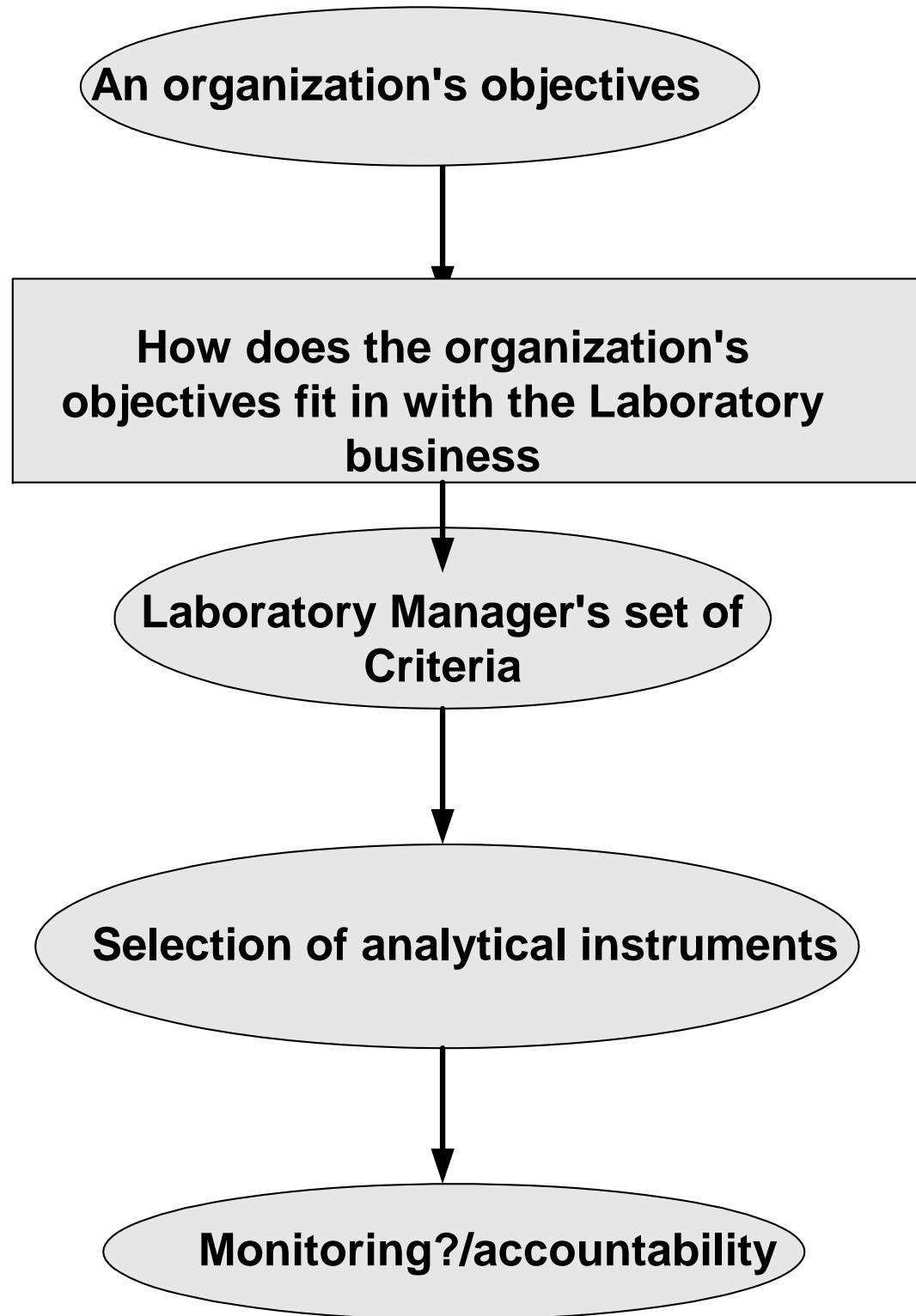


ANALYTICAL INSTRUMENTATION: SELECTION, COST vs BUSINESS REQUIREMENT

Sabah M. A. Al-Maawali

OUTLINE



An organization's objectives

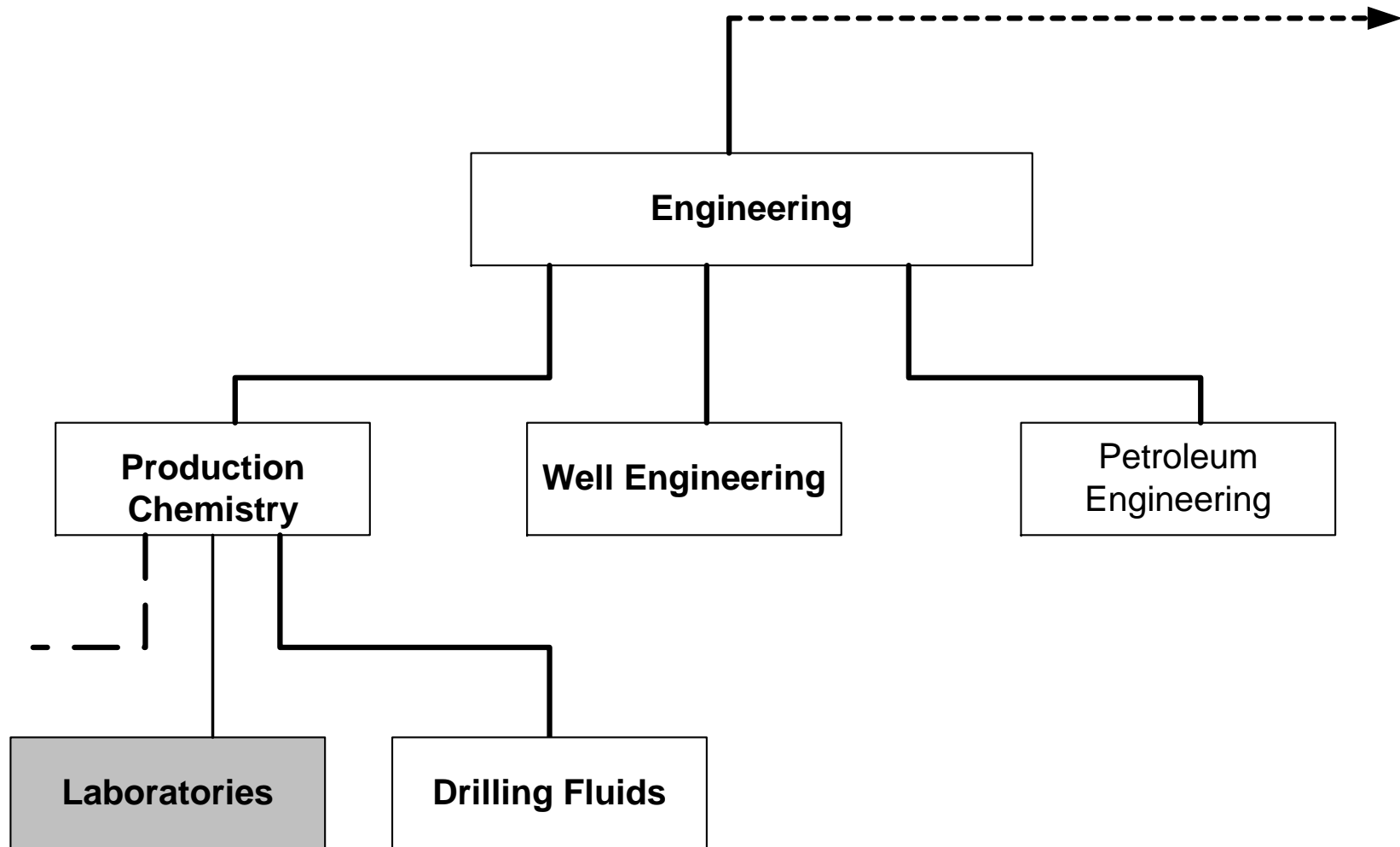
What are the main functions?

Examples

- **Industrial setting** *e.g. Oil and Gas*
- **Research setting** *e.g. Geological/Mineralogical Exploration*
- **Quality Control** *e.g. mining*

Where and how does the laboratory fit in an organization's hierarchy?

(An example)



How Does a Laboratory Manager Set his Criteria in relation to the objectives?

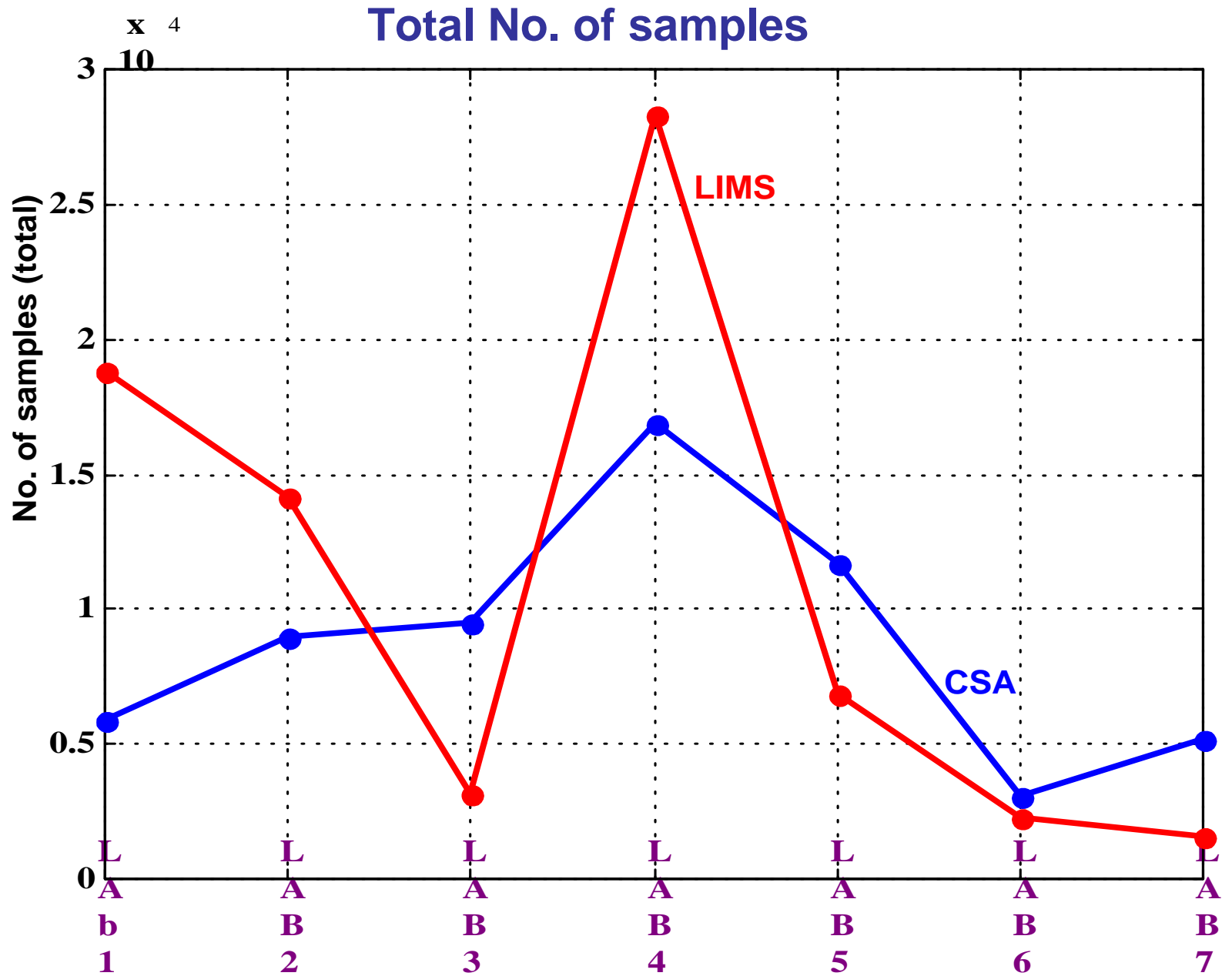
Analysis of a Laboratory Business within an organization

- ☐ Identify available budget allocated for the laboratories within a given department**
- ☐ Identify analytical workload to a laboratory/or laboratories (e.g. previous statistics from LIMS, is all data compiled in LIMS?) estimated daily, monthly, yearly etc**
- ☐ Study and analyze statistical trends of total and “categorized” analysis. Identify analytical work load routine vs non-routine**
- ☐ Identify growth of analytical work**
- ☐ Study and Classify analytical methods used by a laboratory and select the best methods in line with the required analysis by the customers**
- ☐ Establish “cost of analysis” trends, by benchmarking locally and internationally**
- ☐ Analyze Demands of quality compliance? (detection limits)**

Given Budget to the Laboratory

A laboratory manager needs to know the budget allocated to a laboratory/laboratories by the department

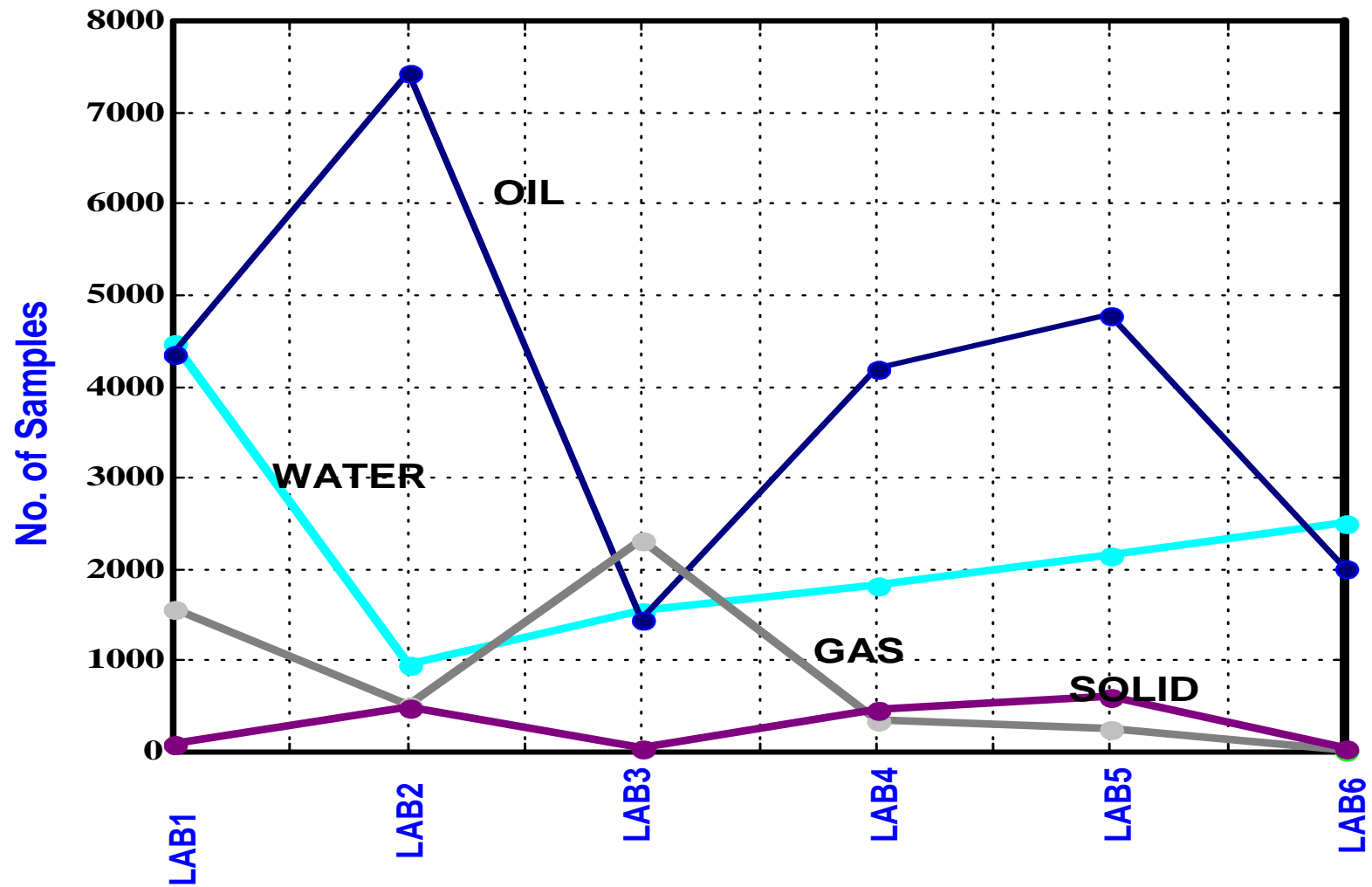
Identify Analytical Work Load



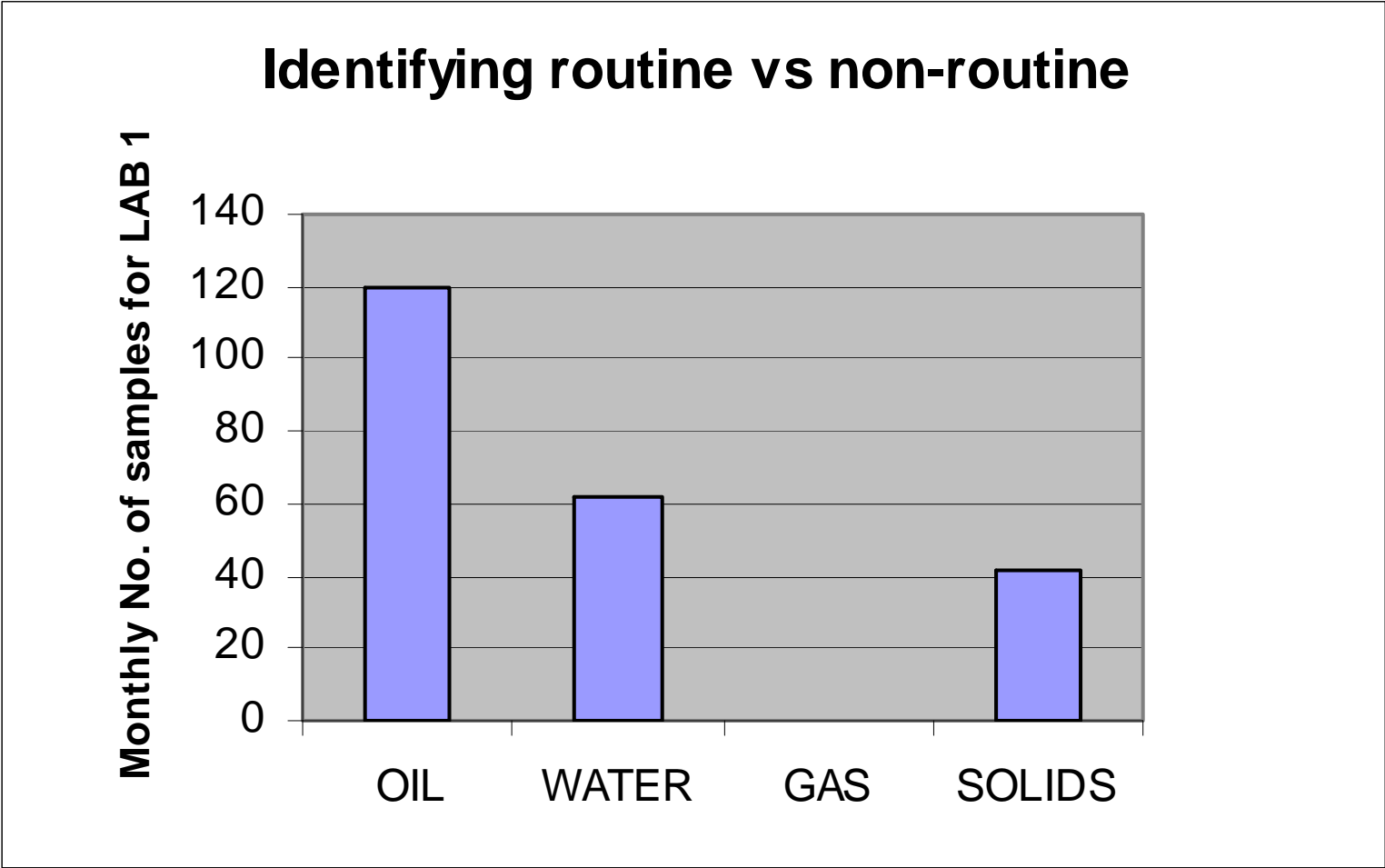
CSA (Customer Service Agreement)

Identify Analytical work load

Categorized Analysis

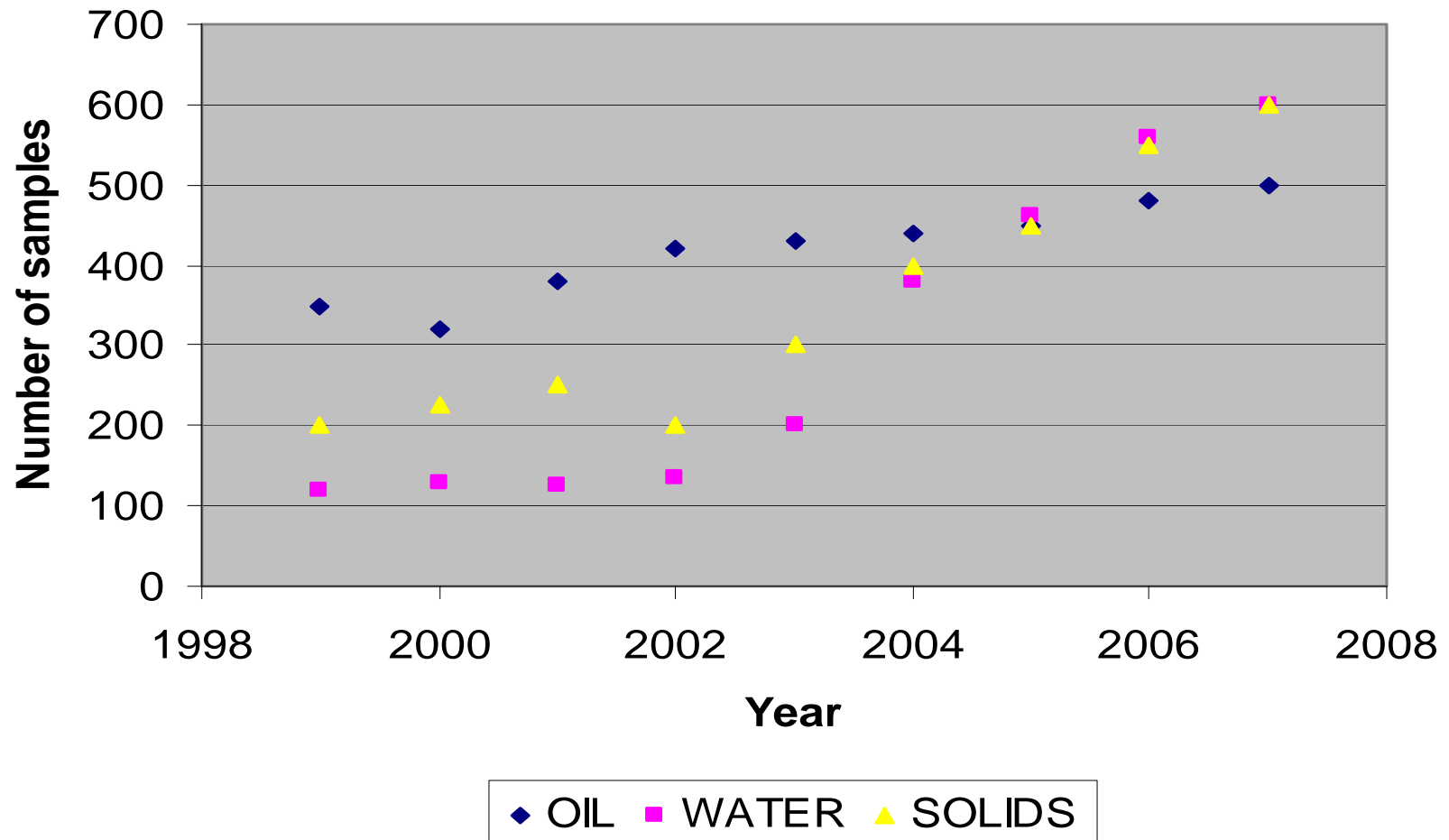


Identify type of analysis routine vs non-routine

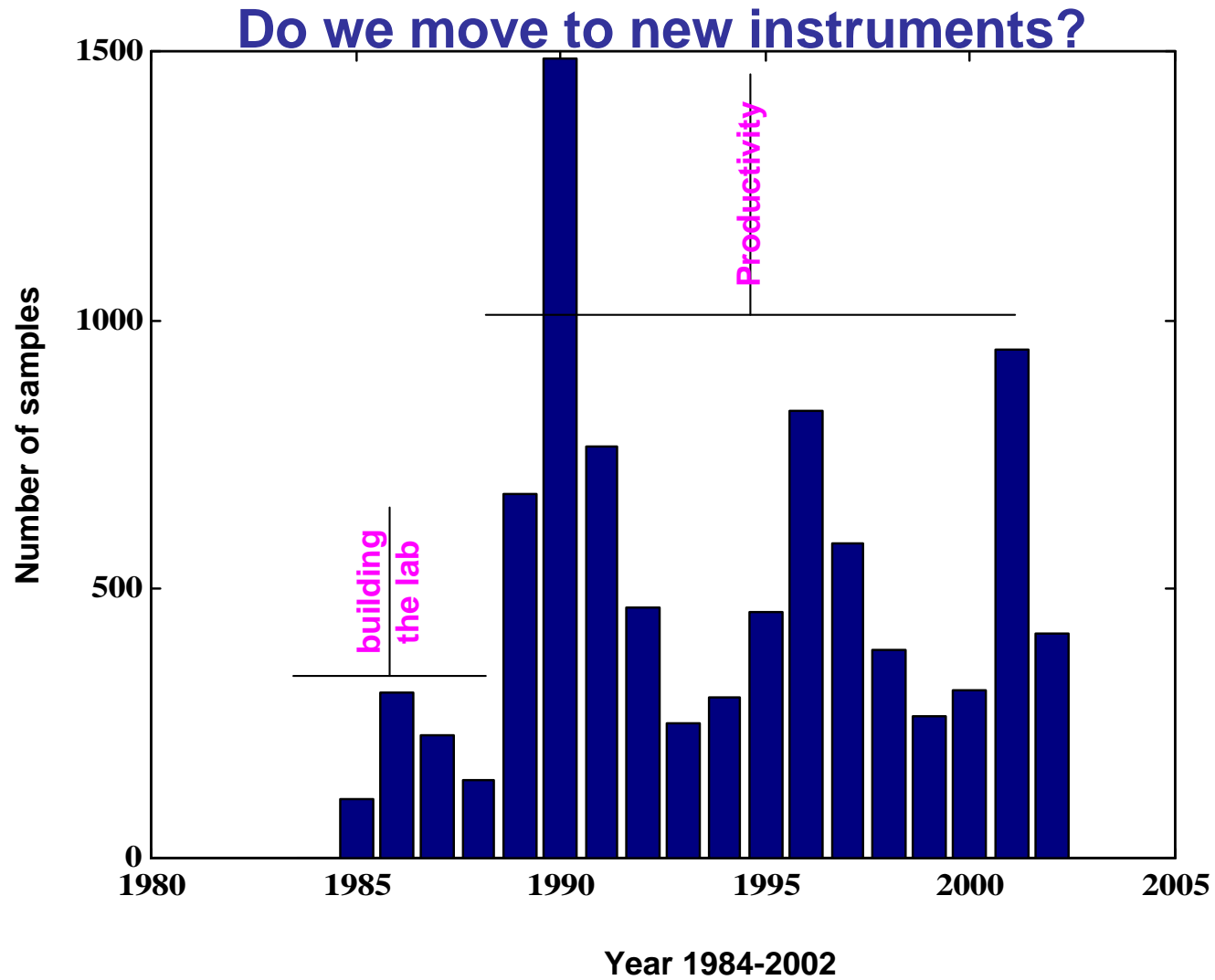


Identify growth of incoming analytical workload

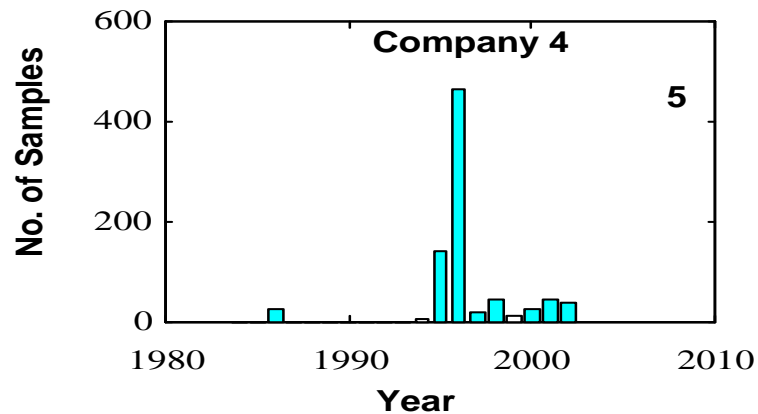
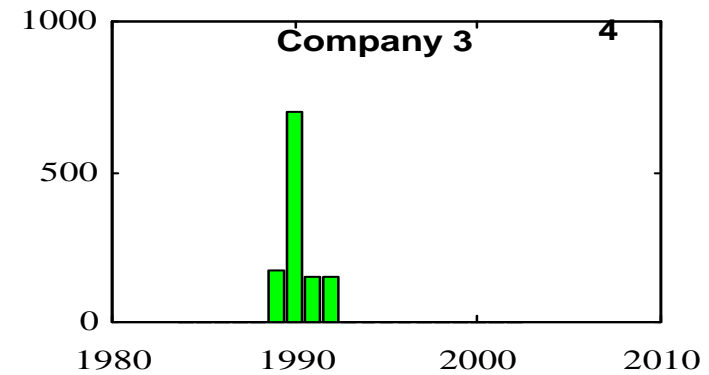
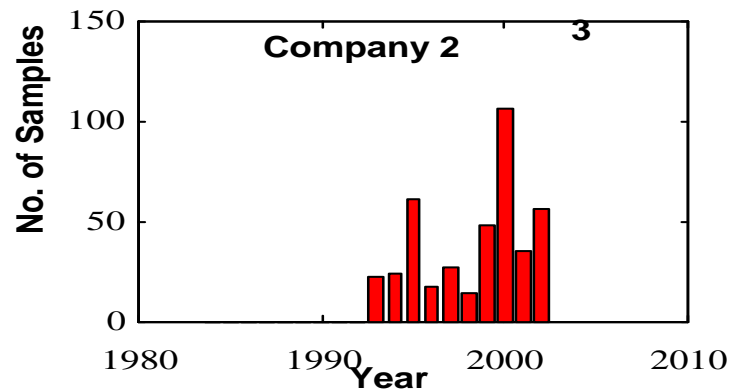
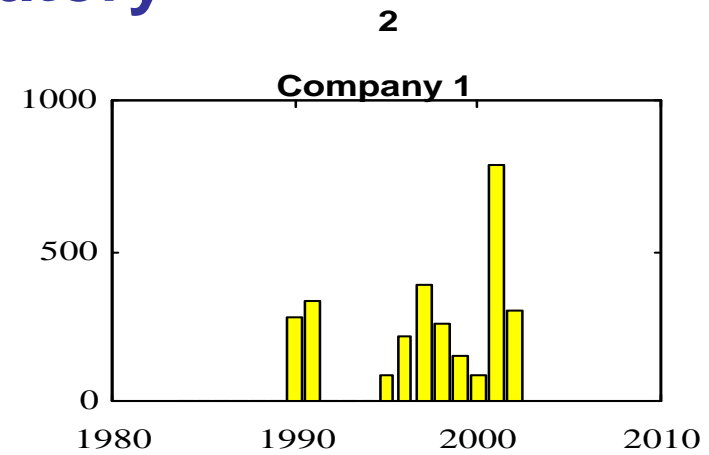
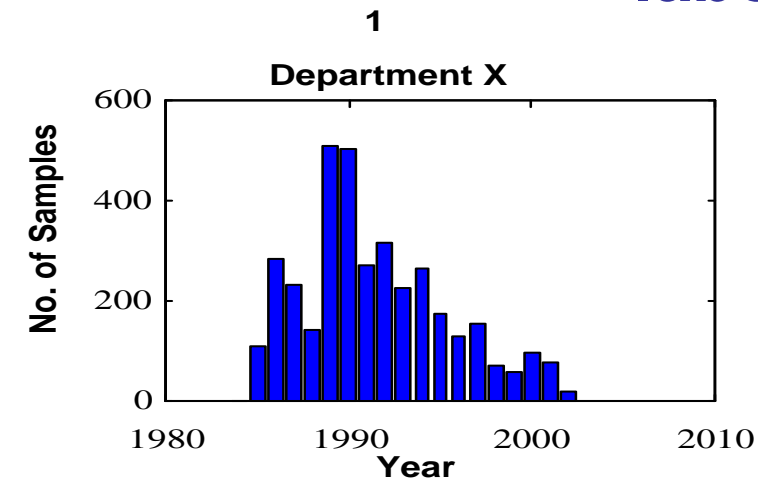
Analyzing statistical trends for LAB1



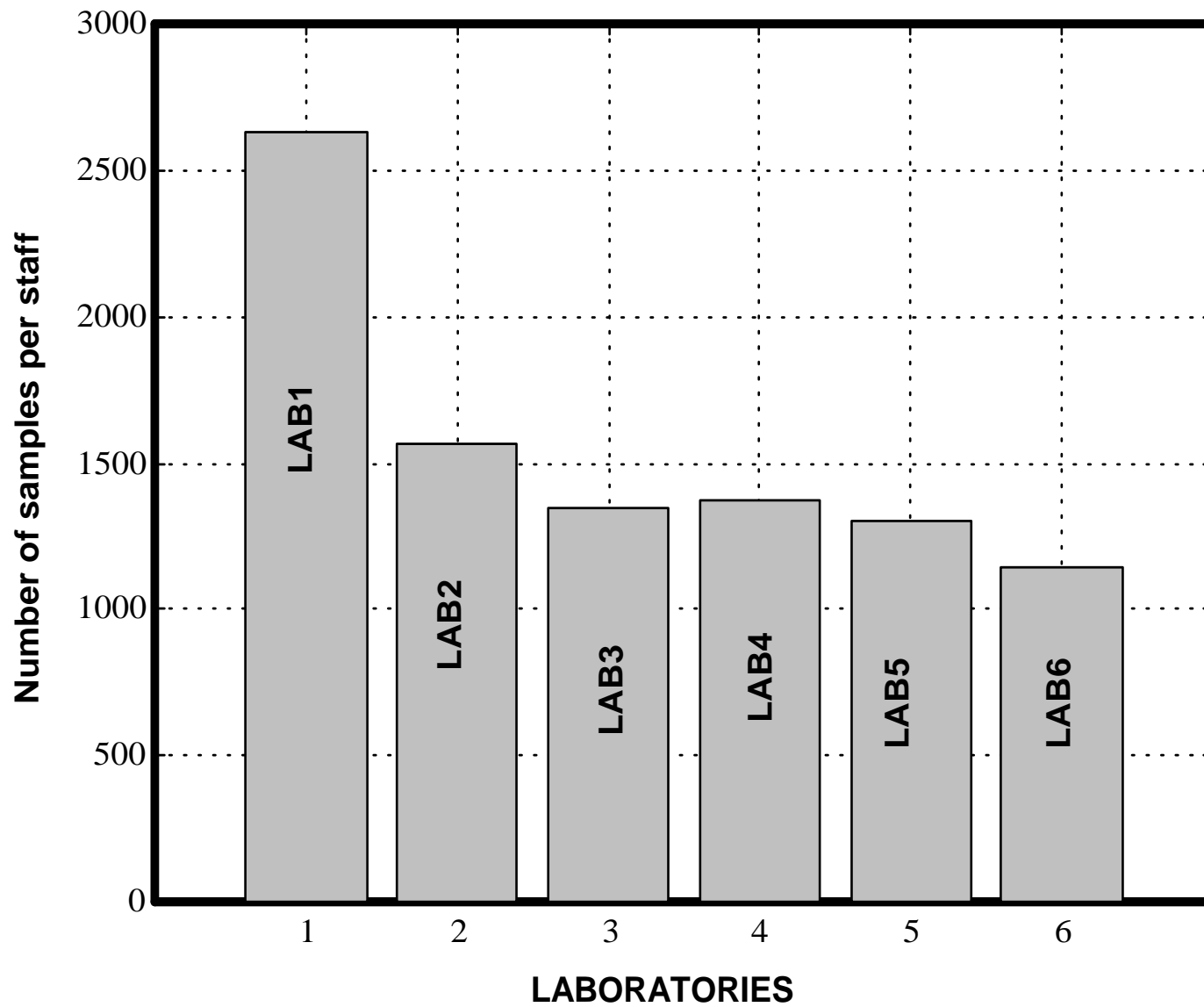
An Example: What is the Growth of a laboratory business



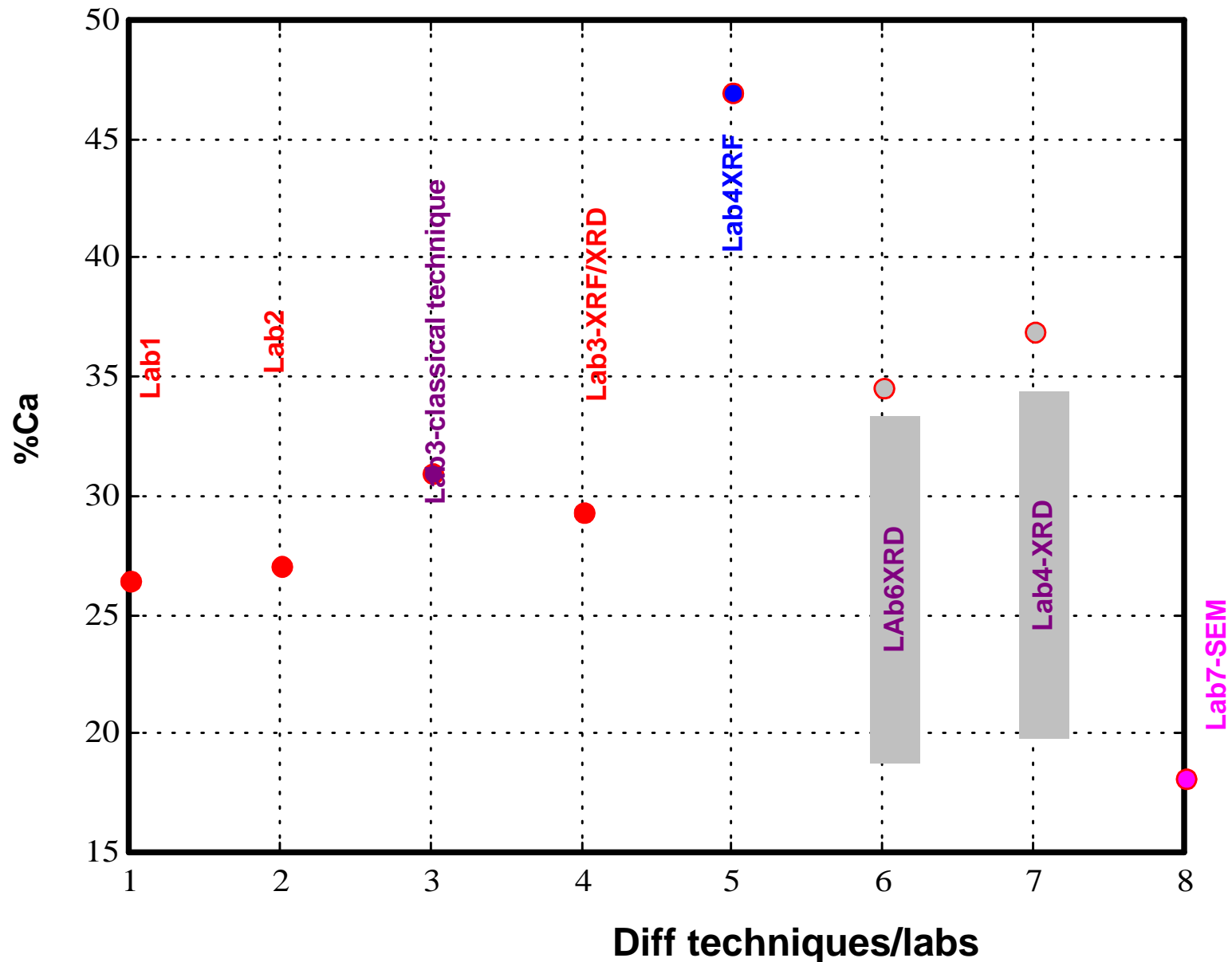
Analyzing source of analytical workload for a laboratory



Analysis of analytical workload per staff



Is Outsourcing is Necessary? Can samples be analyzed in-house?



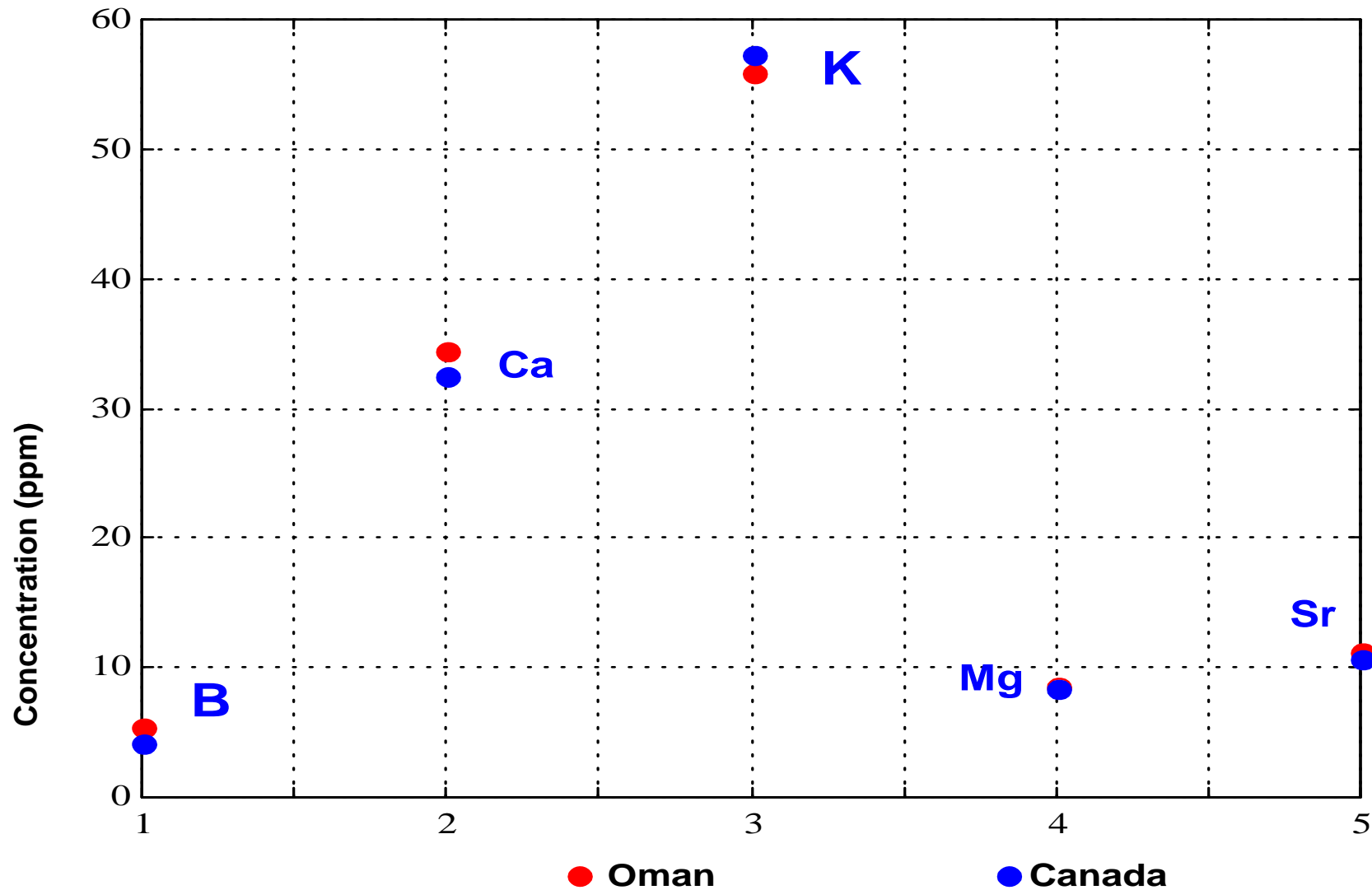
Establish "cost of analysis" trends, by benchmarking locally and internationally (an example)

Water	Lab price/element	Local price	Regional Price	International Price
ICP-OES				
Classical techniques				
OIL				
BS&W(ASTM?)				
Density(ASTM)				
Viscosity(ASTM)				
Oil/water(ASTM)				
SOLIDS				
X-Ray techniques				
Corrosion				
Scaling				
Cement/wells				

Analyze Demands of Quality Compliance

Are accreditation systems required ? GLP practices or is benchmarking enough?

Rima WSW-5



Study and Classify analytical methods

Laboratory manager needs to be dynamic and ready to accommodate change in technology at the same time realizing the value of classical methods.

Selection of analytical Instruments

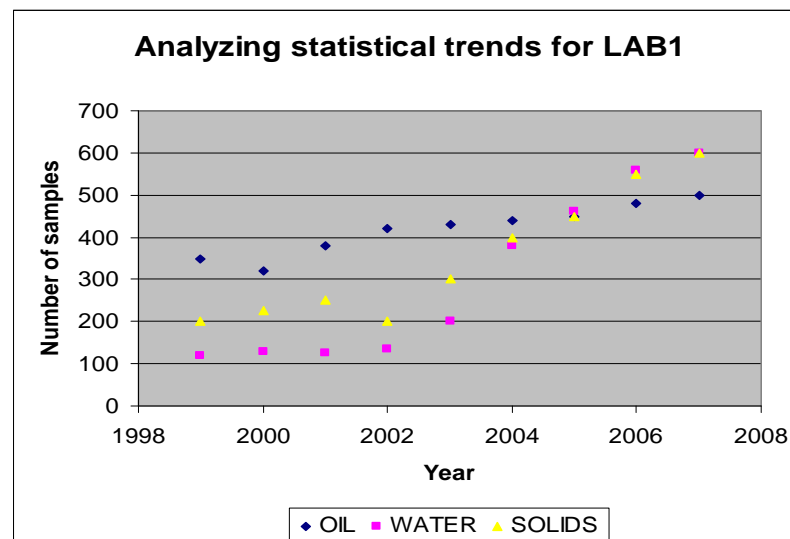
- Cost of equipment**
- Business Needs**
- Staff competence levels/availability of staff**
- Technical evaluation of (Speed, Accuracy, sensitivities, environment...)**
- Location of laboratories (remote /or capital area)**
- Availability of servicing companies**

Selection of Analytical Instruments: An example-GC-Chromatography for gas analysis

	Company	Manufacturer	Offers	Price (OR)	Delivery time/others
1	Local agent 1	Agilent 3000 Microgas chromatograph	4 GC channels. Configure to analyze composition and calorific value of refinery gas streams including labtop and HP laser printer Installation Testing and commissioning (PDO to pay airfare/boarding/lodging/local transportation)	39980 (is it for 2 or 1)	12 weeks
2	Local Agent 2	Agilent 3000 Micro Gas Chromatograph	4GC Channels. Configured to analyze Composition & Calorific value of refinery gas streams including labtop and HP laser printer	27600 (is it for 1 or 2)	Not Mentioned?
3	Local Agent 3	Varian 4900 Quad Micro GC system	(a)Three channel systems(H ₂ S 25ppm-50ppm and mercaptan) (b)Four channel system only single injection req. H ₂ S (25-50ppm and mercaptan) (c)Three channe sytems with DMD (differential mobile detector) analys specs met 3sample injections however advantage with DMD is D.L. to ppb levels	45914.977 (X2) 49962.196 (X2) 56081.404(X2))	Site installation. Free training for 2 technicians (except accomodation/tra vel cost)
4	Local agent 4	Agilent 3000 Micro gas Chromatograph	4GC Channels. Configured to analyze Composition & Calorific value of refinery gas streams includes installation/commissioning/on-site training by Agilent certified support engineer	43960	Not mentioned?
5	Local Agent 5	Varian CP-4900 Quad Micro GC	3 channels(details of each channelis given) Heated inlets/backflush options to avoid contamination Alternative offer with 4 channels Addition of C7-C10	84977(US\$) 94419(US\$)	Note: Detailed offer Offered advise as to the important factors to look for And training etc

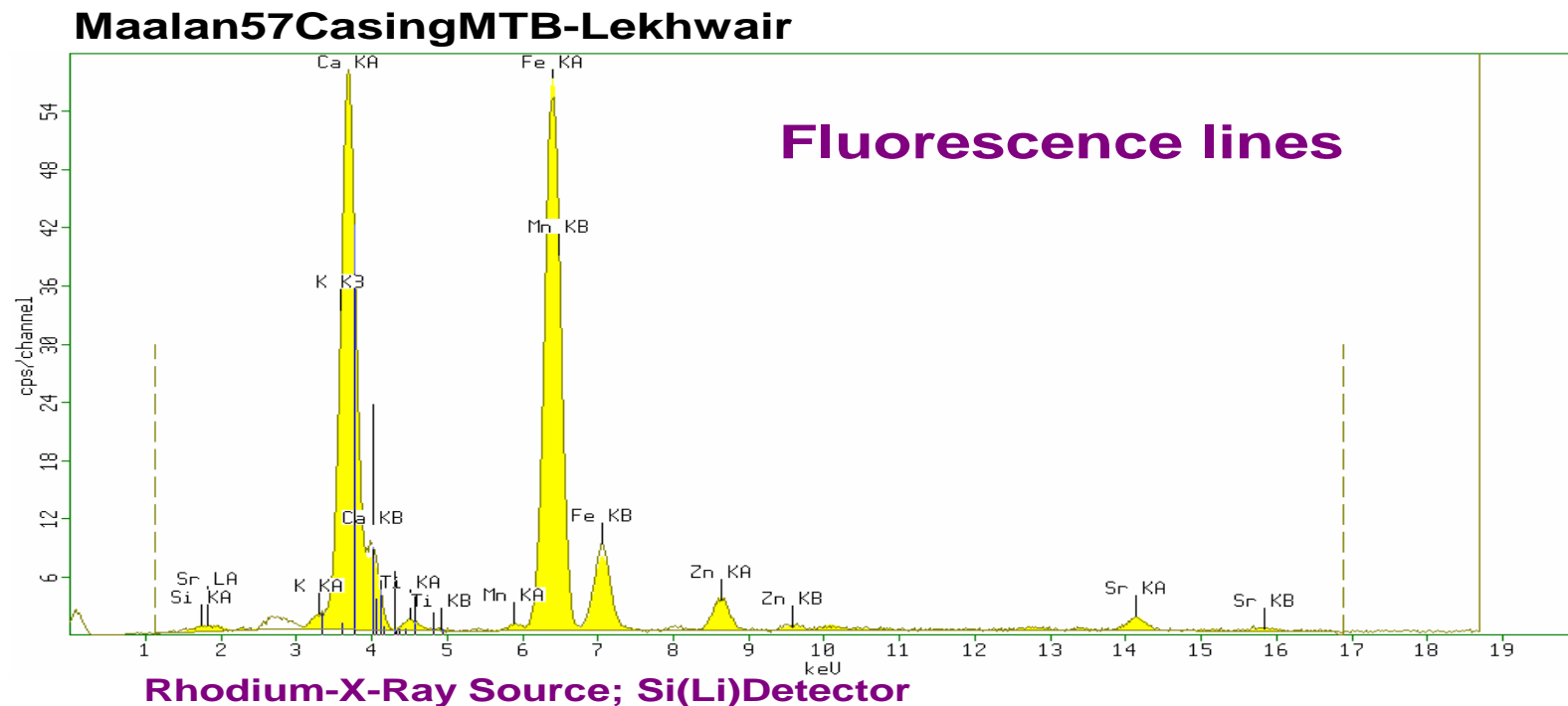
Selection of ICP-OES for increasing number of water samples

	OFFERS			
Technical evaluation (ICP-OES)	Company 1	Company2	Company 3	
Price(OR)	35000	52000	48000	
Does lab environment support instrument	No	No	No	renovate lab room to meet requirement?
Simultaneous analysis	yes	yes	yes	
Detectors	old/grating	new	new	
Plasma to handle high salts	No	Yes	Yes	
Servicing in the region (reliability)	yes	No	Yes	
Lab staff availability	offers Training	offers Training	None	
Location laboratory (Remote)	Supports	Supports	No support	



Selection of XRF Minipal (Panalytical): For identification of solids/problem solving in oil/gas industry

- Problem solving : Increasing solid samples, either due to corrosion, scaling, sulfur solids in gas filters,
- High cost of solid analysis / long transportation time if sent to international/regional laboratories
- Good regional servicing company in the region
- Quick qualitative scans



ANALYTICAL INSTRUMENTATION: BAD CHOICES

An analytical instrument was never used effectively after purchase due to many reasons

- Lack of availability of laboratory staff to operate the instrument**
- Lack of servicing companies in the region**
- Lack of spare parts**
- Cost of servicing and operation was underestimated**
- Lack of a proper laboratory environment e.g. humidity, vibrations, power instabilities, impure gases etc**

Examples: Bad choices

- **FTIR (laboratory near the ocean with no humidity control) -wrong laboratory environment**
- **HPLC (remote laboratory)-wrong laboratory environment, dust /sand**
- **Densitometers-poor manufacturer/corrosion in rough environment**
- **Viscometers-poor manufacturer/corrosion in rough environment**
- **AAS-wrong laboratory environment, high humidity not enough technical understanding**
- **XRF-poor manufacturer (company out of business) therefore lack of spare parts/services**

ANALYTICAL INSTRUMENTATION: GOOD CHOICES

An Analytical Instrument was used effectively

- Analytical data output reliable**
- Lab staff operators responsible, few breakdowns**
- Servicing companies in good coordination with the lab management in case of trouble shooting, problems resolve in short span of time**
- Analytical instrument provided services beyond its life-limit**
- Analytical instrument provided services beyond its boundaries**
- Analytical instrument exceeded its life limit but was donated to schools, colleges etc.**

Major Spectroscopic Equipment	Current Condition	Maintenance Contract Co. and Status	Comments
1.X-Ray Fluorescence Spectrometer	Functioning	PANalytical	Purchased in 1985 (Philips) therefore old and spare parts are becoming redundant
2.X-Ray Diffraction Spectrometer	Functioning	PANalytical	Purchased in 1985 (Phillips), upgraded.
3.Atomic Absorption Spectrometer (Perkin Elmer)	Functioning	Electromann but contract was not renewed 2005	Purchased in 1985, old but functioning
4.Atomic Absorption Spectrometer (Perkin Elmer)	Functioning but needs maintenance	Electromann but contract was not renewed 2005	Donation from JAPAN. FAAS and Hg Hydride system in working conditions bu GFAAS cooling system is currently out of order. Maintenance has not been renewed and spareparts take long time to obtain.
Sample Preparation Equipments			
Crushing Machines			Were found here since 1984
Rock Cutter Machines	functioning		Big cutter-earlier than 1984 Small cutter-
Fire Assay			Donation from JAPAN
Press-pellet machine			
Digestion Unit			

Monitoring/Accountable

Analytical Instruments were malfunctioning < 1 yr after purchase, who was responsible? Who is accountable? Result in overall laboratory business

Conclusions

When selecting analytical instruments for a laboratory, a laboratory manager's decisions most of the time will be dictated by logic based upon a given budget, statistics and business requirement.

However, the work environment will have a great impact on a laboratory manager's decisions and overall performance.

A statement from Stephen Covey's book "The eighth Habit", So much of what we call management consists of making it difficult for people to work"

Acknowledgements

- ❖ I am grateful to Eddie Stevenson (Head of Drilling Section, PDO/SHELL) for his support and fantastic guidance received in OIL and GAS matters

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I thank you for your attention