HC 4 ICTSM

- Grosch's Law (slide 2 – 4)
  - Is Grosch's Law true ? → $Cost \approx \sqrt{capacity}$?
  - w = capacity
  - a = proportional constant
  - r = interest rate
  - NPVa is de Netto Present Value van T2 ; NPVb is de NPV van T
  - The 141% interest rate is only the case for long time periods T or high inflations (over 100 % during one time period). Hence the consequences of Grosch's law are less trivial than might be expected at first.
  - Without recognition of response time and throughput, the definition of capacity could easily lead to a Grosch's law illusion. For example :a system with double speed can produce twice as much transactions with half the response time if that load is indeed available.
  - ILLUSION (consequent of Moore's Law) → gives you the impression of decreasing return on scale → there is no Grosch's Law (it is an Illusion)
  - Grosch's law was and is a statistical illusion. Its validation was (wrongly) based on a regression analysis through data series subject to decreasing computer prices, analogous to Moore's law. Furthermore, every technology that is subject to Moore's law type of effects can give rise to further illusions of the existence of Grosch's law, depending on the cost structure of the technology. Modern definitions of computer capacity, expressed by power and speed could also give rise to Grosch-like effects if the appropriate micro-economic features are not taken into consideration.
  - Comparing machines from over the years → cost/ capacity is decreasing over the years
- MIPS (slide 5)
  - Microprocessor without Interlocked Pipeline Stages
  - MIPS is a RISC → reduced instruction set computers → De Reduced Instruction Set Computer (RISC) is een processorarchitectuur waarbij iedere mogelijke instructie dezelfde hoeveelheid tijd nodig heeft om uitgevoerd te worden. Daaruit is de MIPS-architectuur gegroeid.
  - A old measure of a computer's speed and power, MIPS measures roughly the number of machine instructions that a computer can execute in one second.
  - RISC vs CISC → complex instruction set computers

MIPS ?

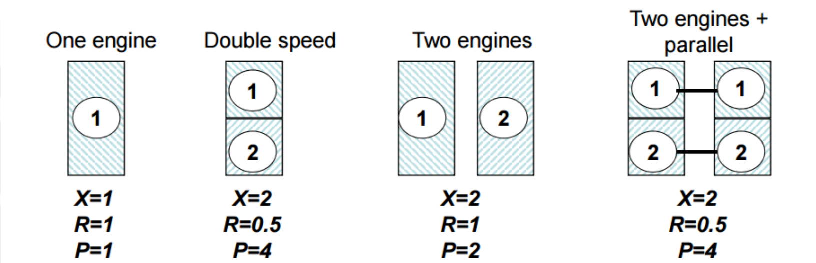
$$MIPS = \frac{10^3}{(Cycle\_time) \times {}^{cycles}/_{instruction}}$$

$$MIPS = Mhz \times ({}^{Instructions}/_{Cycles})$$

- A procedure to measure relative 'speed' (slide 6)
  - Service time = actual speed (without waiting time)
  - S = U / X
  - ITR : internal throughput ratio = relative busy time per transaction (service demand)

- internal throughput ratio’s indeed express the relative <u>speed</u> of a processor for a workload, while the external throughput ratio’s rather give <u>power</u> ratio’s

- The ‘Power’ of an infrastructure: cloud vs grid (slide 7)
    - VT = value throughput ; VR = value response time
    - Cloud
        - allows you to do multiprocessing
        - Cloud is basically an extension to the object-oriented programming concept of abstraction. Here cloud means the Internet. For the end users it is just getting outputs for certain inputs, the complete process that lead to the outputs is purely invisible. Computing is based on virtualized resources which are placed over multiple servers in clusters.
    - Grid
        - Grid systems are designed for collaborative sharing of resources. It can also be thought of as distributed and large-scale cluster computing. A Grid is basically the one that uses the processing capabilities of different computing units for processing a single task. The task is broken into multiple sub-tasks, each machine on a grid is assigned a task. As when the sub-tasks are completed they are sent back to the primary machine which takes care of the all the tasks. They are combined or clubbed together as an output.
    - Cloud vs. Grid
        - Server computers are still needed to distribute the pieces of data and collect the results from participating clients on grid.
        - Cloud offers more services than grid computing. In fact almost all the services on the Internet can be obtained from cloud, eg web hosting, multiple Operating systems, DB support and much more.
        - Grids tends to be more loosely coupled, heterogeneous, and geographically dispersed compared to conventional cluster computing



    - P : pow
    - Parallel vs speed? Which one fits better? It can be seen that with one server working twice as fast customers spend less time in the system on average, but have to wait longer for service and also have a higher probability of having to wait for service. (stel er komen twee mensen tegelijk binnen, bij parallel kunnen die beide direct behandeld worden, bij double speed moet er eentje wachten ©SiSi)
    - By just doubling the engines the power and throughput doubles but the response time stays equal so either work with one engine and increase the speed or work with two engines that work parallel to become the optimal response time and power.
    - parallel processing can deliver the economical capacity of a faster processor. It should be stressed however that this only holds for a fully parallelizable workload, which is hard to achieve.

- recent applications of parallel technology include the implementation of parallel operating systems on slower cheaper processors, to emulate the speed of faster processors with the same operating system, and the implementation of parallel algorithms for speeding up query processing in relational DBMS.
- The above arguments demonstrate that the notions of speed versus capacity should not be interchanged and can largely influence the discussion of possible Grosch effects.

- Moore's Law (slide 9-11)
  - Moore's law refers to an observation made by Intel co-founder Gordon Moore in 1965. He noticed that the number of transistors per square inch on integrated circuits had doubled every year since their invention.
  - Moore's law predicts that this trend will continue into the foreseeable future. Although the pace has slowed, the number of transistors per square inch has since doubled approximately every 18 months. This is used as the current definition of Moore's law.
  - **BREAKING DOWN 'Moore's Law' :** Because Moore's law suggests exponential growth, it is unlikely to continue indefinitely. Most experts expect Moore's law to hold for another two decades. Some studies have shown physical limitations could be reached by 2017.
  - the cost of the chips remains stable, so that Moore's law is seen to imply again the illusion of Grosch's law for that technology
  - The biggest challenge for the information and communication technology is the moment where Moore's law starts to slow down, due to the physical limits of the material that is used in the chips. From that point on, it makes no longer sense to manufacture smaller chips. However, due to market expansion for example, prices can still go down for the same amount of capacity and in this way still give rise to Grosch like effects.

- ICT LIFE CYCLE (Total Cost of Ownership = TCO) (slide 12)
  - While IT budgets are nowadays increasing, the revenue from them for most companies is still low, because there is inadequate control in IT spending. However, IT infrastructure is critical for competition, and provides organizational change, so the effectiveness of IT expenditures needs to be maximized.
  - **Total cost of ownership (TCO)** is a measure of IT expenditures, it refers to costs related with owning and maintaining computers or workstations. The TCO is directly proportional to IT service levels, so **to maximize the value of IT expenditures** one needs to **reduce** the TCO and **maintain/improve** the IT service levels.
  - **Centralization** (consolidate software access, distribution & network administration in a few central locations) and **standardization** (minimization of hardware/software configuration differences) are two policies for reducing IT costs by simplifying operations, and it is shown that they pay off. Another way to reduce costs is by **reducing the service**.
  - **Futz factor:** Wasting time "futzing" around with new technology
  - **Slide 13:** Traditionally, IT costs are treated as overhead rather than direct costs. Overhead costs are either inappropriately absorbed by IT departments or charged out equally to all business units regardless of individual consumption. Such indiscriminant cost-allocation schemes encourage the overutilization of underpriced services and the

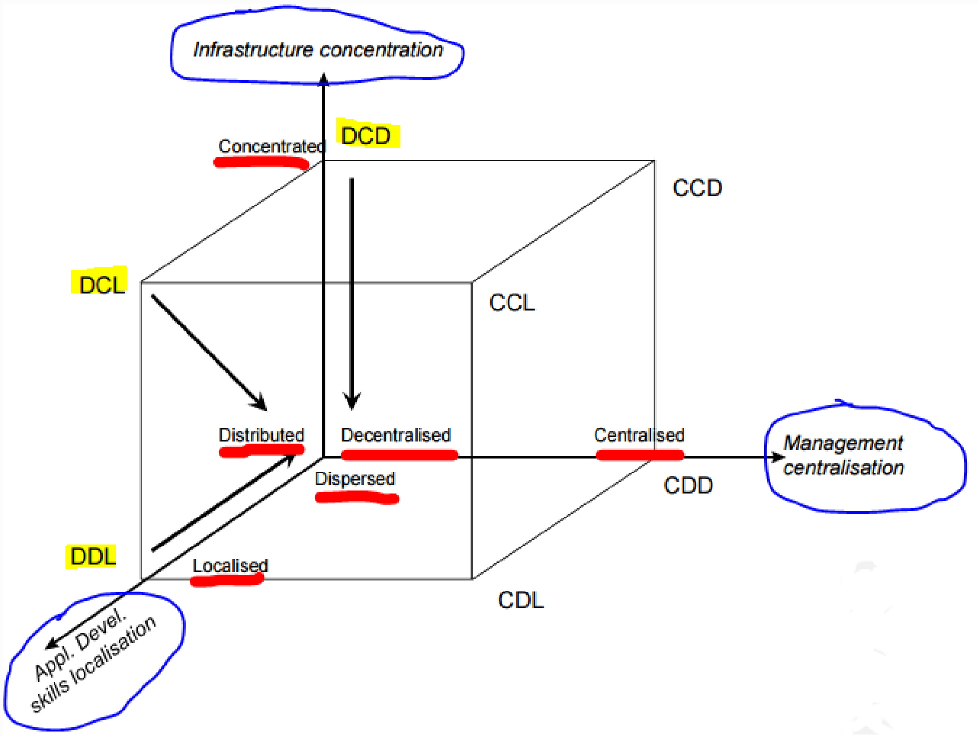
underutilization of overpriced services—both of which lead to suboptimal organizational performance. (overhead costs : ipk : indirecte productie kosten)

- Increasing Returns Economy (Slide 14):
  - Grow in market share is more important than the quality → the one with the most market share is not necessarily the best one.
  - 'winner takes it all' → e.g. there is no second facebook
  - 'killer application' → zorgt voor increasing return of scale (is een starter)
    - SMS for cellphone
    - Spreadsheets for computers
  - MAAR gevolgen;
    - Geen traditioneel optimum
    - Chaos theory → no nice top-down structure (i.p.v. 1 optimum)
    - Optimum meestal niet de beste kwaliteit
  - Realistischer: meerdere lokale optima
    - Taal → geen 1 optimum
    - Keyboards → lokaal evenwicht maar verschillende keyboards in verschillende landen
- Why standardization? (slide 15)
  - Linearlize complexity
  - Companies choose non-compatible systems (most of the time)
  - The more components you add, the more complexability (in the production function you have the opposite effect)
- ICT standards (slide 16)
  - **Game Theory**!! (example slide 17)
  - Every system has FC and VC (may be an additional benefit by choosing the same technology)

	B takes system 1	*B takes system 2*
A takes system 1	*750, 570*	*1.210, 410*
A takes system 2	*2.210, 1.030*	*2.150, 350*

  - S1 : FC stijgen ; VC dalen; S2 FC dalen; VC stijgen
  - Assumption: A&B don't know what the other will chose
  - Nash equilibrium : rood
  - Best solution: geel (zo laag mogelijke kost)
  - A can solve with **transfer** cost but because no one knows what the other will do it does not happen spontaneously
  - A & B suffer from **ASSYMMETRY OF INFORMATION**

- ENTROPY LAW : centralization (slide 18)
  - Examen!!! Verschil goed kennen tussen standardization en centralization



- yellow: unstable configurations (daarom zijn er geen voorbeelden van gegeven)
- Only 5 configurations can be considered (slide 19 – 23) !!