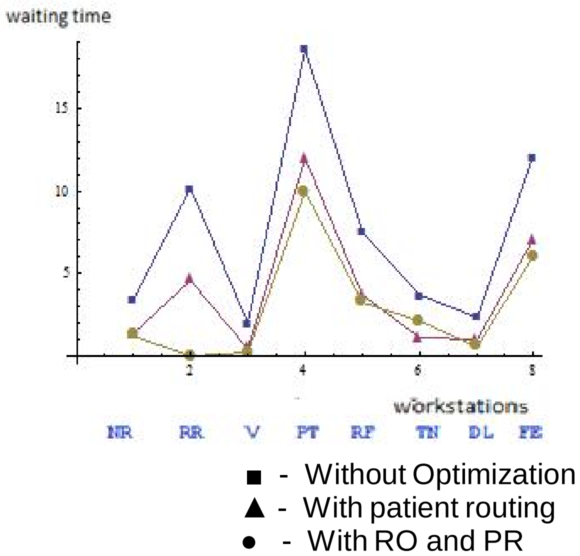
- ❖ Determine the workflow and capacity characteristics of Aravind.

- ❖ Resource Optimization: Reschedule staff during the day.
- ❖ Real time Patient Routing to minimize the patient wait time.

Results

❖ The resource optimization and real time patient routing algorithms are implemented. The results obtained are compared.(existing scenario, optimized staffing and optimized patient scheduling). The wait time reduced by 50% with these algorithms.

	Actual Aravind model	Using Patient routing algorithm	Using patient routing + Resource optimization model
Waiting time in minutes	42	18	15
Difference in load in both units	15	11	20



Both examples were of the high volume, low complexity type, but with often great volume variability.

The challenge:

‘A push system schedules the release of work based on demand, while a pull system authorizes the release of work based on system status.’(Hopp and Spearman 2001)

Hopp, W. J. and M. L. Spearman (2001). Factory Physics: foundations of manufacturing management. New York, Irwin/McGraw-Hill.

The challenge:

‘A push system schedules the release of work based on demand, while a pull system authorizes the release of work based on system status.’(Hopp and Spearman 2001)

Hopp, W. J. and M. L. Spearman (2001). Factory Physics: foundations of manufacturing management. New York, Irwin/McGraw-Hill.

In most hospitals the system status is not know.

The challenge:

‘A push system schedules the release of work based on demand, while a pull system authorizes the release of work based on system status.’(Hopp and Spearman 2001)

Hopp, W. J. and M. L. Spearman (2001). Factory Physics: foundations of manufacturing management. New York, Irwin/McGraw-Hill.

In most hospitals the system status is not know

Real time information is the problem, not planning

The way to synchronization.

- Case study 3: Automating health care, avoiding the skill issue.

Ophthalmology screening workflow

Refractor(Myopia Hyperopia)

Step 2
Refractometry

Step 3
Put eye drop &
Wait for pupil dilation

Retinal camera
(Image of Retina)

Step 4
Retina Imaging and save image

1. Costs 40-50 Lakhs
2. Need ~ 2 kW power
3. Need Doctor's presence
4. Not easily portable
5. One optometrician & Fundus photographer, & Nurse
6. Data Integration before Counseling & Reporting
7. Wait for ~ 3 hrs

Slit Lamp
(image of cornea)

Step 1
Cornea for cataract or any external infection

NC Tonometer
(Glaucoma by measuring intraocular pressure)

Step 5
Check Inter ocular pressure

Step 6: Collate all reports and send to Ophthalmologist for pril diagnosis and send to expert based on problem
Step 7: Council patients, wait for 2-3 hrs till the effect of dilation nullifies before leaving the hospital

Affordable: Ophthalmology screening workflow

A device that can screen for 5 common eye problems
OPD workflow at Eye Hospital / Screening centre/ camps

Refractor(Myopia Hyperopia)

Step 2
Refractometry

Step 3
Put eye drop &
Wait for pupil dilation

Retinal camera
(Image of Retina)

Step 4
Retina Imaging and save image

Slit Lamp
(image of cornea)

Step 1
Cornea for cataract or
any external infection

3nethra

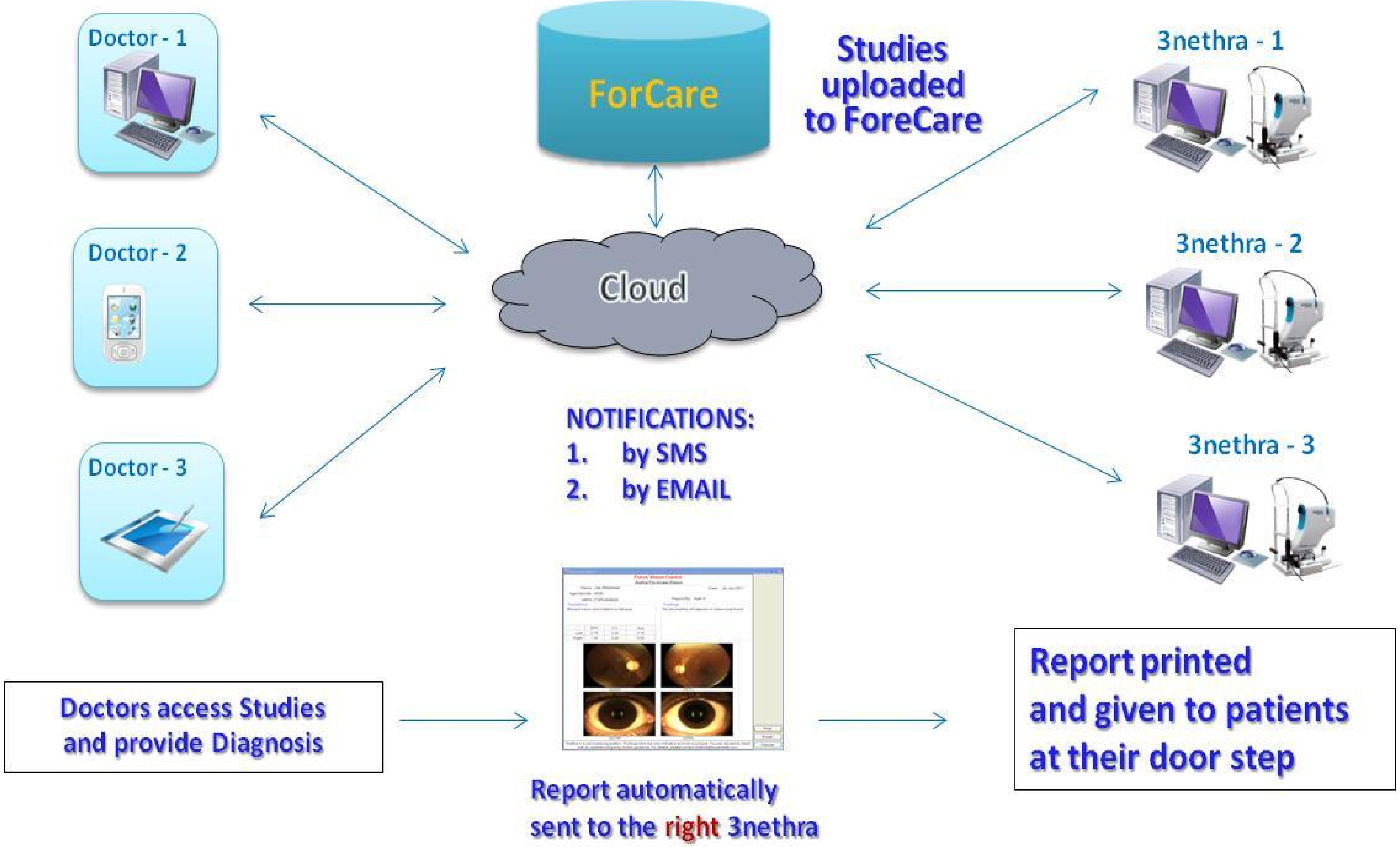
NC Tonometer
(Glaucoma by measuring intraocular pressure)

Step 5
Check Inter ocular pressure

Step 6: Collate all reports and send to Ophthalmologist for pril diagnosis and send to expert based on problem
Step 7: Council patients, wait for 2-3 hrs till the effect of dilation nullifies before leaving the hospital

Availability: 3nethra ForCare

3nethra Pre-screening in Rural India



Pre-Screen Report

Forus Vision Centre

3nethra Pre-Screen Report

Name: Jay Masekar
Date: 28-Jan-2011
Age/Gender: 28/M
MRN: FORU048632
Report By: Ajith S

Symptoms:
Blurred vision and irritation in left eye.

Findings:
No anomalies of Cataract or Glaucoma found.

	SPH	CYL	Axis
Left	0.75	0.25	0.75
Right	1.00	0.25	0.50

0005SR

0007CL

0007KR

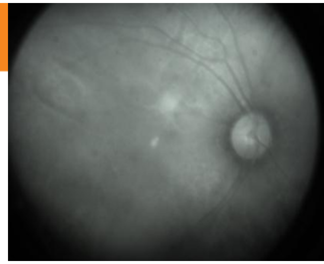
0005KL

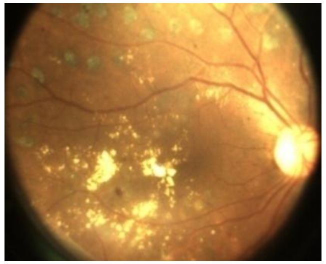
Print

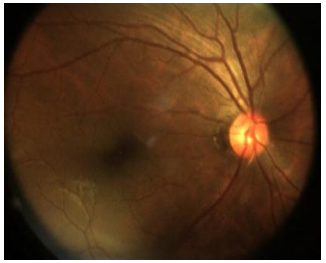
Email

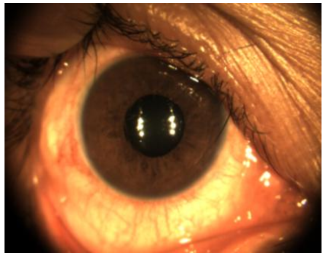
Cancel

3nethra is a pre-screening system. Findings here are only indicative and not conclusive. You are advised to check with an ophthalmologist for further guidance. For details, please contact 3nethra@forushealth.com.









Thank you