"商务视角下的数据分析"课程所覆盖的专题

1. **简介**

2. **商务思维 (Business thinking)**
   - 所谓的"商务 (BUSINESS)" – 其实就是学会做出获得更多利润的决策 (making decisions to earn more profit)
   - 管理技巧 (Management skills) – 如何落实那些决策
   - 试试创业？ – 可以！但是要慎重！！

3. **数据分析的方法概览 (Data Analytics methods)**
   - 其实，数据分析有着悠久的历史 (HISTORY view about Data Analytics)
   - 理解数据分析方法的 – 一点优化的技巧 (OPTIMIZATION)
   - 来自统计学的数据分析方法 (STATISTICS) – 基于抽样的推断 (一个有趣的视角来梳理而已，不重复)
   - 来自机器学习的数据分析方法 (BASIC + ADVANCED) – 基于数据的知识发现 (KDD)

4. **实用技巧 (Practical skills)**
   - 大商务，需要大数据
   - 大商务的两个挑战: "秒杀" 和 "精准广告/推荐"

5. **课程总结**

所谓的"商务 (business)"

□ **所谓商务 – 一种简单理解**
- 3元模型 (3 element model) – 商务循环
- 商务的首要任务就是深入理解你的目标客户
  - 只有在解决首要任务后，才能设计商务活动
- 商务，意味着众多的决策要做

□ **创业的准备**
- 要知晓"三链分析"
  - "3链" – 客户链、价值链 和 产销链 (生产链和供应链)
- 要进行盈利性评估
  - 成本，利润，损益表 (Income Statement) 等
  - 时间价值的核销 (TVM)
  - 评估投资的简单例子
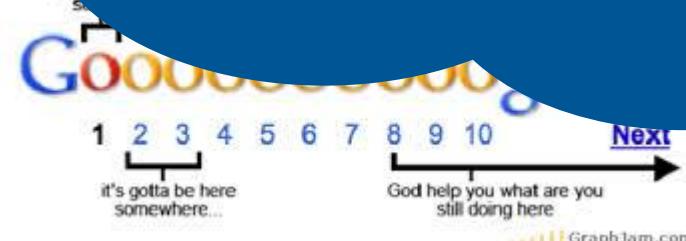
商务？当下昌明时代，地球人都知道！

你的理解呢？

– 当然，大家也都知道商务肯定是要满足人们的某种需求: CLOTHING, EATING, INHABITING, TRANSPORTING, … [衣, 食, 住, 行]
- 随着科技的发展，引发新的需求：电子游戏，信息社区，网上购物等
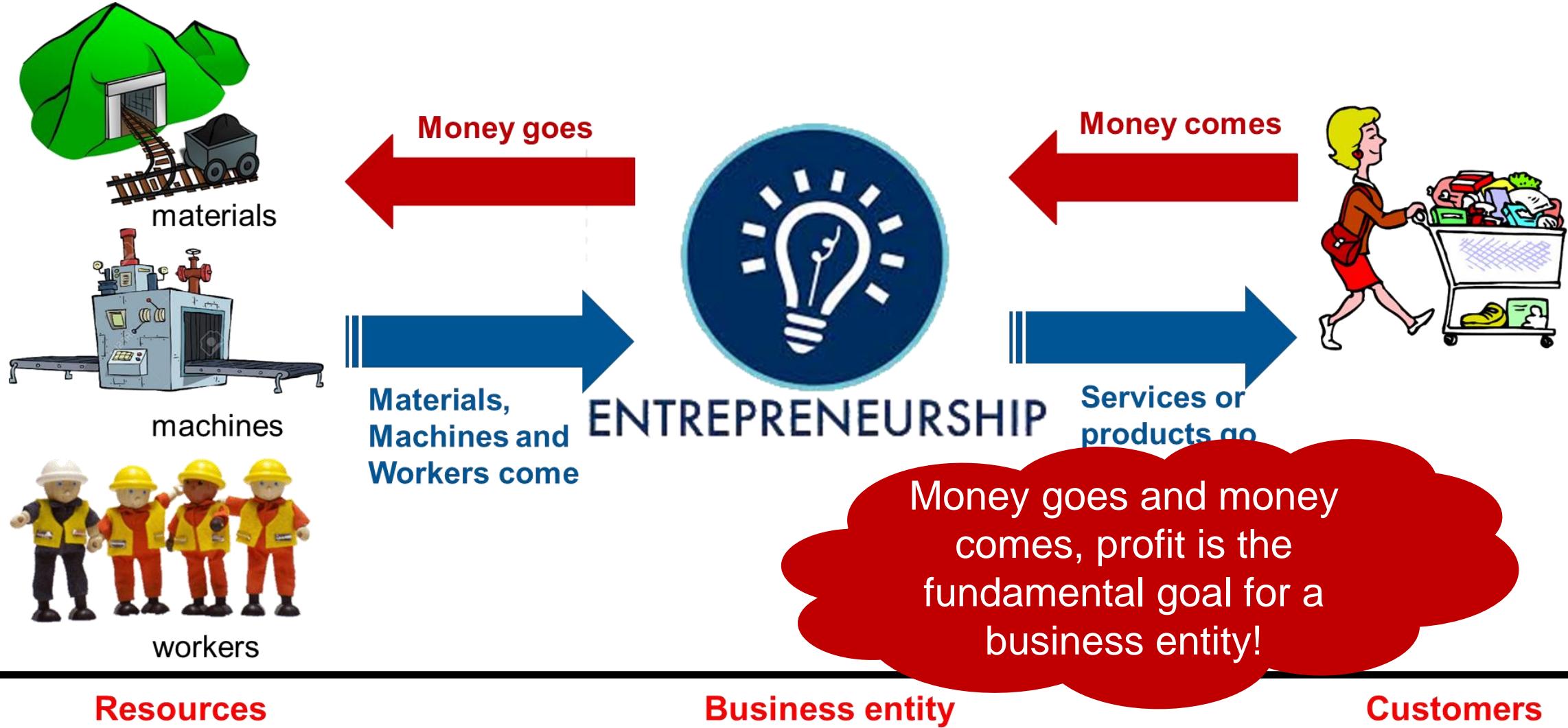
我的简单理解

☐ **我想，你们大概同意我的如下理解:**
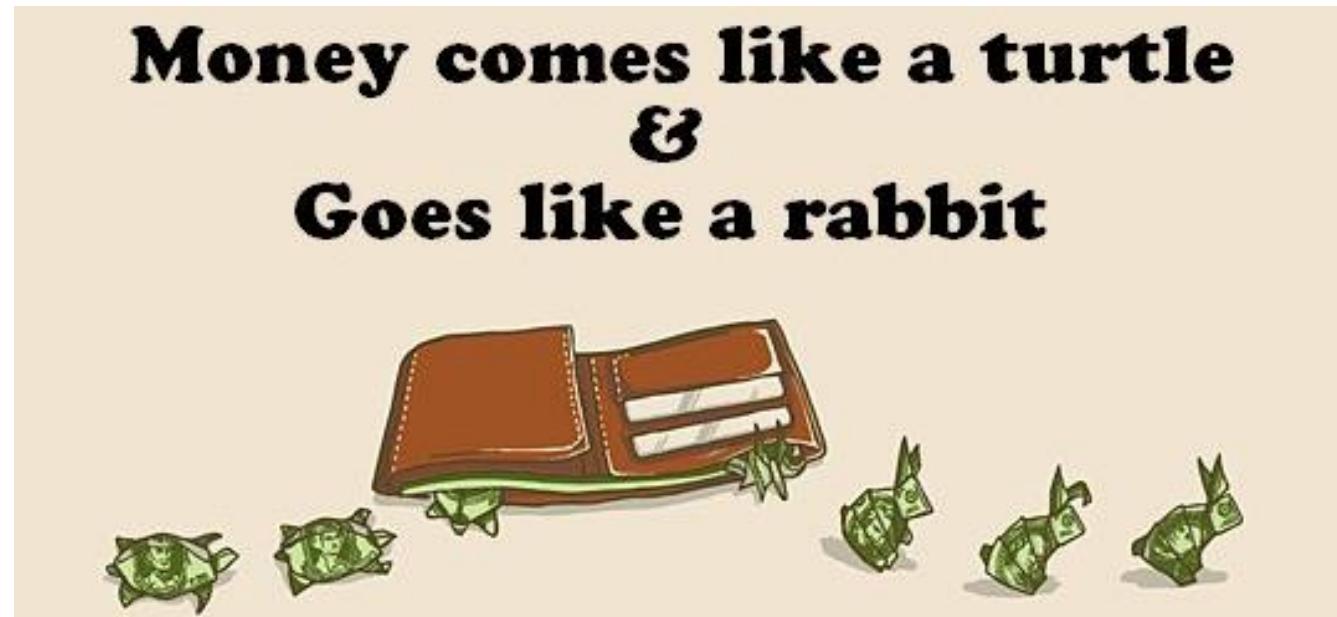
■ **所谓商务，就是找到(更好的)方式为你(自己)的公司赚取更多的钱!**

■ 并且, 不管你(自己)的公司是提供咨询服务 (如 Gartner, McKinsey), 还是卖出产品 (Apple, Dell, 华为), 为你(自己)的公司赚钱的方式必然依赖客户的存在!

如何从客户中赚到钱!

商务的3元模型

Money goes

Money comes

materials

Materials, Machines and Workers come

Services or products go

machines

ENTREPRENEURSHIP

Money goes and money comes, profit is the fundamental goal for a business entity!

workers

Resources

Business entity

Customers

- ❑ 对于中间的 商务实体，商务的本质就是
  - ◼ 通过以高于成本的价格售卖产品或服务给目标客户来赚取利润
- ❑ 也就是"钱来钱往，商务的魔术就在于如何挖取利润"

  - ◼ *Money comes and goes, magic business digs out profit*

感觉，创业很简单嘛！(Start your own business)
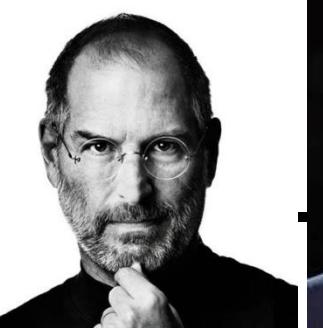
尤其是在大众创业万众创新的时代 (Mass Entrepreneurship, and Innovation)
有没有心潮澎湃?

□ **但是，要小心!**
  ■ 你真的了解商务吗?

只有一个点子(即便有创新)是不够的的！Bill Gates? Steve Jobs? 褚时健, 任正非, ...

应该学习和了解一些基本的、也很有趣的评估你的点子是否有商业价值的规则、套路！

因为...

□ 据统计，青年创业的失败率高达**90%**以上 (**failure rate >= 90%**)

■ https://www.douban.com/note/44619205/

> **创业的根本，不在于知识、也不在于能力，而在于一种商业意识和商业思维。——**是的！

> 而这些商业意识和商业思维，通常只存在于成功创业者的脑袋里，是我们通过学校教育、企业工作和日常交流难以接触和学习到的 ——这一点我不太认同：懂是可以学的，但，是否有胆量创业，和有毅力坚持，这是难以学习到的。

■ The key to succeed in starting an enterprise is the **business idea/thinking**, not your knowledge or capability.

> 于是，很多人都是在不了解创业是怎么回事儿的情况下就开始上路了。又因为不了解，创业者前期经常会走弯路；因为弯路，很多创业者都坚持不到"山重水复疑无路、柳暗花明又一村"的那一天。这是创业失败率高居不下的又一原因。

哈哈 ☺
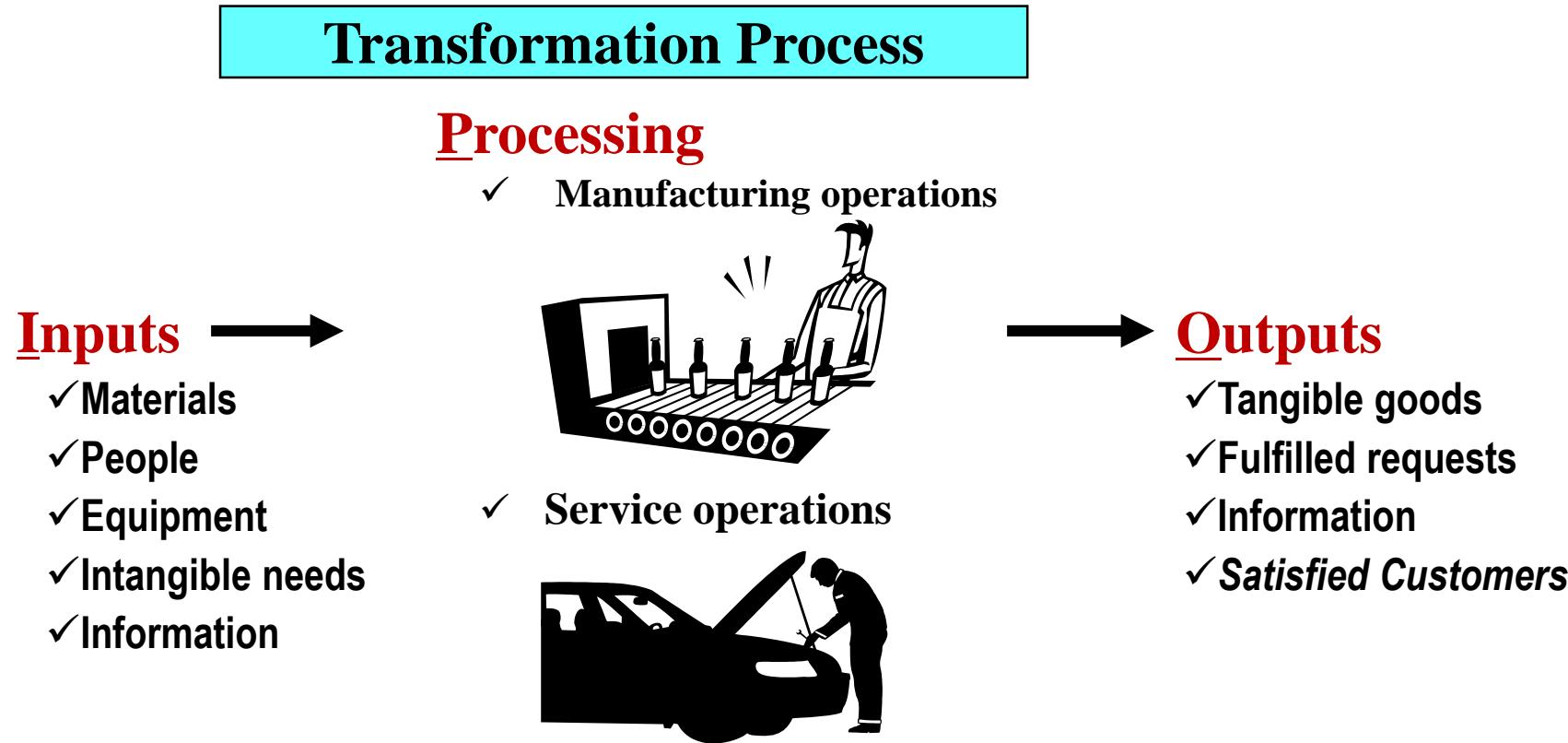
□ **《富爸爸，穷爸爸》作者公司申请破产保护，清崎本人资产在清盘过程中不会受到波及。不过还是很好奇，应该如何评价这本书。**

□ **这本书是洗脑神书。一定要读。但是整个系列有点罗嗦。我来总结一下。这本书讲得就是这些内容：**

- 1. 找好的工作
- 2. 存钱
- 3. 如果找不到好工
- 4. 把存下来的钱买资
- 5. 资产就是可以给你
- 6. 当被动收入超过你的开支的
- 7. 奔向财务自由

即便是这本书，作者的公司也 破产保护了！☺

应该是没平衡好风险和投资间的关系！

□ **其中，最重要的是3，和5。**

□ **但是就我所见，**

□ **绝大部分人做不好3，看不懂5。**

也因为，商务很复杂！- I.P.O

Transformation Process

Processing

✓ **Manufacturing operations**

Inputs →

✓Materials
✓People
✓Equipment
✓Intangible needs
✓Information

✓ **Service operations**

→ **Outputs**

✓Tangible goods
✓Fulfilled requests
✓Information
✓*Satisfied Customers*
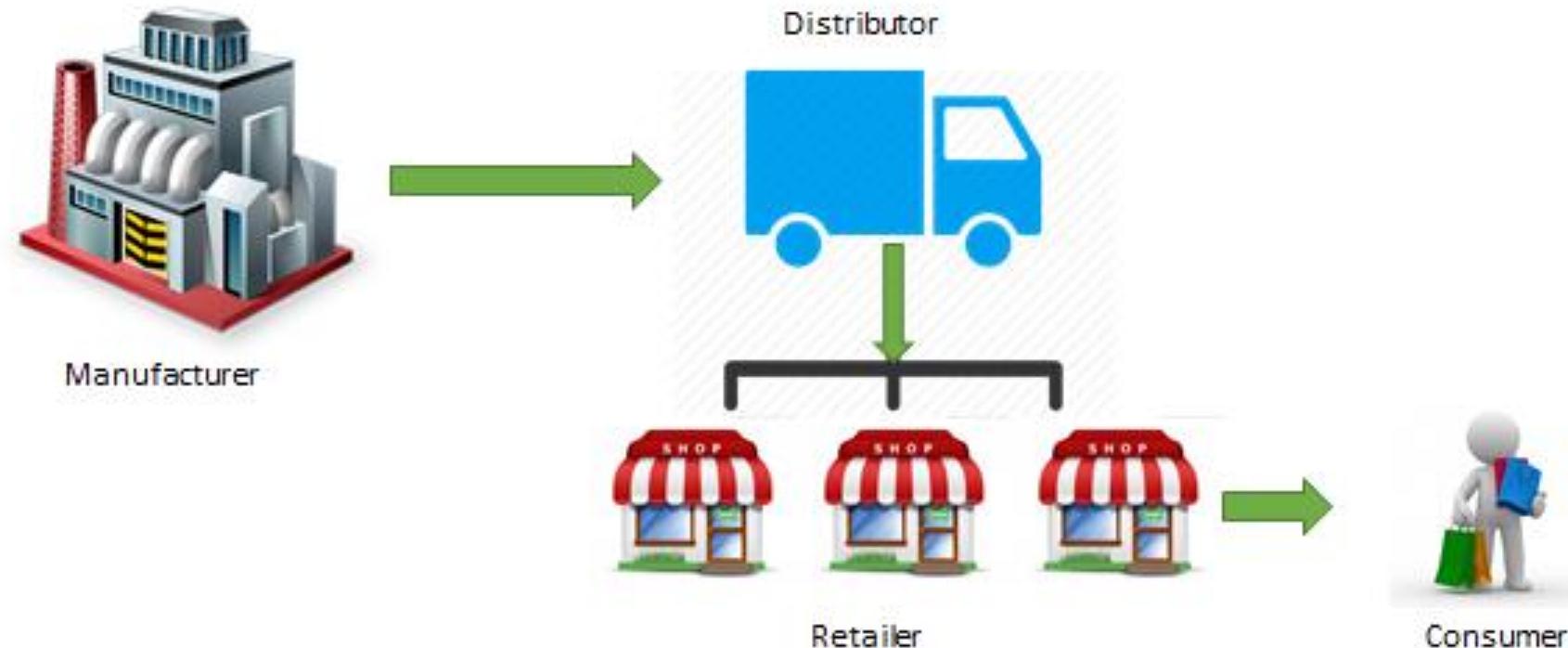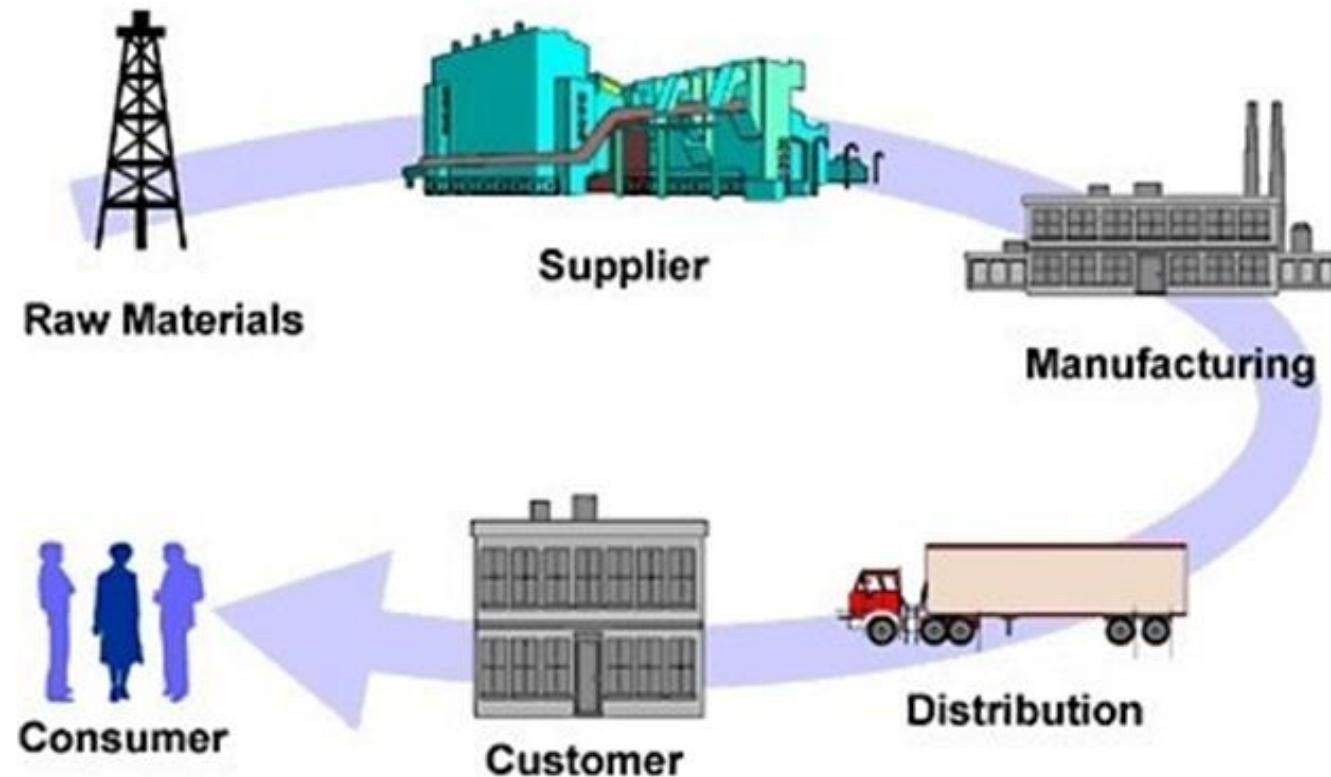
☐ **The planning, scheduling, and control of the activities that transform inputs into finished goods and services**

商务将很多的环节串联在一起！

Basic pathway for a product to get to the consumer

Manufacturer → Distributor → Retailer → Consumer
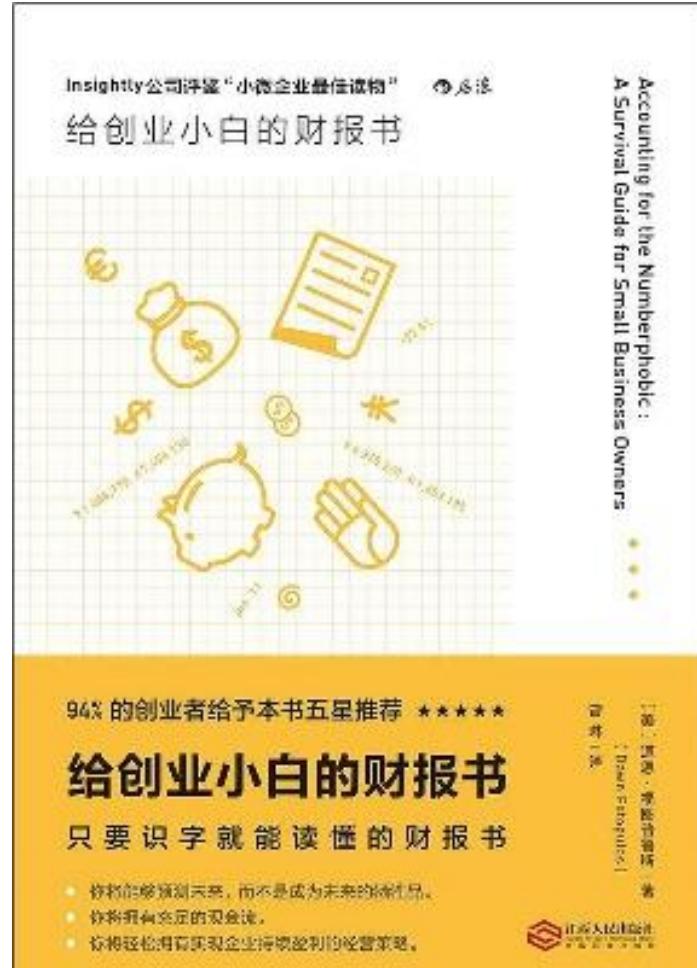
□ **稍微在复杂点的流程和更多的环节**

更复杂的流程和更多的环节！

You've to manage them well

如果 …

☐ **连财务报表都看不懂，你有什么资格创业?**

■ 如今，在互联网的加持下，创业的门槛确实低了不少。但是，正因为如此，反而会让创业者形成一个思维误区：在他们眼里，初创公司的成败关键是看产品和服务。其他的一切都是浮云。

■ 可是，事实并非如此。

➢ 美国作家道恩·福图普鲁斯(Dawn Fotopulos)所写的《给创业小白的财报书》一书中就点破了这一"残忍"的现象。**绝大部分的创业公司死于管理混乱，而非资金短缺。(管理混乱，造成资金短缺？呵呵)**

➢ 即便创业者多是其所在领域的精英，往往掌握了一流的技术，他们有着优秀的产品和服务，但是这并不代表他们就可以创业成功。事实表明，大部分的初创公司会因为忽视甚至**看不懂财务报表而对公司缺乏管理**，因此而使得公司夭折。

不过，这门课并不想那么复杂！抓住简单的角度来理解商务思维
– 那就是如何盈利 (PROFITABILITY)!

- ❑ **Business is the activities carried out by <u>Business Entity</u> to earn money (*more than the cost*) by providing service/products to customers**

- ❑ **The key idea to carry out the activities is simple - how to ensure profitability**
  - ■ **Profit = Sales - Cost**
    - ➢ NB: This is just a simplified equation for profit. In MBA textbooks, there are many versions
      - ✓ **Gross profit**: You buy 1000 pairs of shoes with $50 as price, but sell them with $70. Without considering the money you spend for marketing, GP = 1000*(70-50) = $20000
      - ✓ **Net profit**: $1000 for the stall, and $200 for the transportation + salesman, NP = GP-1000-200 = $19800

☐ **基于前面的公式，可以直接得出 *"earn more money"* 的意思**
  ■ 即尽可能控制较低成本，并以更高的价格卖出产品或服务
    ➢ 一次售卖，可以简称为一次商务循环 **(business) LOOP**

☐ **要注意的是，商务循环的频率 (Frequency) 也同样重要**
  ■ 商务周期往往以年计，如果一年能能完成更多次的商务循环，自然一年所得也就更多
  ■ 例如，如果你的商务循环一次两个月所得 $10000，而我的是六个月所得 $10000，显然,你的财富 (wealth) 增长的更快!也就是说你的商业价值更大！

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■ 并且, 不管你(自己)的公司是提供咨询服务 (如 Gartner, McKinsey), 还是卖出产品 (Apple, Dell, 华为), 为你(自己)的公司赚钱的方式必然依赖客户的存在！

如何从客户中赚到钱!

小知识：<u>Customer VS Consumer</u>
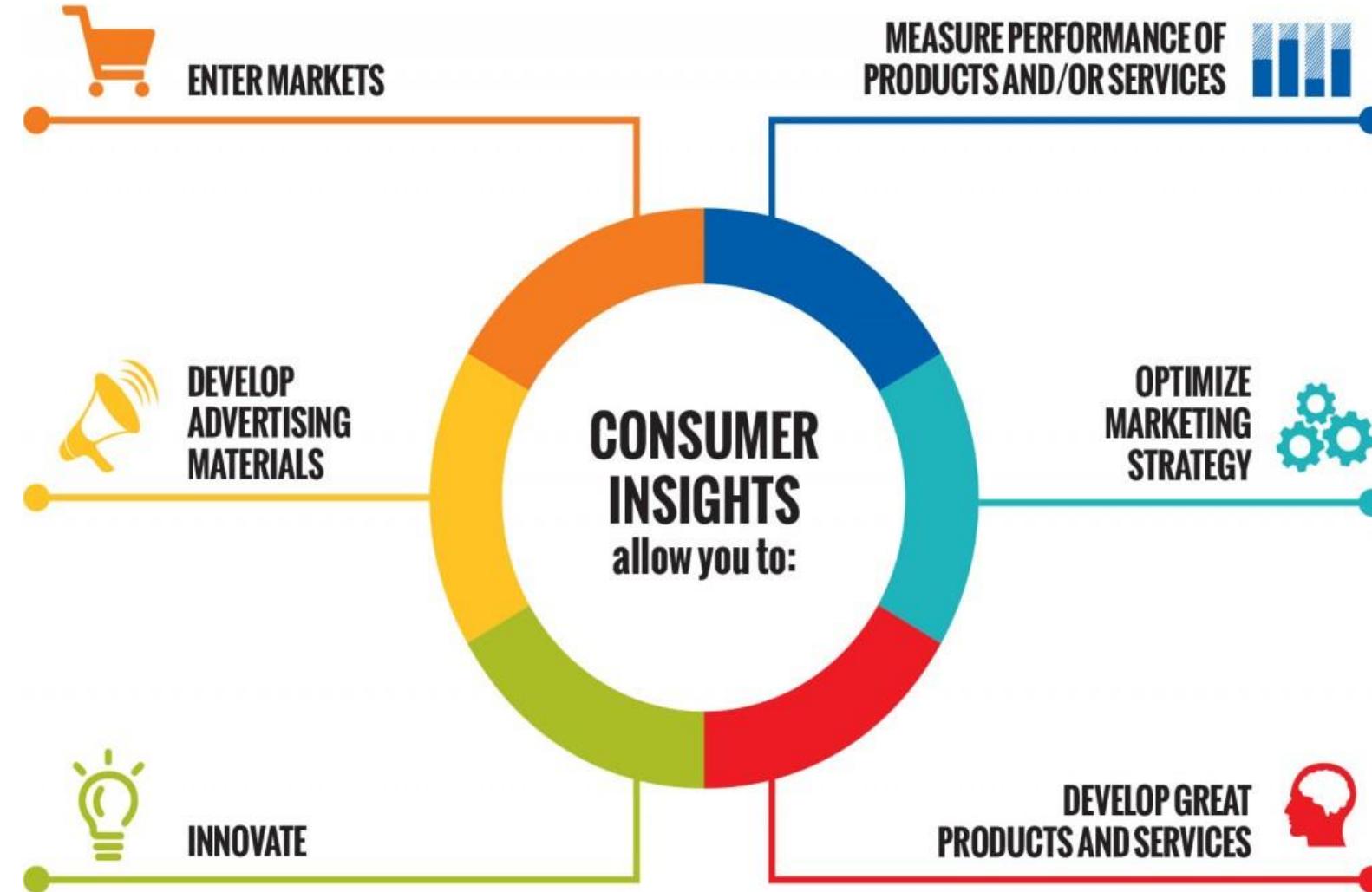
Customer (顾客) is someone who purchased the product.

Consumer (消费者) is someone who uses the product.

只有了解了目标客户，才能很好地设计你的商务

ENTER MARKETS

MEASURE PERFORMANCE OF PRODUCTS AND/OR SERVICES

DEVELOP ADVERTISING MATERIALS

CONSUMER INSIGHTS allow you to:

OPTIMIZE MARKETING STRATEGY

INNOVATE

DEVELOP GREAT PRODUCTS AND SERVICES

如何了解你的目标客户?!
– Yourself!
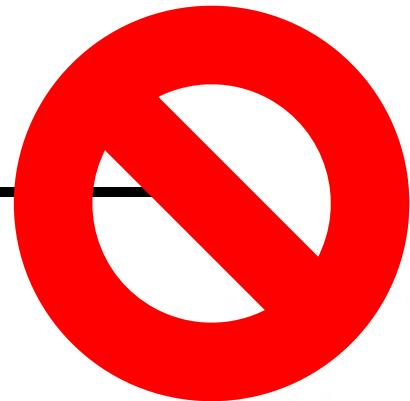
□ **别忘了你自己!**

- 你自己就是客户! – 肯定有过购买和使用产品或服务的经历
- 实际上，某种程度而言，很多时候促使你开启你的创业的动机，通常就来自于你自己生活中的实际需求 – 不能满足或已有产品没做好.

□ **对于我而言，我就希望有这样的产品**

- read digital book,
- **freely write my understanding**, - handwriting not keyboard
- easily compose the related materials – URL, images, videos, …
- Translate my handwritings/voice correctly
- **Publish** related materials into formal documents with reference
- …

Far from good

Good but not good enough!

Close but not good enough

I even bought an expensive MS Surface book!

☐ **Suggested by former students** ☺

Better for teaching (with pen) but not good enough!

如何了解你的目标客户?!
– **Learn from others' business (ecosystem)!**

□ **This may be the proper way**
  ■ Many companies you can learn from IT history
    ➢ **Computer**: ENIAC (which year?) – IBM – Apple/MicroSoft/Lenovo…
    ➢ **OS**: Multics – UNIX – Mac OS/Linux/Windows – NO OS from China
    ➢ **Internet**: TCP/IP – Internet – Information Highway – Internet[+]
    ➢ **Search Engines**: Yahoo/Google - Baidu
    ➢ **E-commerce**: E-bay – JD/Alibaba/TMall/…
    ➢ …

如何了解你的目标客户?!
– Learn by sampling! – the popular way!

□ **你也可以直接 收集采用顾客的数据，亲自进行分析 (或雇佣专门的咨询公司，如Gartner、麦肯锡等)**

■ 实际上，有这类专门的课程

➢ 帮助如何设计调查问题，设计采样策略等

□ **数据收集和分析的方法有很多，分散在 统计学 (statistics), 数据挖掘 (data mining), 机器学习 (machine learning)，大数据 (big data analysis)等**

■ 例如 如何发现有价值的客户，并进行进准营销，方法就包括 分类 (classification), 聚类 (clustering), 欺诈识别 (fraud detection), 推荐 (recommendation), ...

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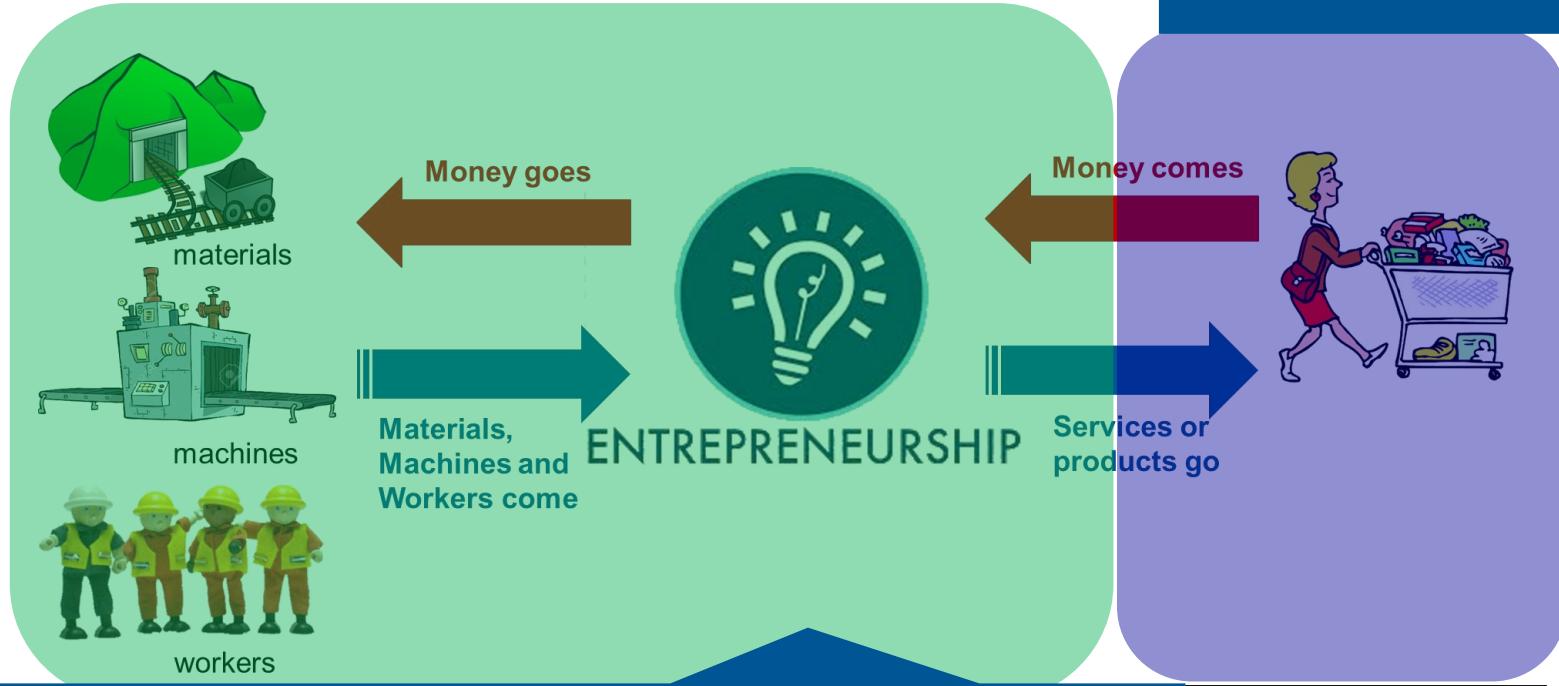
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商务，意味着众多的决策要做

☐ **觉得可如下记忆**

Customers – always the kernel:
- Requirement [需求]
- How to sell AMAP [卖出]

Money goes
materials

Money comes

Materials, Machines and Workers come

machines

ENTREPRENEURSHIP

Services or products go

workers

Customers

You – Inferring is important: Finance, HR, Op, …, and do evaluation all the time!
- High quality but Low cost [物美价廉]
- Efficiency [效率]
- Evaluate risk [风险]

另一个有趣的视角 – 钱来钱往的角度
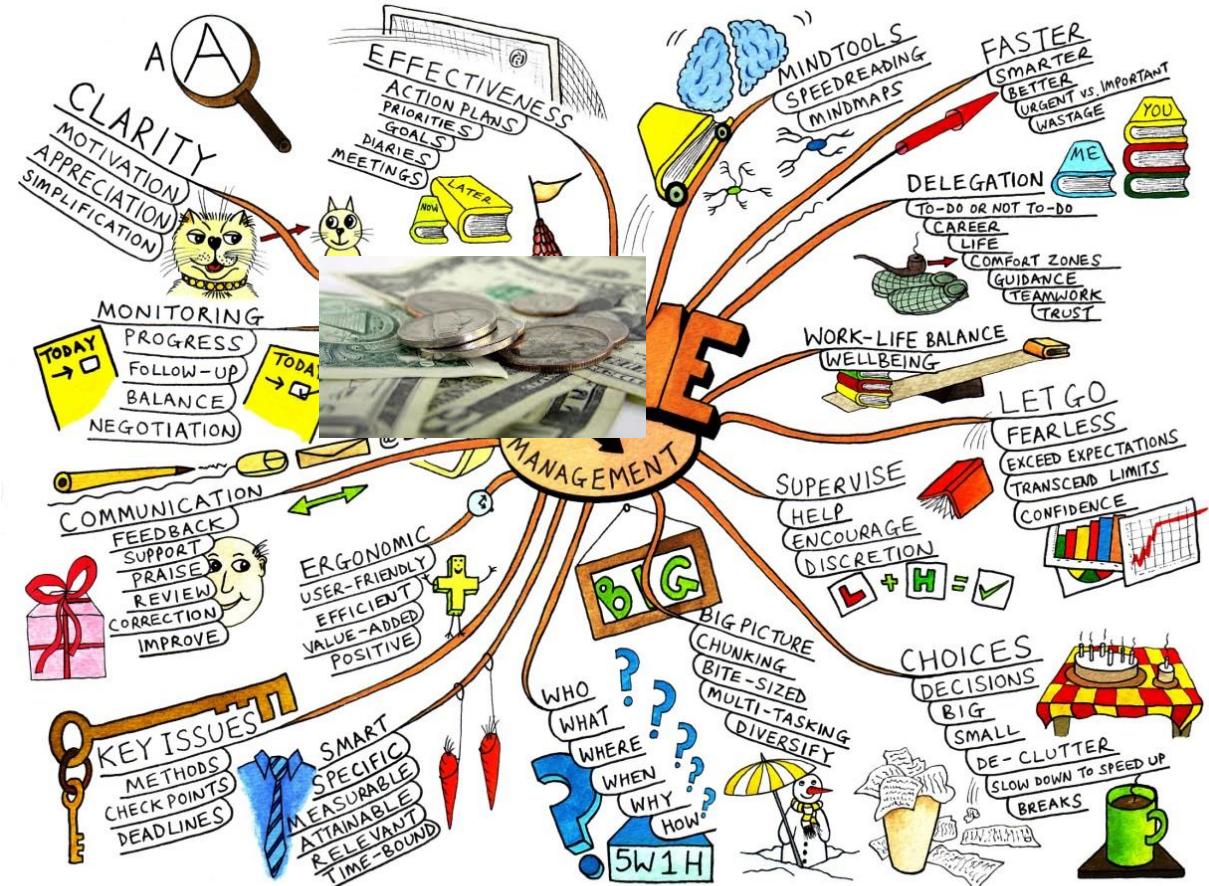
- ☐ **<u>Outer</u> [Money <u>from</u>]**
  - ■ To understand **where** to earn coins **from**
- ☐ **<u>Inner</u> [Money <u>for</u>]**
  - ■ To know **where** the coins are spent **for**

- ☐ ➜ **to find the risk, waste, chance**

很多的分析方法用于
- 商务管理 (MBA courses)

☐ **Common MBA Core Curriculum**

■ The MBA core curriculum offered at most b... includes combinations and variations of the following courses:

➢ Accounting (**Profitability**)

➢ Business Strategy (**SWOT** in this cou...

➢ Economics (**Profitability**)

➢ Finance (**Profitability**, **Risk**)

➢ Human Resources (**MBTI**)

➢ Manufacturing and Production (**3**...

➢ Marketing Management (**3Cs**)

➢ Operations Management (**Management skills**)

➢ **Statistics**

➢ Technology and Information Systems

All of them could be distilled following 3-element model: just Supplier →Provider → Customer

And, the kernel is to evaluate the **profitability** of your product (know customer's requirement, well organize the producing) and ensure to **selling** more products to more customers AMAP

很多的分析方法用于
– know **consumers**

☐ **目标客户是什么样子?**
- 如何界定那些潜在的目标客户
- 他们的消费模式
- 可接受的价格?

☐ **一个有趣的例子啤酒 (beer) 和 尿裤 (diapers) 竟然频繁一起出现!**
- 通过购物小票的分析，发现
买了尿裤的顾客，竟然很多都会再买些啤酒"
- 这显然是个购物习惯的模式
- 基于此模式，可以用来提升盈利性:
  - ➤ 例如，在商品货架摆放时，将尿裤和啤酒
稍微隔开一定的距离。
  - ➤ 期望，顾客在买这两件商品的时候，顺路再
发现其他有兴趣购买的商品

☐ 直销 **(Direct Marketing)**

■ Goal:

➢ Reduce cost of mailing by *targeting* a set of consumers likely to buy a new cell-phone product. – Recommender system

■ Approach:

➢ Use the data for a similar product introduced before.

➢ We know which customers decided to buy and which decided otherwise. This *{buy, don't buy}* decision forms the *class attribute*.

➢ Collect various demographic, lifestyle, and company-interaction related information about all such customers. demographic [demə'græfik] adj.人口统计学的

✓ Type of business, where they stay, how much they earn, etc.

➢ Use this information as input attributes to learn a classifier model.

From [Berry & Linoff] Data Mining Techniques, 1997

□ 欺诈识别 **(Fraud Detection)**
- Goal: Predict fraudulent cases in credit card transactions.
- Approach:
  - Use credit card transactions and the information on its account-holder as attributes.
    - ✓ When does a customer buy, what does he buy, how often he pays on time, etc
  - Label past transactions as fraud or fair transactions. This forms the class attribute.
  - Learn a model for the class of the transactions.
  - Use this model to detect fraud by observing credit card transactions on an account.
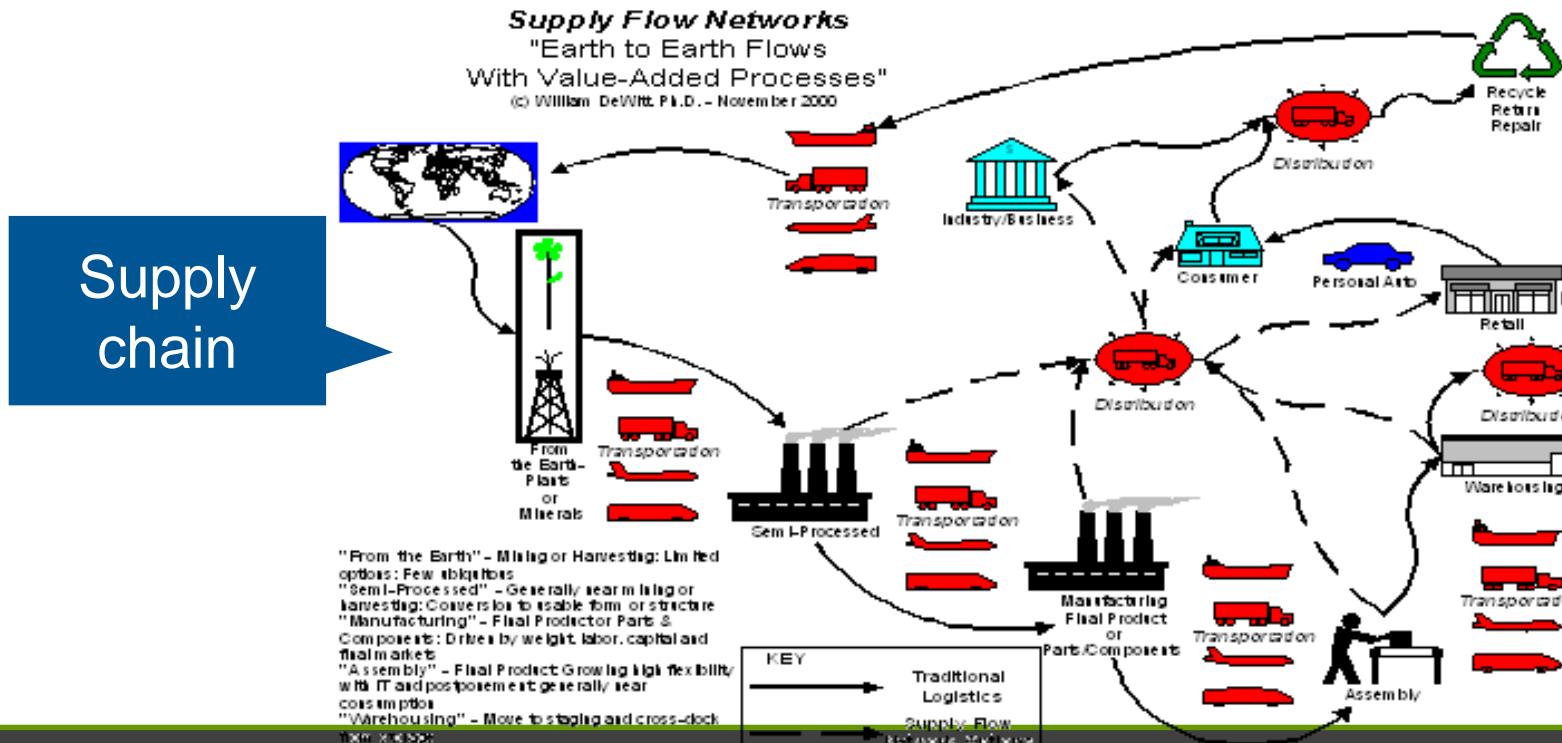
☐ **如何保障你的商务的核心竞争力?**

■ **Producing** your service/product

➤ **Low cost** but high quality & **efficiency**

➤ **Low risk**

Supply chain

Supply Flow Networks
"Earth to Earth Flows
With Value-Added Processes"
(c) William DeWitt, Ph.D. – November 2000
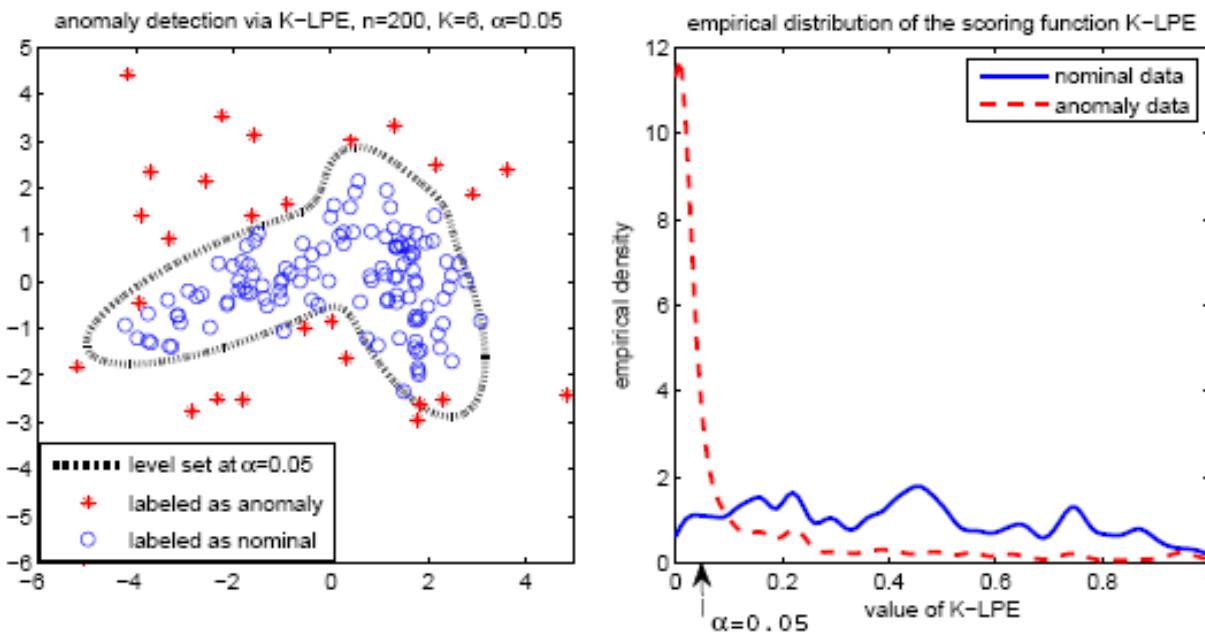
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Fraud detection

anomaly detection via K−LPE, n=200, K=6, α=0.05

empirical distribution of the scoring function K−LPE

❏ 如何保障你的商务的核心竞争力?
■ **Marketing**
➤ Sell your service/product as many as possible

绝对是交叉学科

- ❑ **盈利**
  析的诸多

  - 如何评估盈利性？– 围绕前面的公式可以简
  - 如何理解你的目标客户，需要诸多的计算方法，甚至可归入智慧 (**Wisdom**)
    - ➢ **Mathematics**
      - ✓ **Statistics**,
      - ✓ …
    - ➢ **Artificial Intelligence**
      - ✓ **Machine Learning**,
      - ✓ **Data Mining**,
      - ✓ **Deep Learning**,
    - ➢ …
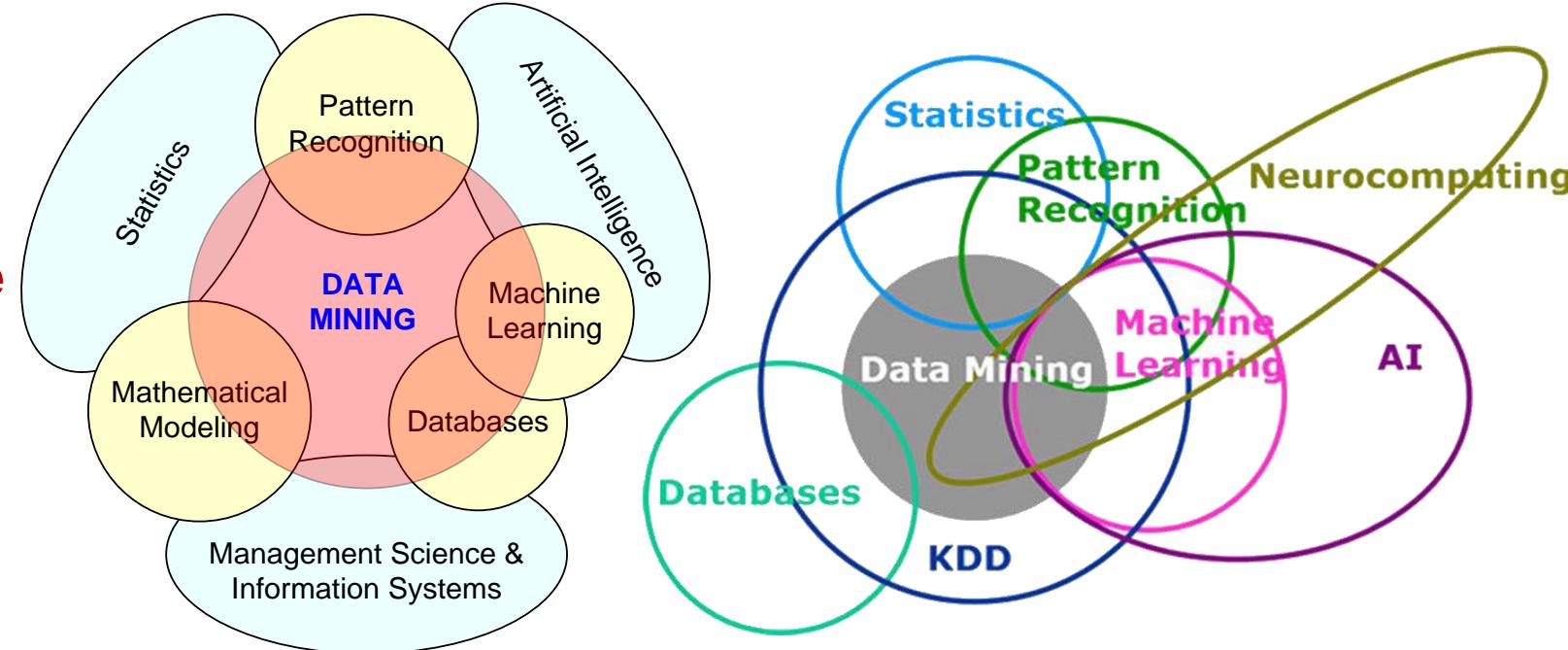
To ensure the profitability, many methods could be used

I try my best to combine the related methods in a friendly way/whole

虽纷繁复杂，但有一个有趣的切入 – "假装自己创业"

☐ **Simplified Business Thinking in this course**

Idea

← Producing (IPO/**ProductionChain**)
→ Selling (**Customers**, Price)

Profitability

Gross Profit = Net sale - COGS

→ **Evaluation**: TVM (Time Value of Money) …

3 chains & Managements

← Production/**Customer**/Value **chains**

→ HR, Finance, Materials (人、财、物是谓也)

→ Efficiency, High Quality, Low Cost, Risk control

Society Responsibility

→ Environment
→ Society Spirit
→ World Peace
→ …

明白所谓的商务 (**business**), 尤其是如何保障盈利性(**profitability**)
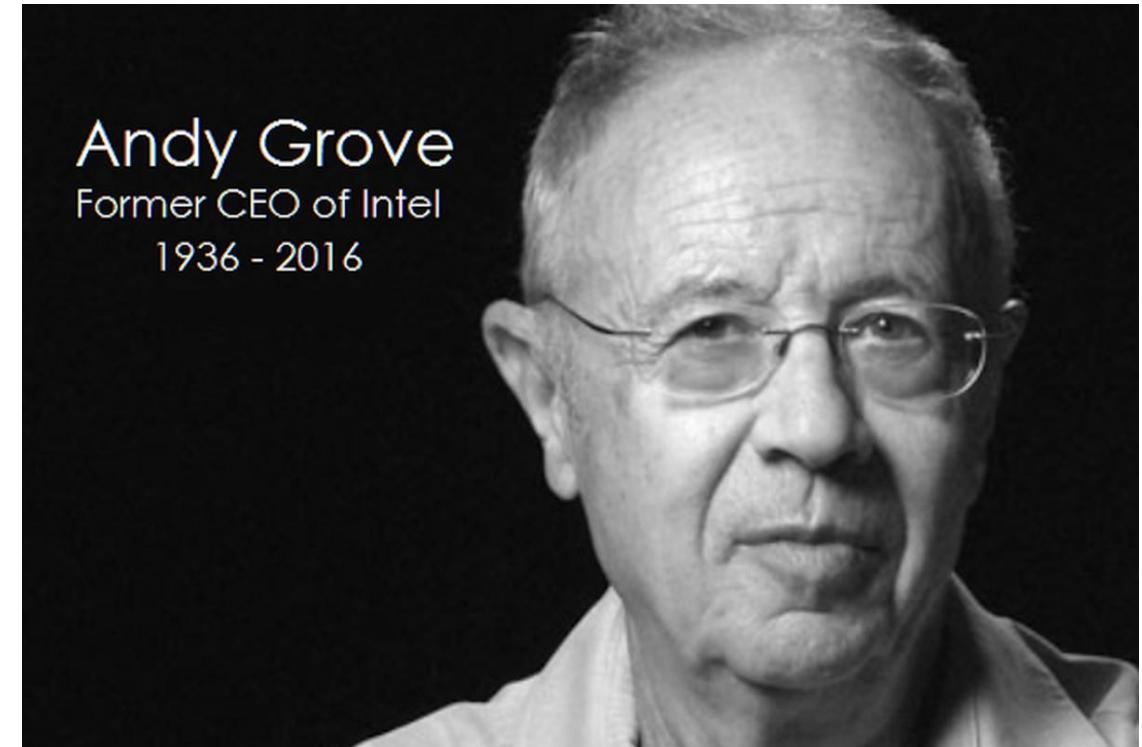
- **对于每个人都是重要的,**
  - 如果你是受雇于人，那就有助于你的职位晋升 (**promotion**) – 如果你能提升企业的盈利性
  - 如果你自己创业，自然更为重要!
- **Andy S. Grove**
  - Accept that no matter where you go to work, you are not an employee you are a business with one employee, you. Nobody owes you a career. You own it, as a sole proprietor.
  - 成功的关键在于 "*不管你在哪里工作, 都别把自己当成员工 - 应该把公司看成是自己开的一样*"

Andy Grove
Former CEO of Intel
1936 - 2016

Business is a good hint to connect many data analytics questions

❑ **The Business Thinking? – Simplified as some questions like "Is my idea valuable?", which is helpful to hinge the DA topics**

■ How to define "valuable"?

➢ Applicability of your product/services? Of course, but …

✓ Yes, it's true. Many business ideas are first triggered from your own bad experience.

➢ **Profitability (盈利性—赚回更多的钱)**

✓ You have to ensure you could earn money more than you've spent.

» Do you know "**Gross Profit = Net Sale – Cost of goods sold**"?

■ How to earn more money?

➢ It seems simple: decrease the cost, sell more, and profit

✓ You have to ensure you could sell product/service to customers

➢ But, …?

✓ You have to do/know many data analytics for better business

所谓的"商务 (business)"

☐ **所谓商务 – 一种简单理解**
- 3元模型 (3 element model) – 商务循环
- 商务的首要任务就是深入理解你的目标客户
  - ➤ 只有在解决首要任务后，才能设计商务活动
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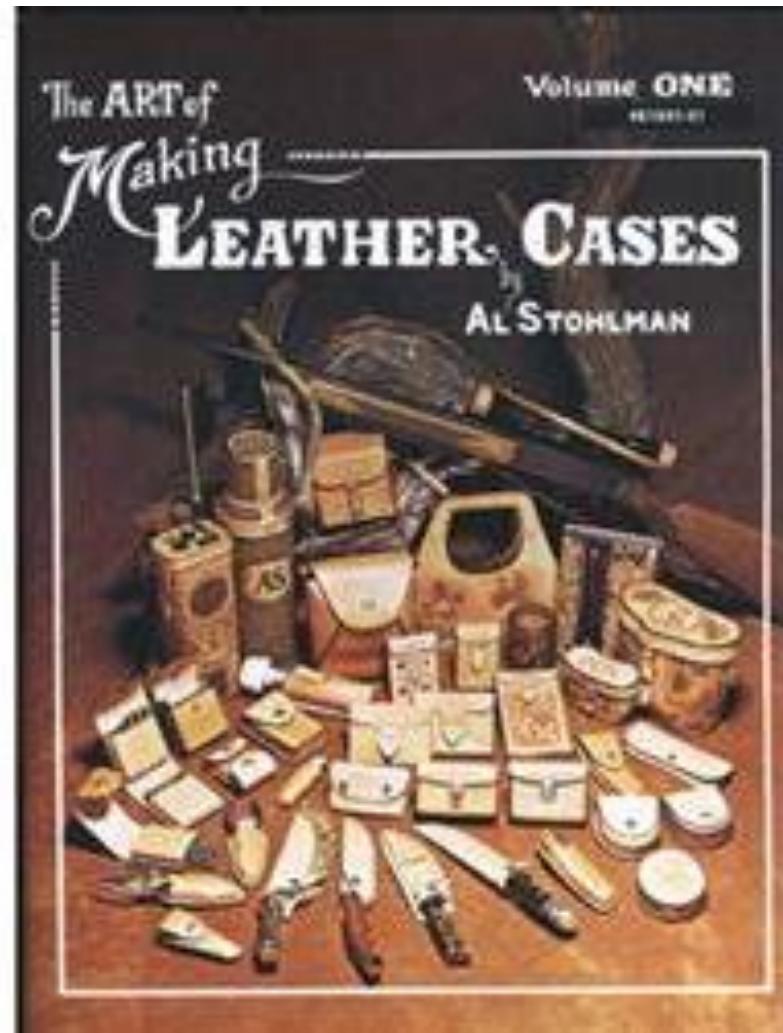
要知晓"三链分析" – 一个简单的例子

❑ **You are a shoe maker, and want to sell some shoes to teachers like me.**

❑ **Of course you are familiar with how to manufacture shoes**
  - Production chain [生产链]
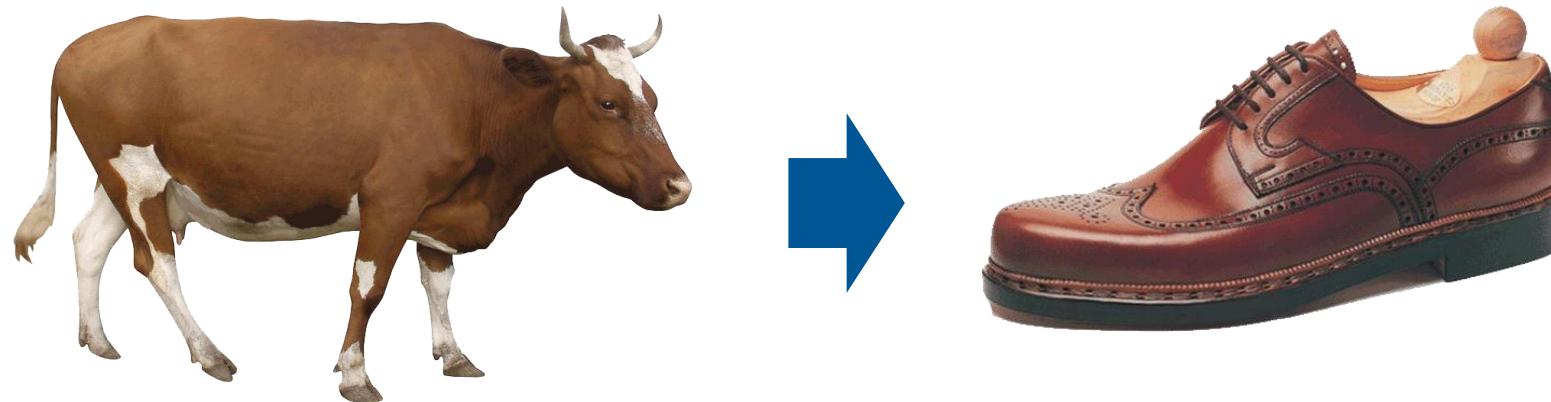
鞋的生产链：从牛到鞋的过程

- **如果你是使用牛皮制作公务鞋的厂家**
  - **INPUT**: 需要厂房，设备，材料，和人员
    - 材料往往从其它商家购得——供应链（Supply Chain）
  - **PROCESSING**: 鞋的生产——设计，制作
    - 提升生产效率是提升竞争力的因素
  - **OUTPUT**: 自营或借助代理将鞋卖给目标客户
    - 为卖给更多的客户，需要好的营销（Marketing）
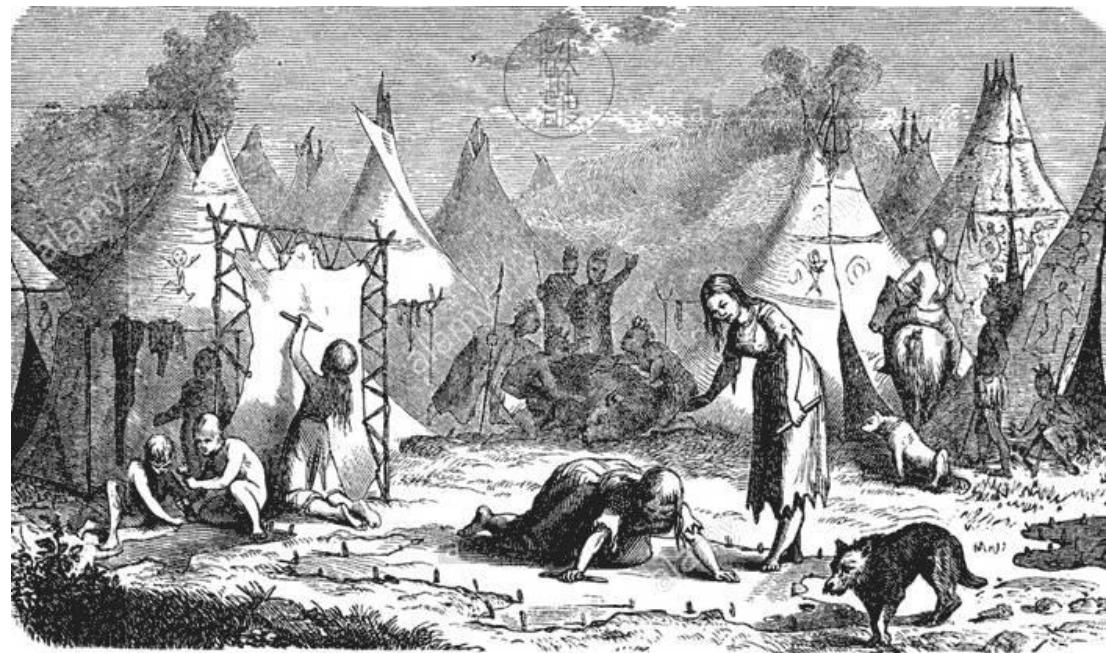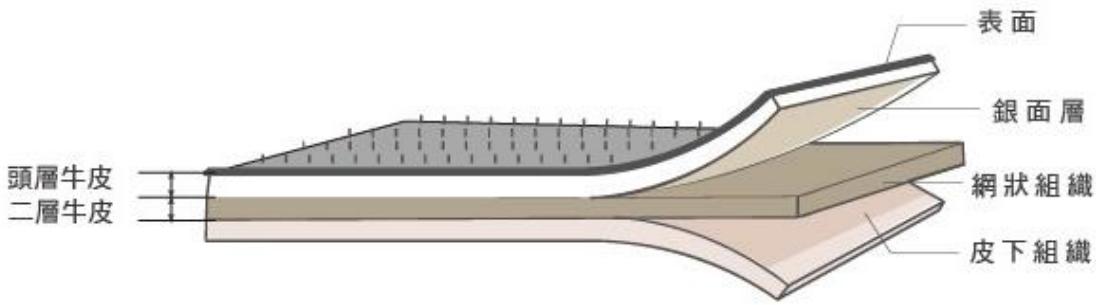
Cut off the flesh   Process it with chemical materials

表面
銀面層
頭層牛皮
二層牛皮
網狀組織
皮下組織
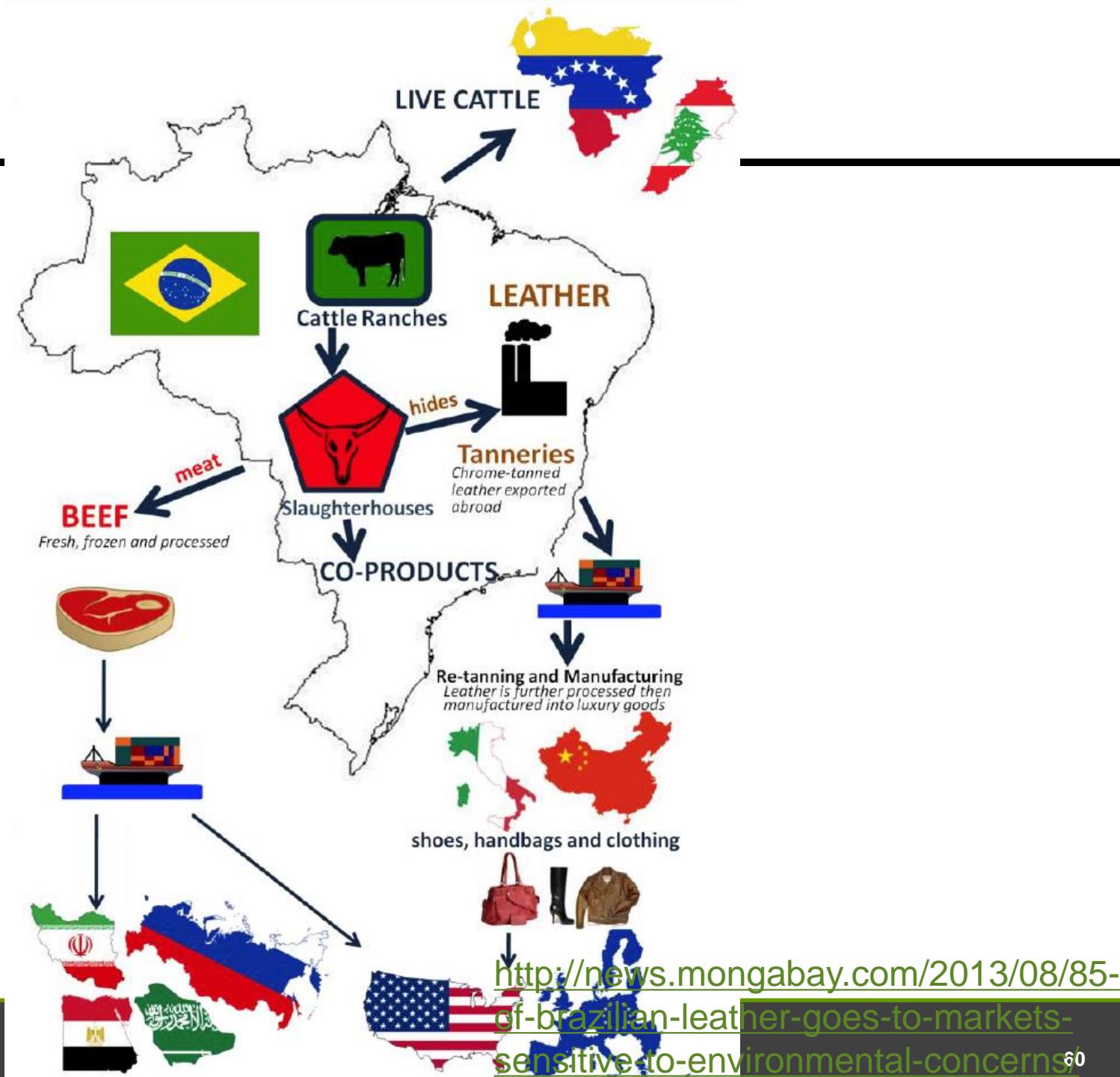
Dry and stretch …   Paint & empathic pressing

这就已经涉及很多决策了

□ **你最好对全球的皮革市场有一定的了解**
  ■ 以便于选择核实的皮革, …

LIVE CATTLE

Cattle Ranches

LEATHER

hides

Tanneries
Chrome-tanned
leather exported
abroad

meat

BEEF
Fresh, frozen and processed

Slaughterhouses

CO-PRODUCTS

Re-tanning and Manufacturing
Leather is further processed then
manufactured into luxury goods

shoes, handbags and clothing
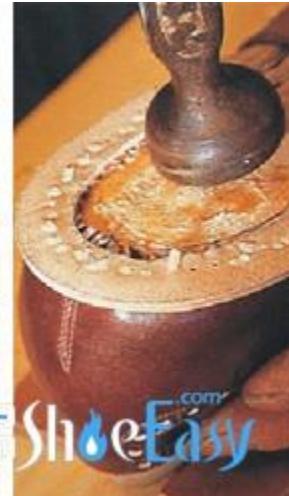
设计 (Design)

- 是否适合教师?
- 价格是否能被普通教师接受?
- …

http://www.shoeeasy.com/home.php?mod=space&uid=428&do=blog&id=56

Select the appropriate leather for your shoes

Determined by your target **CONSUMER**s

Cut the leather according to the design

需要做出很多决策!
- 学者昂贵的皮革?
- 是否需要雇佣全球知名的设计师来设计皮鞋?
- 在奢侈品卖场售卖你的皮鞋?
- …
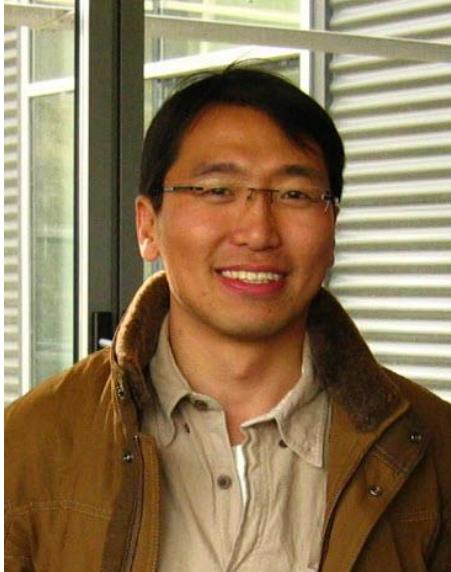
? – means high expense

Determined by your target **CONSUMER**s

www.efu.com.cn

Supermarket? – what kind of customers will be interested?

Consumer chain – 我更倾向于以此为核心！

☐ **如果想要保障商务的顺利，对目标客户有所了解是非常重要的！**

☐ **例如，如果像我这样的教师是鞋厂的潜在客户，那么，"我这样的教师" 的诸多消费模式，对于厂家就是非常重要的**

☐ 作为教师

- 薪酬一般般啦 → 一般负担不起奢侈品得劲价格 → 也就意味着很少会去逛专卖店之类的店面 (franchised store).
- 职业要求着装不要太不着调 → 正装最佳

一旦确定了目标客户

☐ **你就可以基于目标客户的消费模式做出许多商务决策**

- No need to use **luxury** leather

- Expensive Instruments? – but you do need to improve efficiency

- Open stores in supermarket – maybe later franchised store

- Design of the shoes should consider how to cater for many situations – meeting, class, …

- Price for 300~1000 may be proper

- Advertisement? – maybe some Digest"?

- …

所有这些决策都是要保证尽可能以较低的成本将鞋卖给尽可能多的教师

Determined by your target **CONSUMER**s

Value chain

- 也就是说，通过对目标客户的消费模式的分析，你可以得出如下的商务设计
  - Hire local designers to design the shoes
  - Buy leather from China
  - Build factories in ChongQing city
  - Hire local people to work
  - Advertise the shoes in campus
  - Open store in campus
  - …

  Determined by your target **CONSUMER**s

- 需要承认的是，这里的阐述仅仅是示意，极有可能不具有实际的价值 ☺

注意！

□ **此处的3链，跟MBA中常讲的3链是不同的**
  ■ MBA中的3链：生产链，供应链和价值链

□ **不过，看资料，即便是在 MBA领域，对于商务分析也有不同的见解**
  ■ 如早期偏重流程分析，后来将客户分析为核心

注意! 要慎用 BI!

□ **应牢记 – PEOPLE is still the soul of BI, because BI systems could not CREATE [创造]!**

□ **就像目前所谓人工智能(AI)的进展!**

■ We human have to configure the parameters to run methods so as to get rational results!

➢ BI could not reach that level of intelligence to automatically finish all those data processing activities!

■ 但是，深入了解和理解BI系统，仍然是有价值的：毕竟 BI 可以大大提升处理的效率!

所谓的"商务 (business)"
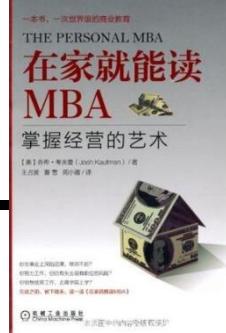
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10 种评估市场的方法

- **<u>Urgency</u> (How badly do people want now?)**
- **<u>Market Size</u> (How many people are actively purchasing?)**
- **<u>Pricing</u> Potential, <u>Cost</u> of Customer Acquisition, <u>Cost</u> of Value Delivery**
- **<u>Uniqueness of Offer</u>**
- **<u>Speed to Market</u> (How much will you have to invest before you're ready to sell?)**
- **<u>Upsell Potential</u> (Are there related secondary offers that you could also present to purchasing customers?)**
- **<u>Evergreen Potential</u> (Once the initial offer has been created, how much additional work will you have to put into it in order to continue selling?)**

有更加复杂的公式

- ☐ **Costs, Profits, Income Statement etc.**
  - Gross Profit = Total Revenue - Costs of Sales (or COGS)
    - ➤ 毛利润 = 总收入 – 销售成本
  - Total Revenue = Price of Product*Number of Product Sold
    - ➤ 总收入 = 产品价格*产品销售数
  - Costs of Sales = Beginning Inventory - [Materials Costs + Labor]
    - ➤ 销售成本 =期初存货 – [资料成本 + 劳动力成本]
  - Gross Profit Margin = Gross Profit / Total Revenue
    - ➤ 毛利率 =毛利润 /总收入
  - Net profit = Total Revenue -Total Expenses
    - ➤ 纯利润 = 总收入 – 总成本

☐ **Suppose you buy/make something for $100, and sell it off for $150.**
- cost price = $100
- selling price (revenue) = $150

☐ **If you have sold 10,000 units**
- Profit per unit = $150 - $100 = $50
- Gross Profit = $50 X 10000 = $500,000
- profit **percentage** = $50/$100 = 50% (profit as percentage of cost price)
- profit **margin** = $50/$150 = 33.33% (profit as percentage of selling price or revenue)

3 financial statements

☐ **A balance sheet (statement of financial position) [资产负债表]**

  ■ reports on a company's assets, liabilities, and ownership equity at a given point in time.

☐ **An income statement (statement of profit and loss report) [利润表]**

  ■ reports on a company's income, expenses, and profits over a period of time.

☐ **A statement of cash flows [现金流量表]**

  ■ reports on a company's cash flow activities, particularly its operating, investing and financing activities.

❑ **Time Value of Money (TVM)**

- Intuitively, we all know that $100 in 2000 is more valuable than $100 in 2014
  - This means we can buy 100 eggs in 2000, but maybe only 70 eggs in 2014

- Before the introduction of the related equations, here is the list of some concepts.
  - **PV** is the value at time=0 (present value)
  - **FV** is the value at time=n (future value)
  - **n** is the number of periods (not necessarily an integer)
  - **i** is the discount rate, or the **interest rate** at which the amount will be compounded each period

Example A-1

☐ **You may be familiar with the following equation:**

■ Future value of a present sum

➢ $\mathbf{FV = PV \times (1 + i)^n}$

➢ This is like you deposit some money (PV = 10000) in the bank, and the bank guarantees you the interest as 5% per year. After one year, you will get the more money in your account, namely $FV = PV \times (1 + i)^n = 10000 \times (1 + 0.05)^1 = 10500$.

■ Present value of a future sum

➢ $\mathbf{PV = \dfrac{FV}{(1+i)^n}}$

➢ **You have \$10000 in 2014, how many dollars are in 2005?**

✓ Don't forget: \$100 in 2000 is more valuable than \$100 in 2014

☐ **Evaluate your investment**

■ Now I get a project of building inventory system, which needs 5000. And according to the budget, this system could be used for 5 years, and each year it could save 2500 for me.

■ If the interest is **12%** per year, how to compute

1. Payback period? – 投资回收期
   ✓ the period of time required to recoup the funds expended in an investment
2. Net income? – 净收入
3. Rate of **return on investment (ROI)**? – 投资回收率

中国10年期国债收益率 (CN10YR)

3.191　-0.002 (-0.05%)

交易中，2021-04-30 15:59:31 (北京时间)

概览　　图表

| 1m | **5m** | 15m | 30m | 1H | 1D | 1W | 1M |

| 昨收：**3.193** | 最高：**3.222** | 52周最高：**3.377** |
| 今开：**3.193** | 最低：**3.171** | 52周最低：**2.549** |

按消费者价格指数衡量的通货膨胀（年通胀率）[2019年]

所有国家和经济体

国家的名字	最近年份	最近数值	
不丹	2019	2.7	
东帝汶	2019	1.0	
中国	2019	2.9	
中国澳门特别行政区	2018	3.0	
中国香港特别行政区	2019	2.9	
中非共和国			

- **To answer those questions, we should convert the money saved for you in each year into its value of current time**
- **We have following table**

year	FV	$(1+0.12)^n$	PV (year 0)	Cummulative Value
1	2500	1.12	2232.142857	2232.142857
2	2500	1.2544	1992.984694	4225.127551
3	2500	1.404928	1779.45062	6004.57817
4	2500	??	??	??
5	2500	??	??	??

1. **Payback period**? – 投资回收期

- We can find from the previous table that
  - ✓ After two years, the inventory system could save 4225.12.
  - ✓ While after three years, it could save 6004.57
- Clearly two more years later, the original investment of 5000 has reached
- We need to compute the period

  ✓ (5000 - **4225**) / **1779** = 0.44 year

1992.984694	4225.127551
1779.45062	6004.57817

- So the Payback period is 2+0.44 = 2.44 years

2. **Net income**? – 净收入
   - If the cumulative value of saving is X after 5 years, the net income is just
     - ✓"NI = X – Original investment"
     - ✓Net Present Value，简称NPV
3. Rate of **return on investment (ROI)**? – 投资回收率
   - ➢ TVM is generally connected with the bank interest
   - ➢ Namely, if at 2015, you want to know the future value of your money at 2030, you should use **bank interest** as shown before
     - ✓ $FV = PV \times (1 + i)^n$

■Rate of **return on investment (ROI)**? – 投资回收率

> ➤Rate of ROI is used to evaluate the rate of a project to earn money for you – use similar equation but different name
> > ✓For banking, **INTEREST** is the professional name
> > ✓For project, **RATE OF ROI**

> ➤Given a project, you spend 10000 \$ at 2000 for it; after 10 years (**at the end of 10th year**), it earns 100000 \$ in total (the money earned for each year may not same)
> > ✓You still have $\mathbf{FV = PV \times (1 + i)^n}$
> > ✓But now, you know FV, PV and n, **i** is required to compute – that is the RATE of ROI
> > ✓100000 = 10000*(1+i)^{10} ➔ i = 0.2589, namely 25.89%!

☐ **Now back to the previous question**

- ■ PV is 5000

- ■ n is 5 (years)

- ■ Bank interest is 12% - **used for TVM**

- ■ FV??

  - ➤ We only have "2500 for every year", we don't know the money at the end of 5th year!

  - ➤ You have to convert "2500 for every year" to get that FV

  - ➤ You have know it

    - ✓ FV = $2500*[(1.12)^4+(1.12)^3+(1.12)^2+(1.12)^1+1]$

- ■ And finally

  - ➤ $2500*[(1.12)^4+(1.12)^3+(1.12)^2+(1.12)^1+1] = 5000*(1+r)^5$

  - ➤ Now you can compute the **r** – Rate of ROI of the project

■**Break-even analysis**？ -损益平衡分析，保本分析
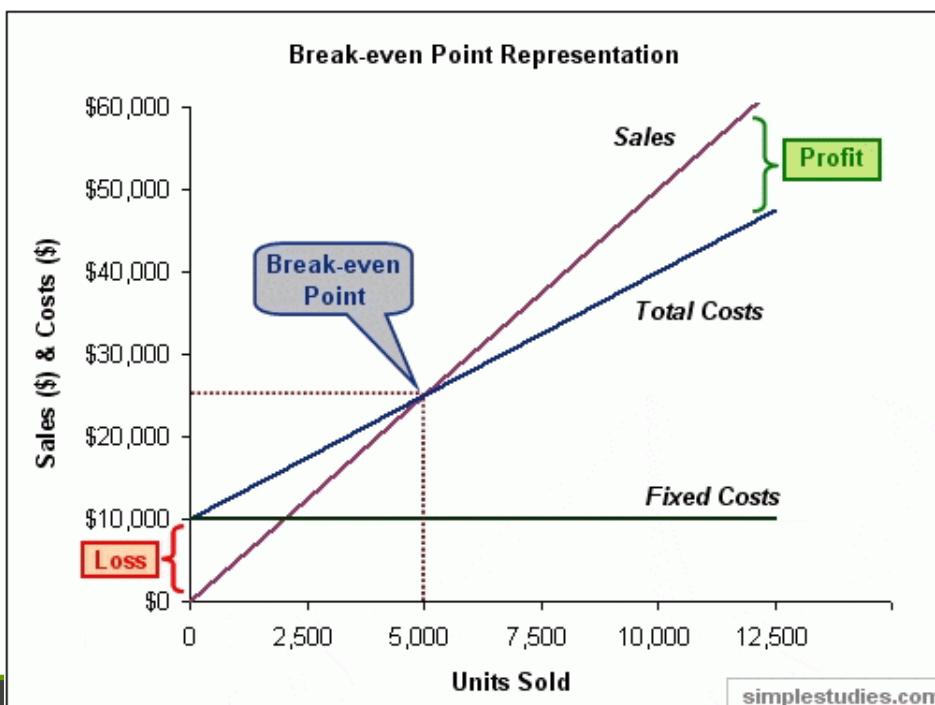
➤Its computation is similar with that for Payback period, but the number of products you should sell

➤http://en.wikipedia.org/wiki/Break-even_%28economics%29

✓In economics and business, specifically cost accounting, the **break-even point** (BEP) is the point at which total cost and total revenue are equal: there is no net loss or gain, and one has "broken even."

■How many products you should sell so as to make sure you could get profit later

☐ **You have a factory to produce some kind of products**

- ■ The fixed cost is $10,000 – no matter how many products you produce
- ■ Variable cost for each product is $3
- ■ You want to sell the product with the price of $5

Break-even Point Representation

# of products (X) you should sell to get BEP

- • X*price = FixedCost + X*VariableCost

☐ **You have a factory to produce some kind of products**

- ■ # of products (X) you should sell to get BEP
  - ➢ X*price = FixedCost + X*VariableCost
  - ➢ X*(Price – VariableCost) = FixedCost
  - ➢ X*2 = 10000
  - ➢ X = 5000

- ■ You can conclude that you should sell 5000 units at least then you can get profit

- ■ Break-Even sales (BES) is just 5000*Price = $25,000

You can try

- **This year, you spend 100000 for a factory. The price of one product is 150, while the cost of one product is 100. In future 5 years, you could sell 1000 products every year.**

- **If the price and cost are stable for all future 5 years, and the bank interest 5%, you're required to**
  1. Draw the table [2 pts]
  2. Pay-back period? [1 pts]
  3. Net-income (NPV)? [1 pts]
  4. Rate of Return on investment (ROI)? [2 pts]

For real life – to balance

- ❑ **We all know the price to buy an apartment (pigeon house) in BeiJing is too expensive.**
  - ◾ You have to loan some money from the Bank/Accumulation fund (公积金), which means you have to pay back with interest – do you remember the "Interest expense" in the "Income statement"?
- ❑ **Two popular method**
  - ◾ Fixed-payment mortgage (等额**本息**还贷) [constant payment mortgage]
    - ➢ Pay the bank with equal money every period
  - ◾ Fixed-basis mortgage (等额**本金**还贷) [constant amortization mortgage]
    - ➢ Pay the bank with money degressively - more money at first. – with less interest expense compared with the former

☐ **With Fixed-payment mortgage [等额还贷]**

- ■ I try to borrow 10000 from the bank with interest of 10% for 10 years, how much should I pay back every year.
  - ➢ FV of 10000 now after 10 years is
    - ✓ $FV = PV*(1+i)^n = 10000*(1+0.1)^{10} = 10000* 2.59374$
  - ➢ I have to pay fixed X back every year, of course what I pay should be equal with the above FV
    - ✓ If I pay X at the end of 1st year, which means after 9 years, its FVx is $X*(1+i)^{n-1} = X*(1+i)^9$
    - ✓ 2nd year, FVx is $X*(1+i)^{n-2} = X*(1+i)^8$
    - ✓ … last year, $X*(1+i)^{n-n} = X*(1+i)^0$
  - ➢ The total I pay is $X*[1+(1+i)^1+…+(1+i)^{n-1}]$, where $(1+i)>1$.
    - ✓ This is a "geometric series/sequence"
    - ✓ **$[(1+i)^n - 1]/[(1+i)-1]$**

□ **Namely, $X*[1+(1+i)^1+\ldots+(1+i)^{n-1}] = PV*(1+i)^n$**

■ $PV*(1+i)^n$ $PV*i*(1+i)^n$

■ X = ---------------------------- = -----------------------------------

■ $[(1+i)^n - 1]/[(1+i)-1]$ $(1+i)^n - 1$

■ We have

  ➢   10000* 2.59374*0.1

  ➢ X = ---------------------------- = 1627.445

  ➢   2.59374-1

NB: This is "pay every year!", so we have same interest here

You can try

- ☐ **Your question**
  - ■ I try to borrow 1000000 from the bank with interest of 4.5% per year for 30 years, how much should I pay back every year under "**Fixed-payment mortgage**"??

  - ■ Real Challenge!! How much should I pay Every **season**?? every **month**??
    - ➢ Hint:
      - ✓ Interest per month = Year Interest/12
      - ✓ Interest per season = Year Interest/4

  - ■ You can try the "**Fixed-basis mortgage**" by yourself

日期	短期	短期	中长期	中长期	中长期	个人住房公积金贷款	个人住房公积金贷款
	6个月内(%)	6个月至1年(%)	一年至三年(%)	三年至五年(%)	五年以上(%)	五年以下(%)	五年以上(%)
2015-03-01	5.35	5.35	5.75	5.75	5.90	3.50	4.00
2014-11-22	5.60	5.60	6.00	6.00	6.15	3.75	4.25
2012-07-06	5.60	6.00	6.15	6.40	6.55	4.00	4.50
2012-06-08	5.85	6.31	6.40	6.65	6.80	4.20	4.70

人民币存款利率表2015-03-01

项目	年利率（%）
一、城乡居民及单位存款	
（一）活期存款	0.35
（二）定期存款	
1.整存整取	
三个月	2.35
六个月	2.55
一年	2.75
二年	3.25
三年	3.75
五年	4.00

http://www.bankofchina.com/fimarkets/lilv/fd31/201502/t20150228_4678960.html

项目	年利率（%）
一、城乡居民存款	
（一）活期	0.35
（二）定期	
1.整存整取	
三个月	1.60
半年	1.80
一年	2.00
二年	2.50
三年	3.00
五年	3.05

2015-08-26

http://www.ccb.com/cn/personal/interest/rmbdeposit.html

☐ **Namely,**

■ $X \times [1 + (1+i)^1 + \cdots + (1+i)^{m-1}] = \text{PV} \times (1+j)^y$

➢ Where i is the interest of a month

➢ m is the number of months

➢ j is the bank interest of a year, and j = 12*i

➢ y is the number of years

■ $X = \dfrac{\text{PV} \times (1+j)^y}{1 + (1+i)^1 + \cdots + (1+i)^{m-1}}$

■ $X = \dfrac{\text{PV} \times (1+j)^y}{(1+i)^m - 1 \big/ i} = \dfrac{\text{PV} \times (1+j)^y \times i}{(1+i)^m - 1}$

■ $X = \dfrac{1000000 * (1+0.045)^{30} * \frac{0.045}{12}}{(1 + \frac{0.045}{12})^{30*12} - 1} = \dfrac{1000000 * 3.74532 * 0.00375}{3.847698 - 1} = 4932.03633$

Optional

- ❑ **As for "Fixed-basis mortgage", its idea is**
  - ■ Pay the capital evenly, while the interest is based on the previous residual capital
  - ■ Following the previous example – 10000, 10%, 10 years
    - ➢ # of payment: n = 10
    - ➢ Pay the capital per year: PV/n = 10000/10 = 1000,
    - ➢ While pay the interest
      - ✓ 1st year: previous residual capital = 10000, so pay 10000*10% ➔ You pay in total at 1st year = 1000+10000*10% = 2000
      - ✓ 2nd year: residual = 9000, so 9000%10% ➔ you pay 1000+9000*10% = 1900
      - ✓ 3rd year: residual = 8000 ➔ you pay 1000+8000*10%

❑ **In conclusion**

- ■ Each year, you pay two parts
  - ➢ For capital: PV/n
  - ➢ For interest:
    - ✓ i^{st} year: $PV * \left(1 - \frac{j^{st}\ year - 1}{n}\right) * i$
      - » j = 1, 2, …, n; i is the inte
- ■ The total money you pay
  - ➢ PV+PV*i%*$\sum_{j=1}^{n}\left(1 - \frac{j^{st}}{...}\right)$
  - ➢ =PV+PV*i%*$\left[n - \frac{1}{n}\sum_{j=1}^{n}(j-1)\right]$
  - ➢ =PV+PV*i%*$\left[n - \frac{1}{n}\sum_{j=1}^{n}(j) + 1\right]$
  - ➢ = PV+PV*i%*$\left[n + 1 - \frac{1}{n} * \frac{n(n+1)}{2}\right]$ arithmetic sequence
  - ➢ = PV+PV*i%*$\frac{(n+1)}{2}$

Total = 10000+5500 = 15500.

Do you remember the total of previous? – 25937.4! So the bank usually doesn't tell you this!

Index theory – manmade indicators

☐ **Consumer Price Index (消费价格指数)**

■ Simple understanding of CPI

➢ If you buy same products/services

✓ In 1995, you should spend 800

✓ In 2000, you should pay 1000

➢ So the CPI is

✓ 1000/800*100% = 125%

■ This means CPI is increased by 25% compared with 1995

☐ CPI is useful to understand others
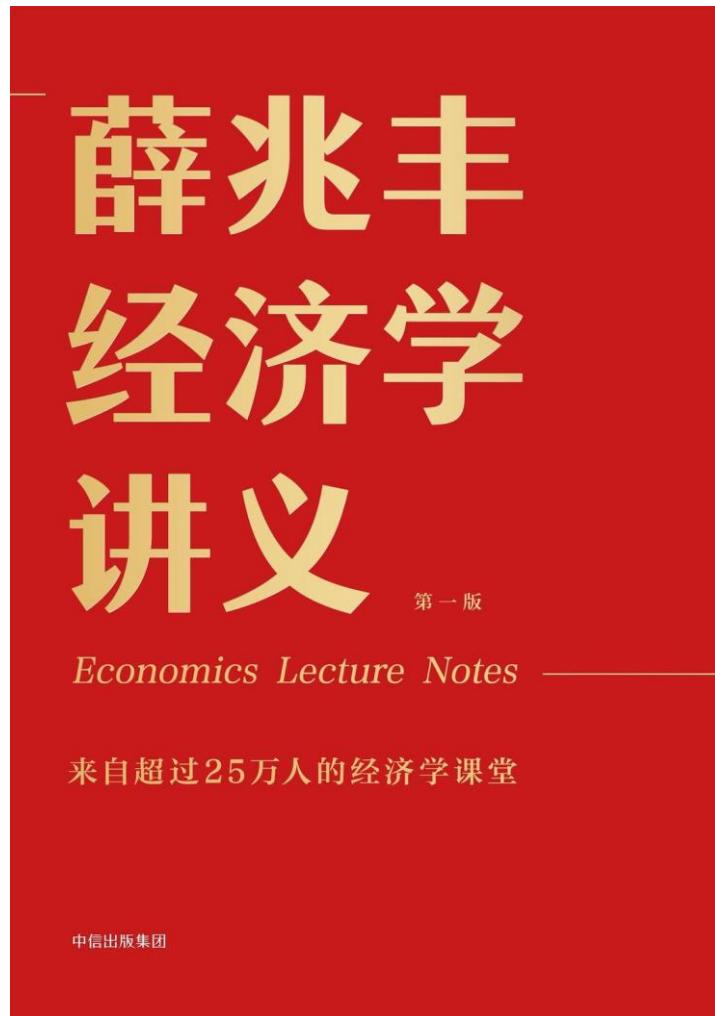
■ Purchasing-power = $\frac{1}{CPI} \times 100\%$

➤ 1/1.25 × 100% = 80%
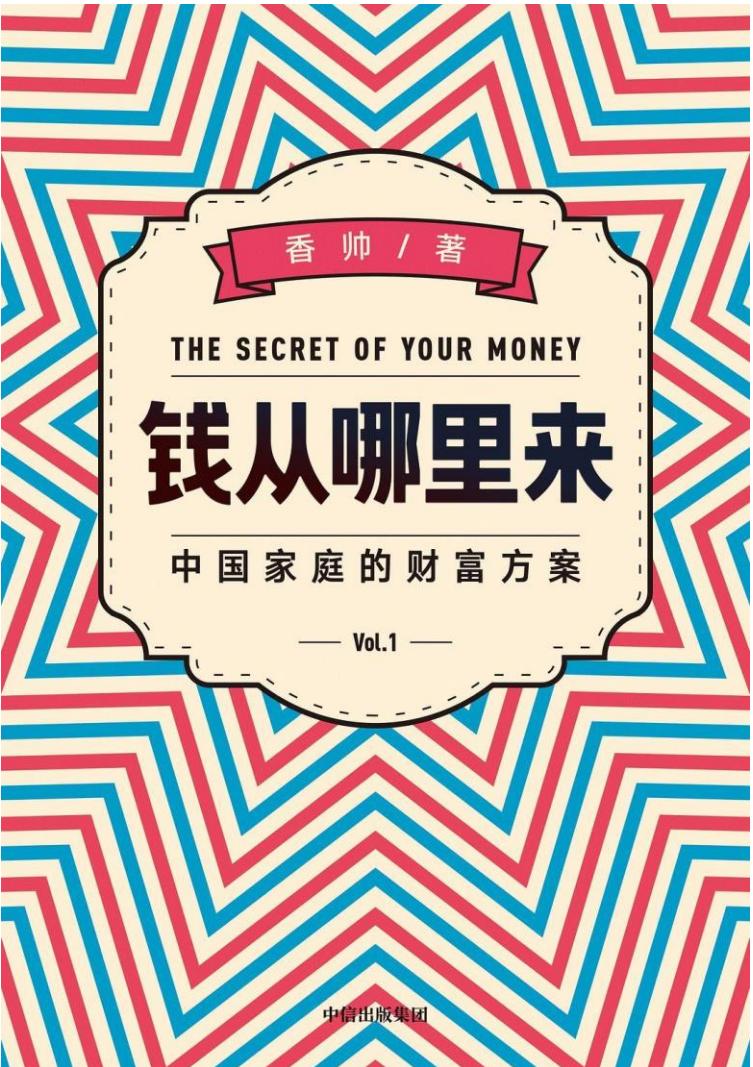
■ Real salary = $\frac{Salary\ that\ you\ get\ now}{CPI}$

➤ 5000/1.25 = 4000
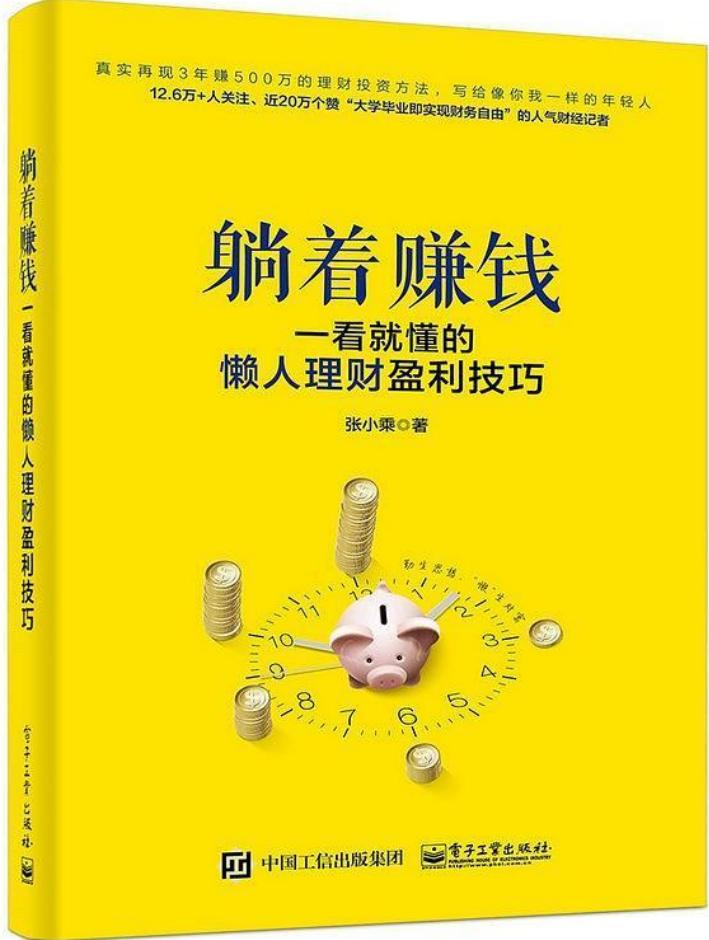
There are many other indices – Industrial Production Index (IPI) etc.

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