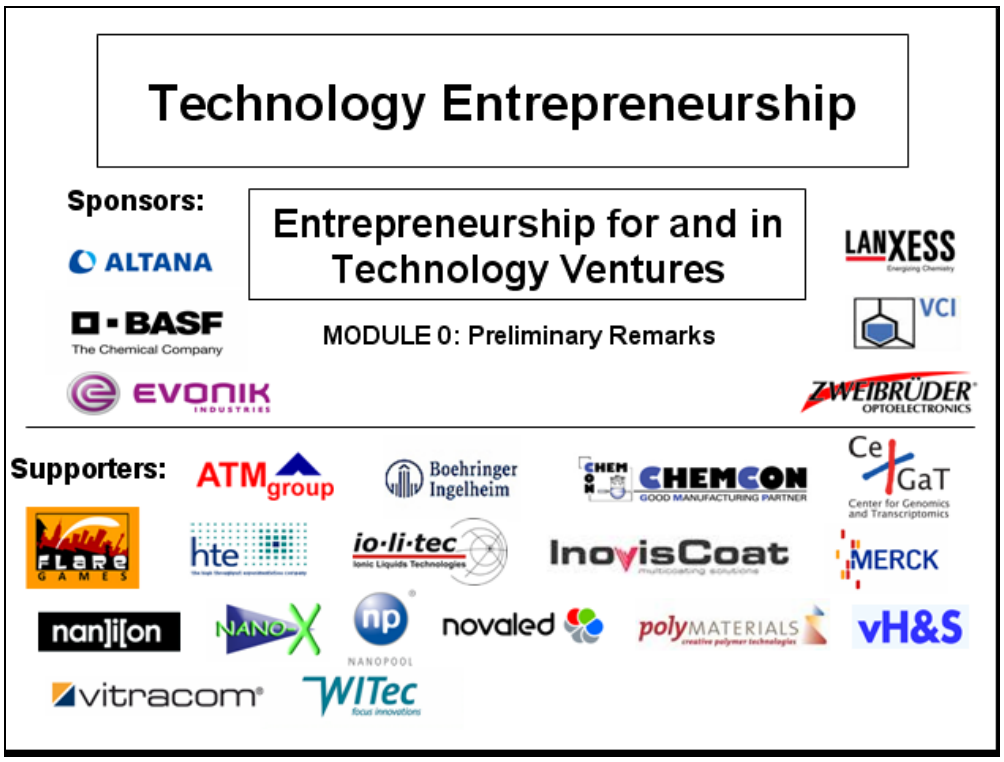


Discipline-Related Entrepreneurship for New Technology-Based Firms (NTBFs)!

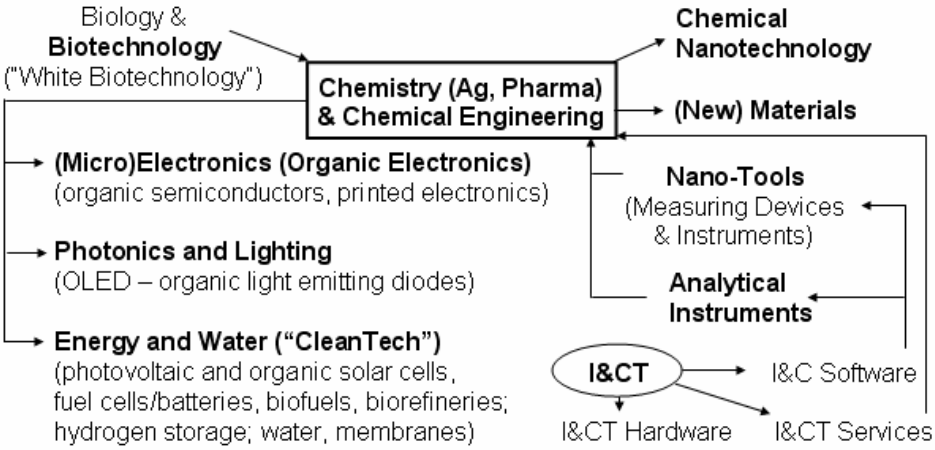
- **Not** a condensation or transformation of a "business school" approach ("MBA") to science (chemistry, physics etc.) and engineering!

- **NTBFs have specific requirements!**
- *Match scientific and technical development with the market.*
- 87% of NTBF entrepreneurs believe: *training for technology entrepreneurs needs to be specialized*, to reflect the ***unique challenges of the discipline.***

(CORDIS – Articles on Innovation. Breeding business success. http://cordis.europa.eu/aoi/article.cfm?article=835)

What Areas Are We Talking About ("Chemistry-Related")

Industrial High-Tech Classification Using "R&D Intensity" - RI > 3.5%
(Proportion of R&D expenditures in relation to total revenues)
High Value Tech (HTW): 3.5% < RI < 8%; **Top Value Tech** (STW): RI ≥ 8%



 0.3

Goals

- Increase **awareness** and **curiosity** about technology entrepreneurship and innovation and influence **attitudes**
- Provide **inspirations**
- Support **mentality/motivation** and **behavior** for founding an NTBF utilizing the current "entrepreneurship climate"
- For startup prepare founders to know **which questions** to ask and **whom** to ask
- Target **entrepreneurship** for founding NTBFs and entrepreneurship in technology-based firms ("**intrapreneurship**")
- Prepare students for **top job tracks** in industry
- Provide education and skills using appropriate educational and training methods, tools and materials following a "**Theory-to-Practice**" approach.

 0.4

Technology Entrepreneurship: A "Need to Know Approach"

- **A General Remark Concerning "Strategy" and "Strategic Planning",**
  Applicable to other Areas and Entrepreneurship

  "A great deal of business success depends on generating new knowledge and on having the capabilities to react quickly and intelligently to this new knowledge. … I believe that strategic thinking is a necessary but overrated element of business success.

  If you know how to design great motorcycle engines, I can teach you all you need to know about strategy in a few days. If you have a Ph.D. in strategy, years of labor are unlikely to give you the ability to design great new motorcycle engines."

  (Richard Rumelt (1996): California Management Review 38, 110)

 0.5

Technology Entrepreneurship: A Process-Oriented Approach

- "Creative" and Attitudinal Requirements
  - Develop ideas and/or embrace opportunities
  - Take initiative, risk and responsibility for change
- Behavioral Requirements (Decisions & Actions)
  - Identify and evaluate opportunity
  - Elaborate a business concept
  - Identify the needed resources
  - Get the necessary resources
  - Implement, operate, track and harvest the venture

 0.6

→ **0.6a at the end**

Your Instructor-Facilitator

Wolfgang Runge

- Independent scientist and consultant; emphasis on innovation and research; competitive intelligence; "Chemical Business Engineering": ***RISC***[Net] (http://www.RISCnet.de)

Basic Research (8 years):

- Chemist by education; doctoral degree (Dr. rer. nat.), Free University of Berlin (Germany) - 1971
- Habilitation (Dr. rer. nat. habil.): Technical University of Munich (Germany) - 1975

Applied Research (11 years):

- "Society for Information and Documentation" (GID); later integrated into "Fraunhofer GMD National Research Center for Information Technology": Chemical Information and Computer Science; Information Science and Systems, Information Economy

Industrial Research (18 years):

- The Dow Chemical Company: R&D Operations Manager (incl. InfoCenter, R&D Computerization, Capital/Expense Planning & Control, Building & Lab Infrastructure); Information Project Leader and "Specialist" ("Intellectual Asset Management", New Business Development; "Competitive Intelligence", "Technology Intelligence" and Patent Systems; Knowledge Discovery in Text Databases (KDT))

 Ref. Runge, p. ix 0.7

Course Program

Date	Style	Modules and Course Content
17.10.2012	Lecture	Preliminary Remarks; Introduction – Setting the Stage
24.10.2012	Lecture (2 Modules), Group Discussion	National Economic Systems, GEM (The Global Entrepreneurship Monitor); Startup Life Times and Personal Traits of Entrepreneurs
31.10.2012	Lecture	Ideas, Opportunities and Strategy
07.11.2012	Lecture	Patents and Intellectual Assets
14.11.2012	Lecture	Entrepreneurship and Technology Intelligence
21.11.2012	Lecture	The NTBF Startup Phase: Operational Competencies, Resources and Innovation Architecture/Configuration;
28.11.2012	Lecture , Group Discussion	Clustering, Networking and Alliances for Startups and NTBFs
05.12.2012	Dr. D. Biskup	CeGaT GmbH
12.12.2012	Lecture	The Entrepreneurs' Market Research and Marketing
19.12.2012	Lecture	Basics in Financial Understanding
09.01.2013	Lecture, Group Discussion	Business Models, Commercialization Models and Business Plans
16.01.2013	Dipl.-Ing. S. Nejad	Der Weg zum Erfolg - durch Technik, Kreativität und Geschwindigkeit (ATM Group)
23.01.2013	Lecture	Intrapreneurship: Company Requirements and Barriers for Entrepreneurial Activities; Differences between Small and Large Firms
30.01.2013	Dr.. P. Wagner	LANXESS AG
06.02.2013	Dr. J. Siegel	InovisCoat GmbH
13.02.2013	Written Examination	For Certificate (55 minutes)

Modules → KIT Promotionsprogramm "Science und Management"

 0.8

Course Material and References

"**Printed Handouts**"; script (slides) with references to books:

1. Runge, W. (2006): *Innovation, Research and Technology Intelligence in the Chemical Industry* – Integrated Business, Technical and Systems Approaches. Fraunhofer IRB Verlag, Stuttgart, 2006
2. Dorf, R. C.; Byers, T. H. (2007): *Technology Ventures: From Idea to Enterprise*. McGraw Hill (2nd Ed. with DVD; January 11, 2007) – emphasis on information & communication technology including software and electronics; *few explicit references*!
3. Tidd, J.; Bessant, J.; Pavitt, K. (2001): *Managing Innovation – Integrating Technological, Market and Organizational Change* (2nd Ed.). John Wiley [3rd Edition 2005] – *very few references*!

- Some references in "slides" to few special texts, which are available on the Internet

Homepage (incl. **Course Files**; http://www.tech-entrepreneurship.de)

 0.9

The Questionnaires

- After the first lecture to get information about the audience
  - Included: anonymously collected personal data to track background and experiences of the audience
- Overall evaluation at the end of the course

 0.10

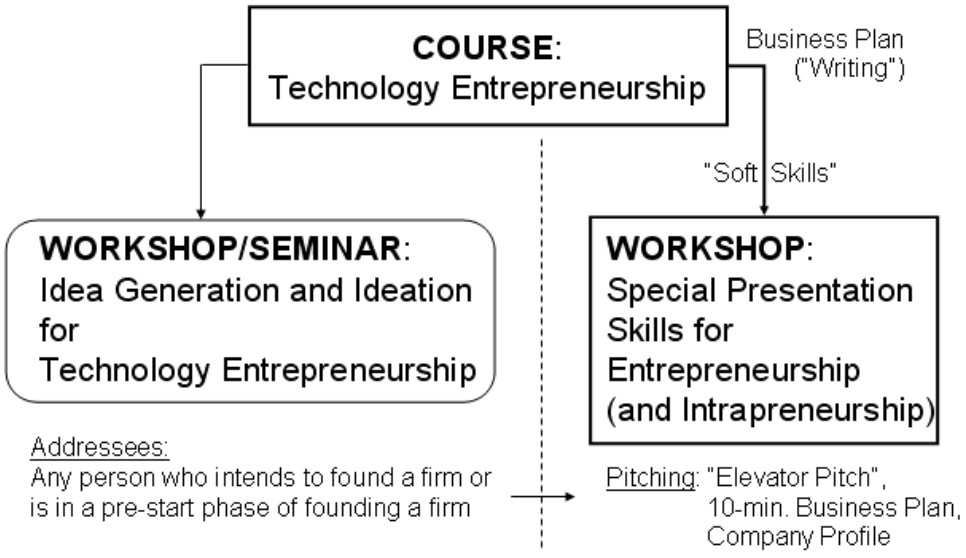
Attendance Confirmation or Certificate

- Attendance Confirmation:
  - Minimum 70% of lectures attended (10 of 14; 11 of 15)
- Certificate (ECTS: 4 Points):
  1. Written multiple choice examination (55 minutes) (referring to contents of the lecture slides)
  2. Create a (maximum) 5 slides presentation (in German or English) of a *business plan* based on provided largely unstructured text on existing new companies/entrepreneurs (6 weeks for preparation; "2 Persons Group" allowed)

Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it. (Samuel Johnson)

 0.11

Technology Entrepreneurship Curriculum



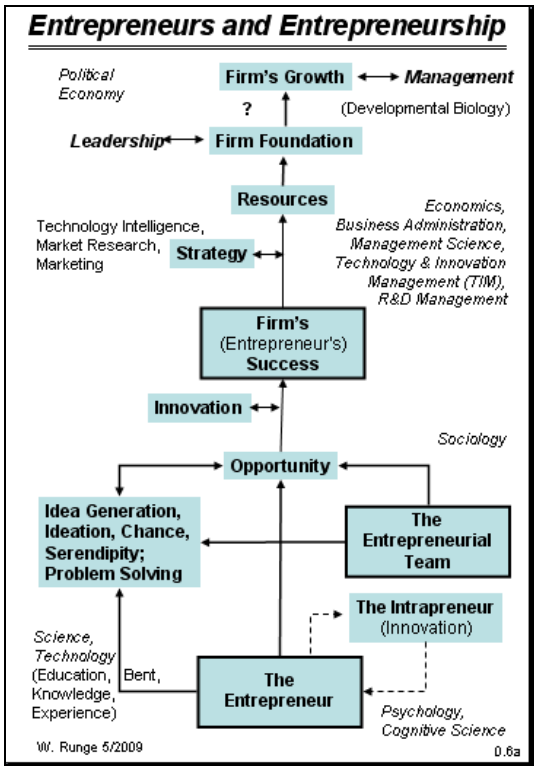
 0.12

Q&A

There are no stupid questions!!!!

Questions may be asked in German or English!

 0.13



Technology Entrepreneurship

Entrepreneurship for and in
Technology Ventures

It is not sufficient to know, you have to apply as well;
it is not sufficient to intend to do, you have to do it.
(Johann Wolfgang von Goethe)

Es reicht nicht zu wissen,
man muss auch anwenden.
Es reicht nicht zu wollen, man muss auch tun.

MODULE 1
Introduction – Setting the Stage

A Different Corporate Landscape

- Students face *a different corporate landscape* than the generations before them did.
- Part of the motivation to present entrepreneurship is to give students, regardless of their interest in business, an *alternative career path.*
- Teach students to *think entrepreneurially*, *a skill* members of the next generation will need to succeed in the corporate world, even if they never expect to be their own boss.

A former boss of mine at Dow Chemical:
"Wolfgang, do your job
as if you run your own small shop."

 1.2

Post-Educational Environment and Conditions

- Very few students (of chemistry, chemical engineering etc.) will start and succeed in a scientific career in a university or (non-profit) research institute
- After graduation the majority of students will work in the chemical or another industry. Few will join state-owned (research or other) organizations.
  - More graduates will be employed in small and medium-sized chemical enterprises rather than large chemical companies
  - Climate is volatile in industry (layoffs, mergers, acquisitions, joint ventures (JVs), spin-offs, etc.)
  - Even, if you start in the Research function of a large (chemical) corporation the majority of people will switch career into other functions or roles and responsibilities (technical service, marketing, planning etc.)
- More graduates may think of founding their own firm ("entrepreneurship")

 1.3

A Researcher's Career in Industry

Dr. Thomas Geelhaar (Merck KGaA) – **CTO** (Merck) doctorate in physical chemistry (1983):

- 1984-1991; heading a liquid crystals *research laboratory*
- 1991-1993, led a research project in electronic chemicals
- 1993-1997, responsible for *liquid crystals physical research*
- 1997-2000 responsible for *marketing and sales*
- 2000-2002 responsible for the *liquid crystals business* in Japan
- Since 2002, *head of research* in the Liquid Crystals division and coordinating research in the Chemicals business sector
- Since the end of 2005, also managing director of Merck OLED Materials GmbH

 1.4

Entrepreneurship – A Learned Capability?

Can entrepreneurship (intrapreneurship) be taught?

- One can definitely learn the tools and processes that will make your startup as efficient and viable as possible.
- "It's like teaching someone how to paint - you can't teach people where to get their inspiration, but there is also technique in it." (**Prof. Noubar Afeyan**)
- Concern: Confusing *entrepreneurship* for the start-up of a firm (NTBF) and *SME management*

NTBF – New Technology-Based Firm
SME – Small and Medium-Sized Enterprise (KMU), micro 0-9, small 10-50, medium 51-249 employees

 1.5

Some Questions on Entrepreneurship

- How is being an entrepreneur different from being a manager, being an inventor?
- What is the significance of selling and production for entrepreneurs
- Why is entrepreneurship important?
- What role does it play in and for established firms?
- What role does it play for society and policy?
- What is its role internationally?

- Peter F. Drucker (1964):
  ..."*maximization of opportunities* is a meaningful, indeed a precise, definition of the *entrepreneurial job*.
  It implies that *effectiveness* rather than efficiency is essential in business. The pertinent question is not how to do things right but *how to find the right things to do*, and to concentrate *resources and efforts* on them."

 1.6

Selected Definitions

Entrepreneurship:

- **Hayes, T. J. (1997), Thesis:** An "*intentional activity* aimed at meeting a *perceived need* through the creation of *innovative* methods, processes or products; and, subsequently, envisioning, organizing, managing, and *assuming the risks* of a *new enterprise or business*."
- **The ability to recognize that which is not obvious!**

Entrepreneur

- **Collins Concise Dictionary:** The "*owner* or manager of a business enterprise who, by *risk* and *initiative*, attempts to make *profits*"

Intrapreneurs:

***Corporate entrepreneurs* who create a new venture working in big organizations ("*inside entrepreneurs*")**

- **Wikipedia:** The practice of *entrepreneurial skills and approaches* by or within a company. Employees, perhaps engaged in a special project within a larger firm are supposed to *behave as entrepreneurs*, even though they have the resources and capabilities of the larger firm to draw upon.
- **Related Activities in Firms:**
  - "Skunkworks" (cf. 13.16)
  - "Bootlegging" (cf. 13.17)

"***Serial Entrepreneurs***": **Persons who "continuously" create new firms**

 Ref. Runge, p. 438 1.7

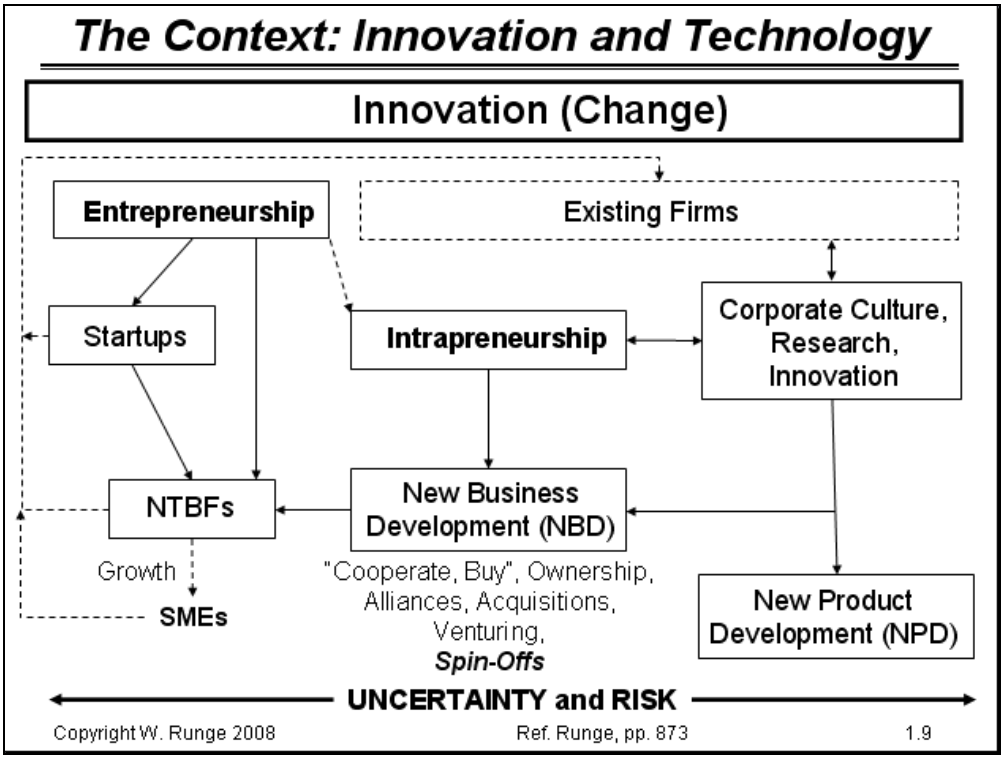
Technology Entrepreneurship

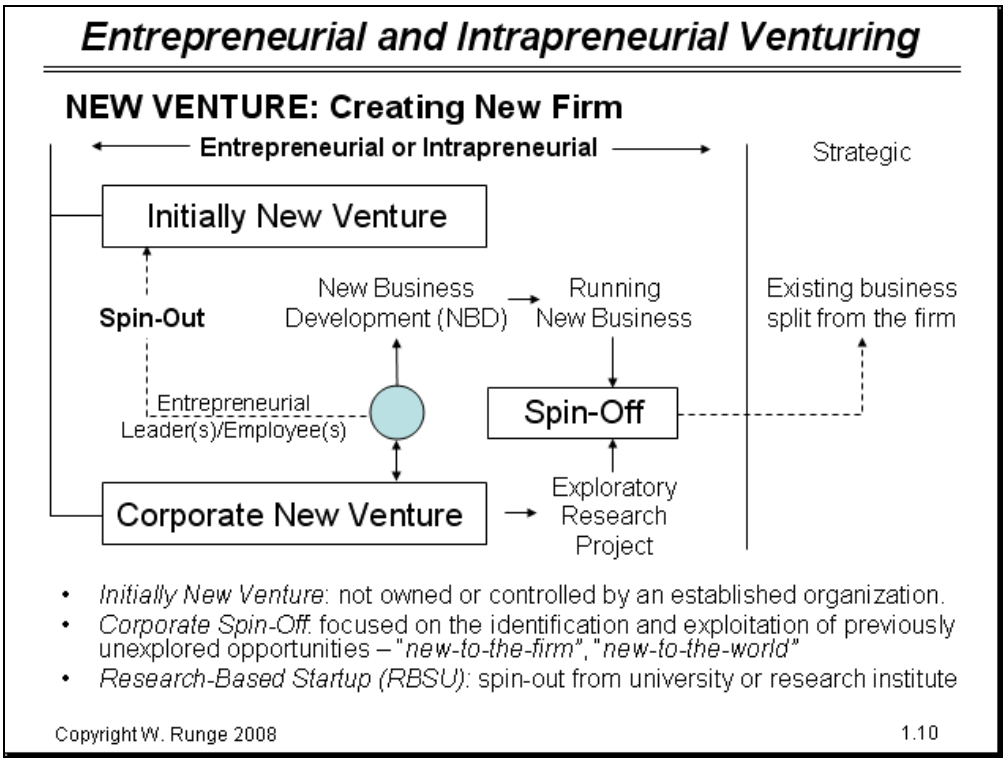
- "Technology entrepreneurship is a style of business *leadership* that involves identifying *high-potential*, technology-intensive *opportunities*, gathering *resources* such as talent and capital, and *managing rapid growth* and significant *risks* using principled *decision-making* skills." (Emphases added)

  Note here:
  the relationship of entrepreneurship and rapid growth of the new firm – which is a *definitional constraint*

NTBF:
a firm working in a 'high technology" sector, less than 10 years in operation and who is lead by the original founder team
(Luggen and Tschirky, 2003 – What means high-tech?)

 Ref. Dorf & Byers, p. xv 1.8


The Context: Innovation and Technology
Innovation (Change)
Entrepreneurship
Existing Firms
Startups
Intrapreneurship
Corporate Culture, Research, Innovation
NTBFs
New Business Development (NBD)
Growth
SMEs
"Cooperate, Buy", Ownership, Alliances, Acquisitions, Venturing, Spin-Offs
New Product Development (NPD)
UNCERTAINTY and RISK
Copyright W. Runge 2008
Ref. Runge, pp. 873
1.9


Entrepreneurial and Intrapreneurial Venturing
NEW VENTURE: Creating New Firm
Entrepreneurial or Intrapreneurial
Strategic
Initially New Venture
Spin-Out
New Business Development (NBD)
Running New Business
Existing business split from the firm
Entrepreneurial Leader(s)/Employee(s)
Spin-Off
Corporate New Venture
Exploratory Research Project
Initially New Venture: not owned or controlled by an established organization.
Corporate Spin-Off: focused on the identification and exploitation of previously unexplored opportunities – "new-to-the-firm", "new-to-the-world"
Research-Based Startup (RBSU): spin-out from university or research institute
Copyright W. Runge 2008
1.10

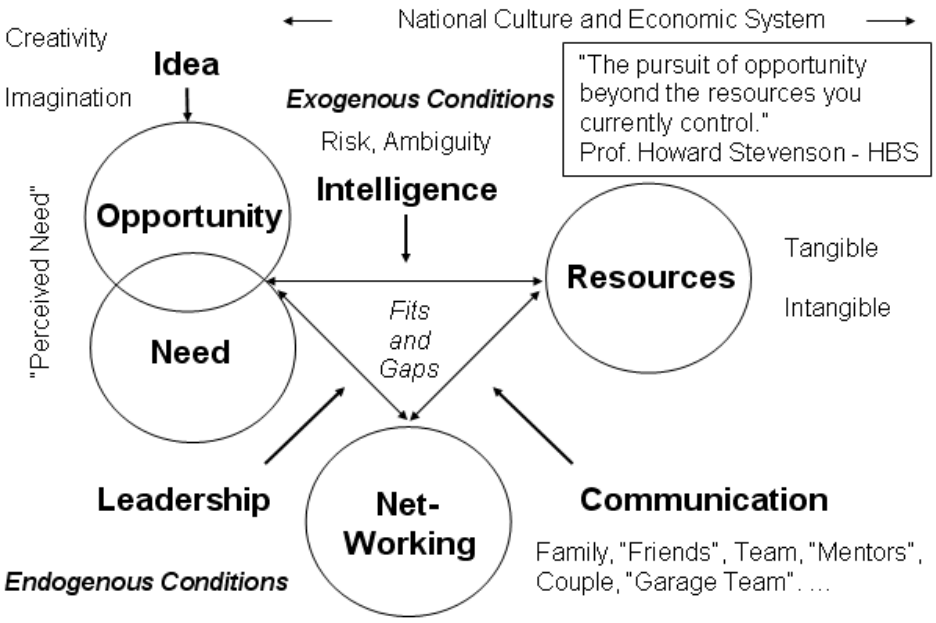
Selected "Risks" for Entrepreneurs and Research and Innovation of Chemical Firms

Entrepreneurs' Risks: Personal financial, psychological and social damage
(for investors' and entrepreneurs' risks cf. Nanogate IPO prospectus – Slide 7.13)

Risk Areas	Comments and References
Production processes	Explosion, fires; but incidents with others may be turned into innovation opportunities (Box I.9; Spec 5)
Product properties and liabilities	Lipobay/Baycol, Vioxx and other chemical cases (Box I.10); the U.S. tort system
Corporate image	Perceptions of pharmaceutical and chemical firms; "*issue management*" (Lipobay/Baycol, Vioxx and other cases; Box I.10)
Future regulations	Loosing markets through missing compliance; missing opportunities
Product "pipeline", product portfolio	Loosing patent protection of pharmaceuticals, generics entering the market (cf. 2.1.4.2); missed "protection hedges" through absent "defensive patents"; focusing on the "wrong" technologies
Intellectual properties (IP)	Patent infringements through unawareness of existing technology protection through patents; "loosing the race" (time-to-patent target not met)
Market and technology competition	Unawareness of current and future threats through known competitors, unawareness of new entrants; "loosing the race" (time-to-market target not met)

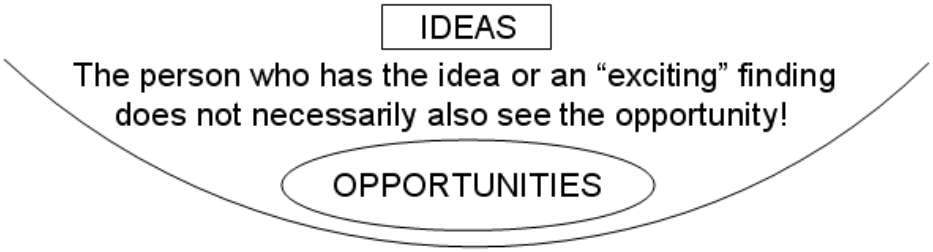
 Ref. Runge, pp. 873; p. 875, Table III.50 1.11

A Structural Model of Entrepreneurship



 1.12

Ideas versus Opportunities



- 1 - 3% of ideas are considered opportunities by venture capitalists (VCs) – cf. views of R&D (12.24)
- A *good opportunity* must be
  - attractive
  - durable
  - timely
- "*Lemons*" ("losers") ripen in about 2 1/2 years.
- "*Pearls*" ("winners") take seven to eight years.

 1.13

Types of Technology Entrepreneurs

Technical Entrepreneur:

Engineering-type entrepreneur; people with *technical educations* (and often a *business mind*), e.g. from various types of technical schools or people with engineering degrees from universities, such as the MIT or U-M (University of Michigan, College of Engineering) in the U.S. or Technical Universities (Karlsruhe, Munich, Aachen) in Germany.

Academic Entrepreneur:

Emphasizing new ventures originating from research and/or (academic) *science- and research-oriented* intellectual properties

Technical Businessman/-woman:

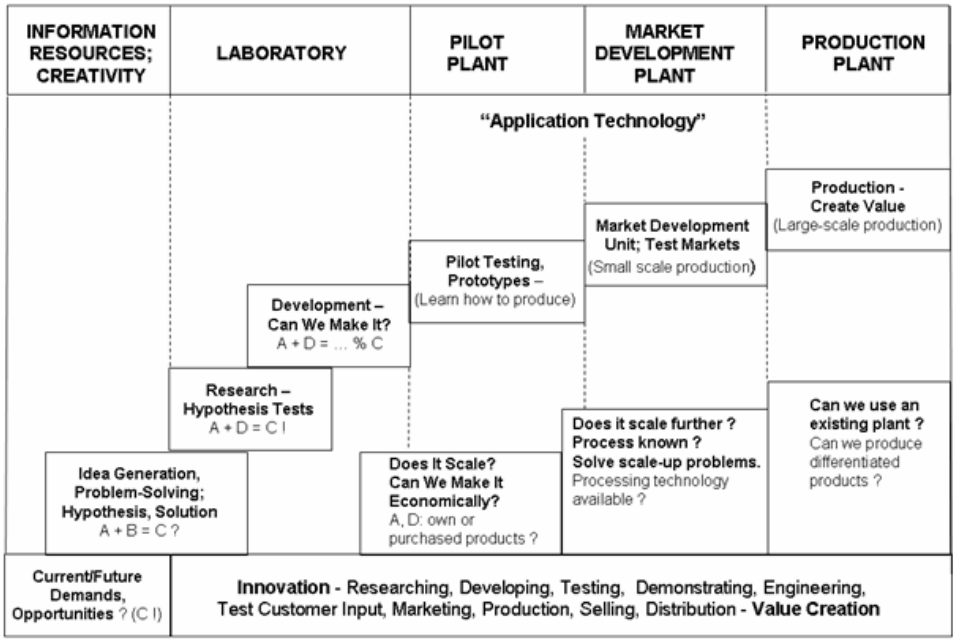
Entrepreneur with *commercial competencies and simultaneously a strong technical bent*

"Entrepreneurial Pair" (or Triple or … ***Team***):

Two (three) persons *combining and complementing* their individual technical and commercial entrepreneurial competencies (often "friends"), each one alone missing a required key characteristic or bent to "initiate entrepreneurial action"
(e.g. co-founders Diesbach & Dippel, Bayer & Weskott (Bayer AG), Röhm & Haas, Eastman & Strong (Kodak), Hewlett & Packard (HP); Rickert & McClusky (Nanofilm LLC))

 Ref. Runge, p. 438, 439 1.14

Transferring Technology from the Laboratory to the World



 Ref. Runge, p. 519, Figure III.1 1.15

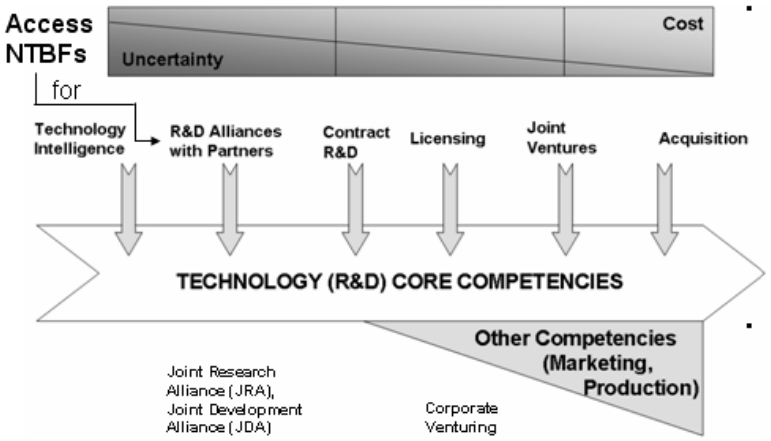
Entrepreneurship, Policy and Society

- Global agreement:
  entrepreneurship and related foundations of startups and SMEs are essential for *national economic wealth and growth*, mainly expressed by creating jobs.
- Correspondingly, national governments have installed various *programs and initiatives* to encourage and support entrepreneurial activities (and SME activities) and are interested in identifying *policies that may enhance the level of entrepreneurial activities*.
- Various *efforts to raise societal awareness*.
  For instance, in the U.S.: (in 2007 the first annual) Entrepreneurship Week USA
  - To encourage young people to think creatively and to turn their ideas into action; also designed to show young people "***that entrepreneurship isn't just about business, it's a way of life***."
- GEM (The Global Entrepreneurship Monitor): a cross-national assessment of entrepreneurial activity now includes 42 countries; a major research project *aimed at describing and analyzing entrepreneurial processes within the participating countries*.

 1.16

Entrepreneurship and Large Companies

Acquiring technology and building competencies by large companies:



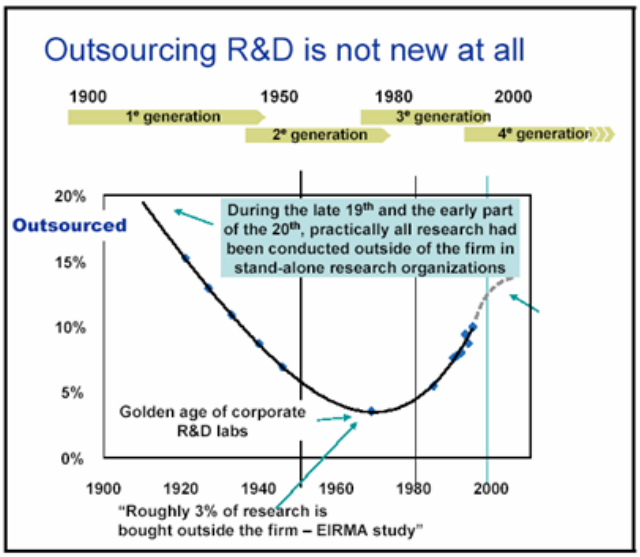
- *Create a **"networked economy" of innovation"**, balancing the greater certainty of in-house R&D and organic growth with an earlier but riskier starting position in emerging technologies.*
- *Usually, entrepreneurs think differently. The startup culture may positively affect the parent's corporate culture*

NTBFs address large companies:

- Access to *market channels* (e.g. via marketing and sales agreements)
- Access to *resources* of the large company (from consulting to services, such as analytical or information services)

 Ref. Runge, p. 618, Figure III.19; p. 558, Table III.6; p. 46, Figure I.6 1.17

Research Alliances and Contract Research is Not New



 Ref. Runge, pp. 683; p. 684, Figure III.35 1.18

Synergies - Alliances

Synergy: The combination of factors which each *multiply the effects* of the other(s) rather than merely adding to them – a *systems feature*

- **Individual Level** (Slide 1.14)**:** "Entrepreneurial Pair" (or Triple or … Team)
- **Corporate Level** (Slide 1.17): Joint Research Alliance (JRA), Joint Development Alliance (JDA), Joint Venture etc. (e.g. new biotech firm + large pharma firm)
- **Industry Level**: Co-Evolution (Slide 4.22)
- ***Alliances:***
- *Complementary* competencies and resources ("win-win" constellation)
- *External* resources management (issue: "Build, Cooperate or Buy")

 1.19

Entrepreneurship: Generics and Specifics

Generic factors, structures and processes (time- and environment-independent): *personal traits; motivation, …skills, … decision-making, …*

For entrepreneurship differentiate

– *scientific discipline and/or technology area* and

– *cultural, socio-economic, industrial and*

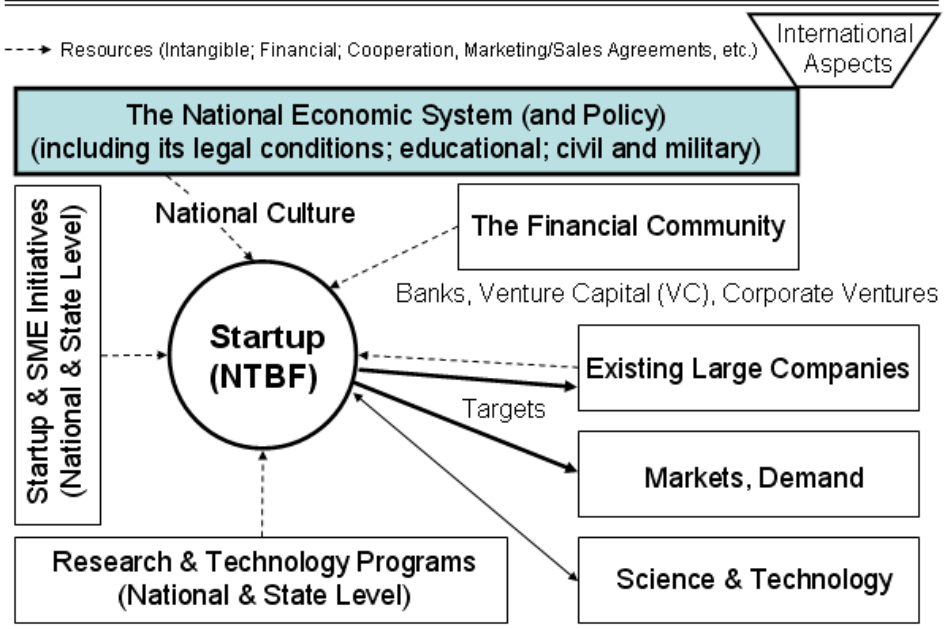
– *political factors*

from *generic* ones.

- For intrapreneurship differentiate
  – (generic) entrepreneurial factors, and
  – additionally *firm-specific* ones ("constraints")

 1.20

The Entrepreneurial Configuration for an NTBF



 1.21

Why Entrepreneurship Now?

- Social Change
- Technological Change
- Economic Change
- Psychological Change

Opportunities for entrepreneurship in the STEP arena!

Further questions:

- What can be done to encourage and enhance entrepreneurial activity?
- What about *national differences* in entrepreneurial activity?

There is life and entrepreneurship - independently from leaving the campus with or without a particular degree (cf. Bill Gates)

"Being first" is over-rated

(cf. Xerox/PARC – Apple - Microsoft;
concerning the *dye industry* German firms overcoming English and French ones around 1880;
concerning the *photovoltaic industry* German firms overcoming those from the U.S. and (partially) Japan around 2000)

 Ref. Runge, p. 267, 275, 743 1.22

More on Educational Aspects and Programs

- Education in entrepreneurship is not absolutely necessary for people who want to start their own companies!
  Entrepreneurship is certainly not for everybody!
- Differentiate between "being taught" entrepreneurship and "learning" entrepreneurship
- One can definitely *learn the tools that will make your startup as efficient and viable as possible*.
- **The MIT emphasizes two perspectives ((Prof. Noubar Afeyan):**
  - The *personal creative side* of imagining an unmet need or identifying an opportunity and being inspired about how to fill that need,
  - The *process-driven side*, which involves methodical techniques of analysis, structured idea generation, channel development, and dealing with market and marketing demands.
  - "It's like teaching someone how to paint - you can't teach people where to get their inspiration, but there is also technique in it."

 1.23

The MIT Approach as a Compass

Technological Innovation & Entrepreneurship

- Technological Innovation & Entrepreneurship (TIE) embraces two areas: *the organization, development, and commercialization of technology-based innovation in existing firms*; and the *formation, development, and growth of technology-based new enterprises*.
  Students can *integrate these areas in their studies* or approach them as distinct elements.
- Prepare students for *top jobs* in today's technology-intensive business world.
  (http://mitsloan.mit.edu/phd/ar-mtie.php)
- Entrepreneurship classes (in the U.S.): learn skills that will go from initial conception and design of a *business plan*, to *financing* a startup and *managing a growing company*, through creating *partnerships* and *strategies*; students will learn more about their *personal traits* and acquire important *soft skills*, e.g. communication and presentation and negotiation

 1.24

Entrepreneurial Fundamentals: Have SMART Goals

There is life and entrepreneurship - independently from leaving the campus with or without a particular degree (cf. Bill Gates)

Goals must be (attribute and process):

- Specific — Spezifisch
- Measurable — "Messbar" ("nachweisbar")
- Attainable — Erreichbar ("realistisch")
- Relevant — Bedeutsam (angemessen)
- Trackable — Verfolgbar ("Spur zum Ziel")

 1.25

Entrepreneurship Is Not New

For instance, in chemistry:

- (German) Süd-Chemie AG (sales in 2010 ca. €1.23 billion) is a globally operating specialty chemicals firm with its headquarter in Munich (recently acquired by Swiss Clariant AG)
- It was founded in 1857, among others by *Justus von Liebig* as the „Bayerische AG für chemische und landwirtschaftlich-chemische Fabrikate (BAG)".
- Siemens AG: founded 1847 as "Telegraphen-Bauanstalt von Siemens & Halske"

 1.26

Setting the Stage

EXERCISE:

- Read the text about the **"Berlin (Prussian) Blue" innovation** (10 min.)
- **Group Action**: Create a (written or mental) list of key *structures, features, situations, strategies or processes* for innovation and entrepreneurship (actual, potential) by chemical endeavors (5 min.)
- **Dialogue/Discussion:** 5+ min.

 Ref. Runge, p. 398; Table II.27 1.27

Technology Entrepreneurship

Entrepreneurship for and in Technology Ventures

A great society is a society in which its men of business think greatly of their functions.
(Alfred North Whitehead)

MODULE 2
National Economic Systems,
Research & Technology Programs and GEM

Entrepreneurship and Innovation

- ***Industry dynamics*** (in capitalistic, technology-oriented societies) follows a model of a ***disequilibrium*** initiated by ***innovation***: there are **"*entrant*" and "*exit*" firms**
- Experience and theory tell that in the development and change of industries and their offerings *discontinuous* or *disruptive* changes of categories, such as *technology*, *performance or value*, occur repeatedly
- Hence, developments of an industry is usually associated with a *change of the landscape* of the players:
  some become bigger, some smaller, some split, some new ones appear and some old ones disappear as a result of acquisition, re-structuring and *competition* (cf. e.g. Degussa → Evonik Industries with three business areas – Chemicals, Energy, Real Estate; Degussa selling its "Construction Chemicals" division – Slide 12.7)
- The renewal and revitalization of industry is part of a *life cycle* of formation, growth, maturing and decline of firms

 Ref. Runge, p. 13 2.2

National Economic Systems

Two basic economic styles:

- *Anglo-Saxon style* (U.S., Canada, UK, AU, etc.); "*free capitalism*"; corporate governance: "shareholder value", firm dominance by "outsiders"
- *Nippon-Rhineland style* (Japan, Germany, Switzerland, Austria, Sweden); "*regulated capitalism*"; banking system; corporate governance: "stakeholder value", firm dominance by "insiders"

… more

- Different *national cultures* (particularly U.S. - Germany)
- Different *attitudes* towards science/technology
- Different *national science and technology systems* (private uni's!) and political systems

Corporate Governance and Effects on Technical Innovation

Characteristics	Anglo-Saxon	Nippon-Rheinland
Management	Business schools and business administration education (U.S.); accountants (UK)	Engineers with business training; often chemists (with doctoral degree in Germany)
Evaluation of R&D investments	Published information	Insider knowledge
Strengths	- More responsive to radically new technological opportunities - Efficient use of capital - Fast crisis management	- Higher priority to R&D than to dividends for shareholders - Remedial investment in failing firms
Weaknesses	- Short-termism - Inability to evaluate firm-specific intangible assets	- Slow to deal with poor investment choices - Slow to exploit radically new technologies

 Ref. Runge, p. 3, 224-233, 235, pp. 265, pp. 392; p. 225, Table II.15 2.3

Entrepreneurial Climate

- The *entrepreneurial climate of a country* (cf. GEM) and its development *can* be based on three (macro) indicators:
  - The number of entrepreneurs in the working populations
  - Birth and death rates; the number of entries and number of exits as percentage of the total number of enterprises, and finally
  - The Total Entrepreneurial Activity Index (TEA); the number of persons that are *active in setting up an enterprise* or who *own a recently setup enterprise*.
- Also reflected by *fast-growing companies*. Fast growers often serve as *models of successful entrepreneurship*.
- But "entrepreneurial growth companies" (EGCs) make up only a minute portion of all new firms (in U.S. ca. 4%). *Most businesses "start small and stay small."*
- Stumbling stone: a *main problem of a growing startup* is the transition from pioneering to consolidation and transition into something new to grow ("stages") – *growth calls for new expertise and structure*

 2.4

High Growth of Enterprises

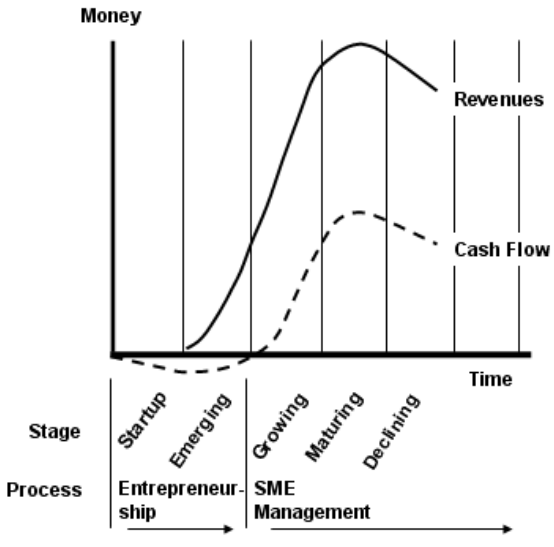
Even with the potential, a business owner may have limited aspirations and keep its firm "small"!

Many indicators for *venture growth*

- Enterprises are considered high growth enterprises if
  1. the *turnover* has increased by 60% or more *within three years*,
  2. the *number of employees* has increased by 60% or more within three years,
  3. the turnover and the number of employees have increased by 60% or more within three years.
- *Expenditures for R&D* of high growth enterprises are significantly higher than those of non-high growth enterprises.

 2.5

The Typical Situation for the Life Cycle of an Enterprise (NTBF – SME - Large Firm)



- Firm growth creates new challenges!
- When the business grows, the person who founded it is incredibly busy. Rapid growth puts an enormous strain on a business. *You outgrow your production facilities. You outgrow your management capabilities.*
- To avoid a crisis, you create a management team. There is *change over to SME management* (which sometimes is also done by the founder)

 2.6

More Startup Phase Hurdles

- Most often people need *assistance and advice at the initial start-up period* ("seed financing") and when they *need to seek financing for further growth*
- ***Financing orientation is strongly determined by national factors!***
- If there is no own money or money from the family or friends, *financing an NTBF* of any scale inevitably involves *presenting a business plan* to either a banker, venture capitalist, "business angel" or governmental agency – or even a counselor or consultant. This in turn involves a detailed view of *marketing* and *sales strategies*.
- Throughout the countries there are numerous "*business plan contests*" (monetary awards!) initiated by various "organizations" involving government, banks, media and consulting firms.
- Due to *governmental programs* there may be money or favorable incentives (e.g. loans, grants, tax benefits) through governmental agencies or research grants by science organizations (DFG in Germany, NSF in the U.S.)
- ***Marketing and sales*** is the field where entrepreneurs are most likely to assume they have taken the correct course of action and find out later that they had not!
- *Venture capitalists* are most likely to find fault with the marketing and sales aspects of a business plan.

 2.7

Entrepreneurial Pitfalls

Peter F. Drucker (1996) - The Four Entrepreneurial Pitfalls:

- The **first** comes when the entrepreneur has to face the fact that *the* ***new product or service is not successful*** *where he or she thought it would be* ***but is successful in a totally different market***. Many businesses disappear because the founder-entrepreneur insists that he or she knows better than the market.
- The **second**: Entrepreneurs believe that profit is what matters most in a new enterprise. But ***profit is secondary. Cash flow matters most*** (cf. 10.29+). Growing bodies need to be fed, and a business that grows fast devours cash. You have to make constant investments just to keep even.
- The **third**: You know, I've worked with entrepreneurs for fifty years and can say that there is a fairly normal curve; 80 percent fall within it. Even if your business is growing at a normal rate - not tripling in size every six months, but growing at a good, solid, sustainable rate - ***the management crunch hits you at the end of the fourth year***.
  Rapid growth puts an enormous strain on a business.
- The **fourth** pitfall is the most difficult one. It's *when the business is a success*, and the entrepreneur begins to put himself before the business. Here is a person who's worked eighteen hours a day for *fourteen years* and has **a $60-million business and a management team that works**. Now he asks himself, "What do I want to do? What's my role?" Those are the wrong questions.
  You should be asking, "***What does the business need at this stage?***" The next question is "Do I have those qualities?" You have to start with what the business needs. That's where an outsider can be very helpful.

 Ref. Runge, p. 438 2.8

False Starts of Technology Entrepreneurship

- **The most prominent example: 3M, currently viewed as *one of the most innovative companies in the world* ("technologically diversified chemistry-rooted company")**
  - 3M (until 2002 "The Minnesota Mining and Manufacturing Company") was founded 1902 by a doctor, a lawyer, two railroad executives and a meat-market manager. They bought land on the frigid shores of Lake Superior *to mine corundum, an abrasive used by sandpaper manufacturers to make the paper scratchy*. The five entrepreneurs drummed up new investors, bought machinery, hired workers and started mining.
    Only then they did discover that their corundum was not corundum at all, but a worthless mineral. The company that tolerates failure was founded on a colossal one. 3M was forced to innovate or to die, and they succeeded.
- **A current example": NanoScape AG (Munich), provider of porous, nanocrystalline materials and a developer of tailored application solutions (http://www.nanoscape.de/pdf/History_NanoScape.pdf)**
  - „Nach einem begeisternden Frühstart in die falsche Richtung ist nun die NanoScape in der richtigen Position, um einer erfolgreichen Zukunft entgegenzustarten".
  - Founded 2001: spin-out of the Department of Chemistry, Ludwig-Maximilians University in Munich; highly awarded in Business Plan Competition; high publicity with a catalytic (nanotubes based) process for styrene
  - Originally: high-throughput technologies focusing on catalysis, now functional materials
    Launched its portfolio of nanomaterial catalysts to complement its activities as catalyst-testing service provider.
  - Sold off its activities in the area of catalyst-testing service provider.
    Ceased its activities in the area of carbon nanotube catalyst development.

 Ref. Runge, pp. 374, p. 446, 460 2.9

Macrostatistics for Entrepreneurship

- Usually based on macrostatistics *across all types of entrepreneurship, incl. NTBF* across all disciplines
  There is the common saying about entrepreneurs that "within 5 years, more than 80 percent of them will fail".
- **However, such an approach counting the members of a statistical sample (class) is no firm indicator for "firm failure". A firm can exit an economy for all sorts of reasons without actually failing (e.g. leaving a particular business, being acquired by another firm).**
- **More thorough studies refer to industry "*entrants*" and "*exits*" (cf. Murmann's recent investigation on the dye industry 1857 – 1914 in Runge).**
- According to Bjerke and Hultman:
  (Bjerke, B.; Hultman, C. M. (2002): Entrepreneurial Marketing: The Growth of Small Firms in the New Economic Era. Edward Elgar Publishing)
  - 20-30% of startup companies will survive more than 8 years
  - 50 percent will survive about 5 years
  - 70 percent will survive 3 years
  - 85 percent will survive the first year

 Ref. Runge, p. 274-276 2.10

Technology Entrepreneurship and the Risk of Failure

(Peter F. Drucker (2002): Managing in the Next Society. St. Martin's Press. essays culled from published magazine articles and interviews during the period of 1996 to 2002)

Question: Do you agree that we in the United States are the best practitioners of entrepreneurship, that we're way ahead of other countries?

- **Absolutely not! It's a delusion, and a dangerous one. We may have the largest number of new business starts and new business failures, but that's all. We're probably not even number two.**

Is there a general estimate or rule-of-thumb about the proportion of startups, particularly NTBFs, that will *survive and grow* and ultimately will show up as a medium to large-sized company?

- There is some sort of "80:20 rule" for NTBF:
  The *mortality rate* of NTBFs is lower than that of most other types of new firms, *around 20% - 30% in 10 years*, compared to more than 80% of most types of new businesses.
- If one looks into *the survival rates of NTBF until the corresponding market consolidates into a stable state 50 – 60 years after the foundations of the first firms* in the particular area, the "survival of the fittest" is around 20% - 30%.

 Ref. Runge, p. 274 2.11

Macrostatistics for NTBF in Germany and UK

Study (Jan. 2007) with sample from 1997- 2003
(http://www.employment-studies.co.uk/summary/summary.php?id=agfsis07)

- Once an NTBF has survived to its 5th year, there is an approximately 80% chance that the firm will still be trading in its 12th year
  In the first 10 years since formation, the German median NTBF had grown 11-fold.
  Employment by 2003 (the 12th year) in the median firm was 12 persons in Germany
- Factors of success and failure:
  - The creation and maintenance of *managerial skills* in small high-tech firms continue to be of profound importance *for both survival and growth*. For example, persistent and unresolved weaknesses in *management* (Germany) and in *effective financial controls* (UK) both increase the long-run risk of firm failure.

 Ref. Runge, p. 374, 2.12

How Does The Global Entrepreneurship Monitor (GEM) Approaches Entrepreneurship?

- No other data set exists that can provide consistent cross-country information and measurements of entrepreneurial activity in a global context (across all types of offerings and across all types of technology)
- **Focus of statistical samples:**
  entrepreneurial activity* and established *business ownership
  - **Nascent Entrepreneurial Activity**
    Individuals, between the ages of 18 and 64 years, who have taken some action towards creating a new business in the *past year*, expect to own a share of the business they are starting and the *business must not have paid any wages or salaries for more than three months*.
  - **New Business Owners**
    Active as owner-managers of a new business that has *paid wages or salaries for more than three months, but less than 42 months*.
  - **Early-Stage Entrepreneurial Activity (TEA)**
    The percent of individuals in a population who owns and manages a business that *has paid wages or salaries for more than 42 months*.
  - **Established Business Owners**
    Population actively involved in running businesses that proved to be sustainable

Early stage entrepreneurial activity includes *nascent entrepreneurial activity and new business owners*. Some respondents are involved in both nascent entrepreneurial activity and new business ownership, hence the result that early-stage entrepreneurial activity rates are generally lower than the sum of both components.

 Niels Bosma and Rebecca Harding: GEM 2006 Summary Results 2.13

Selected GEM 2006 Results: Economies

- Regardless of the level of development, and firm size, *entrepreneurial behavior* remains a *crucial engine of innovation and growth for the economy and for individual companies*
- *Emphasis on two country groups*:
  - *Middle Income Countries* (e.g. Argentina, Brazil, Chile, China, Croatia, Czech Republic, Hungary, India, Malaysia, Mexico, Turkey)
  - *High Income Countries* (e.g. Australia, Canada, Finland France, Germany, Italy, Japan, Netherlands, Singapore, Sweden, UK, U.S.)
- The association of the cross-sectional approach between entrepreneurship and the level of economic development, however, does not imply any specific causal relationships between entrepreneurial activity and economic development.

 Niels Bosma and Rebecca Harding: GEM 2006 Summary Results 2.14

Selected GEM 2006 Results: Activities

- Countries with *similar per capita GDP tend to exhibit similar levels of entrepreneurial activity*, while significant differences exist across countries with different per capita GDP levels.
- Early-stage entrepreneurial activity is generally higher in those countries with lower levels of GDP (CN, TH, IN).
- Early-stage entrepreneurial activity is relatively low in high income countries, especially for the core countries of the European Union (UK, NL, FI, FR, DE, SE) and Japan.
- *Countries with highest levels of GDP (AU, US, CA)* show increasing early-stage entrepreneurial activity *suggesting* a new increase in opportunity related entrepreneurship (other cultural and socio-economic system?).
- Concerning the *prevalence rates* of *established business owners,* the U.S has an established business rate, which is comparable to those of many European countries and Japan, whereas early-stage entrepreneurial activity is higher in the United States (cf. slide 2.13)

 2.15

Selected GEM 2006 Results: Demographics

- Age, gender, work status (employed or unemployed; industry experience), family background, education, income, attitude and perceptions are all significant socio-economic factors in a person's decision to start a business.

Age

- Age distribution of *early-stage entrepreneurs* is comparable between high income countries and middle income countries.
  In particular, *early-stage entrepreneurial activity* is most prevalent in the age group of *individuals 25-34* years old.
  Age distribution of *established business owners* is also comparable between the two country groups. Respondents aged 45-54 years old in both the middle and high income groups reported the highest rate of established business ownership.

Gender

- Men are significantly more likely to start a business than women. This is even more true for NTBFs (but cf. 2.22 and 3.14)

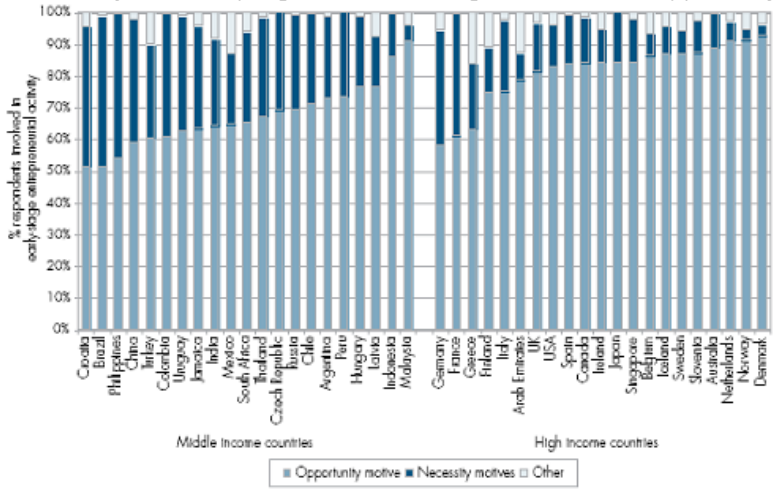
Education

- In both two country groups, people with post-secondary or graduate educations are more involved in early-stage entrepreneurial activity. Overall, however, the relationship between entrepreneurial activity at all stages and education is unclear.

 2.16

Selected GEM 2006 Results: Initiation

- **Motivation of entrepreneurial behavior:**
  opportunity entrepreneurs vs. *necessity entrepreneurs*
- The vast majority of early-stage entrepreneurs across the world claim that they are attempting to *take advantage of a business opportunity*.



German and France have much lower shares of opportunity-driven early-stage entrepreneurs (60%) than the UK and U.S. (ca. 80%)

 Niels Bosma and Rebecca Harding: GEM 2006 Summary Results 2.17

Selected GEM 2006 Results: Innovation (1)

- To *measure innovativeness*, entrepreneurs and business owners were asked how they evaluate the *newness* of their product or service, the *competition* they face, and the *novelty* of their product or service *technology* (entrepreneurial perception, context-specific)

Characteristics:

Market Replication vs. Market Expansion

- **Market Replication ("*Incremental Innovation*" or even *imitation*)**
  - **Customers know product or service well**
  - **Lots of competition**
  - **Using established technology or procedures**
- **Market Expansion or Creation ("*Discontinuous or Disruptive Innovation*")**
  - **Customers unfamiliar with product or service**
  - **No competition**
  - **New technology or procedures**

 2.18

Selected GEM 2006 Results: Innovation (2)

The newness of the products and services among early-stage entrepreneurs and established business owners in the two country groups is very similar for both groups:

Market Replication

- The majority of businesses are offering *products or services that are not new to customers*, and only a small fraction claim that what they offer is new to all customers.
- Most entrepreneurs also *expect to face many competitors in their markets*.
- Established business owners in the two country groups show no significant difference in their evaluation of the degree of competition they face.
- There are significant differences in the use of new technologies between high and middle income country groups. (Perception of middle income countries what is new technology!)

 2.19

High-Tech Macrostatistics for Germany - 1

Industrial High-Tech Classification by

R&D Intensity" – RI > 3.5%

("R&D Intensity": Proportion of R&D expenditures in relation to total revenues)

- High Value Tech (HWT – Hochwertige Technik): 3.5% < RI < 8%; e.g. Specialty chemicals, fine chemicals, high-performance polymers; medical technology (also firms from mechanical/electrical engineering)
- Top Value Tech (SWT – Spitzentechnik): RI ≥ 8%
  Pharma (biotechnology), Ag; (micro)electronic components, photonics
- *I&CT Special* - I&CT Hardware, I&CT Software, I&CT Services; I&CT Services - Technology-Oriented Services (TDL): more than 85% of high-tech foundations belong to TDL (requiring often little startup capital); **TDL *dominates the statistics!***
- In the first half of 2007 the chemical and synthetics and plastics ("Kunststoffe") area had the best entrepreneurial climate in Germany. For every 10000 firms there are 220 new enterprises
  (Nachrichten aus der Chemie 55, 871 (2007))

 Ref. ZEW-Studies on High-Tech Foundations, 2006-2008 2.20

High-Tech Macrostatistics for Germany - 2

Tabelle 3-1: Umsätze, Beschäftigtenanzahl und durchschnittliches jährliches Wachstum der Hightech-Unternehmen

hochgerechnete Mittelwerte	Umsatz im ersten Geschäftsjahr	Umsatz 2006	Beschäftigte im ersten Geschäftsjahr	Vollzeitbeschäftigte 2006 (Mitarbeiter mit Hochschulabschluss)	Beschäftigungswachstum	Umsatzwachstum (Gründungsjahre 1998-2003)
insgesamt	190 Tsd. €	840 Tsd. €	3	7 (3)	24%	34%
STW	260 Tsd. €	1.130 Tsd. €	4	8 (3)	25%	34%
HTW	350 Tsd. €	1.530 Tsd. €	4	10 (2)	29%	39%
Software	140 Tsd. €	480 Tsd. €	3	6 (3)	25%	37%
sonst. TDL	160 Tsd. €	670 Tsd. €	3	7 (4)	22%	32%
Gründungsjahr						
1998-2000	210 Tsd. €	1.270 Tsd. €	4	9 (5)	13%	28%
2001	170 Tsd. €	740 Tsd. €	3	7 (4)	17%	34%
2002	190 Tsd. €	690 Tsd. €	3	6 (4)	18%	40%
2003	220 Tsd. €	760 Tsd. €	3	6 (3)	23%	50%
2004	170 Tsd. €	650 Tsd. €	3	6 (3)	39%	-
2005-2006	150 Tsd. €	260 Tsd. €	3	5 (2)	60%	-

Lesehilfe: Insgesamt erzielten alle betrachteten Unternehmen einen durchschnittlichen Umsatz im ersten Geschäftsjahr von 190.000 €, Unternehmen des Gründungsjahrs 2003 sogar einen Durchschnitt von 220.000 €.
Quelle: ZEW-Hightech-Gründungspanel 2007.

- Ca 7% of the high-tech firms did not achieve any revenues in the first year after foundation.

 Ref. ZEW-Studies on High-Tech Foundations, 2006-2008 2.21

High-Tech Macrostatistics for Germany - 3

- Founding new high-tech firms is 6%-8% of all firm foundations;
  8% of founding firms in high-tech sectors is by *women*
- More than 15% of foundations in research-intense industry segments are "*academic spin-outs*" (Research-Based Startups - RBSUs)
- Ca. 50% of all high-tech firms are *founded by single persons* (rather than teams);
  Foundation by *teams* has turned out to be a success factor for entrepreneurship (*on average 3 persons*)
- More than 85% of high-tech foundations are "TDL" and "Hardware/Software" (includes with a minor proportion "bioinformatics", "cheminformatics – **Ref. Runge, p. 206,210; 347,917**)
- Founding events seem to proceed *pro-cyclic* (in line with *economic cycles*)

 Ref. ZEW-Studies on High-Tech Foundations, 2006-2008 2.22

Some Findings for Spin-Out Companies from UK Chemistry Departments – RBSUs (1)

- Survey completed in September 2002; 65 spin-out companies set up in the 1997-2002 period from 29 UK chemistry departments; ca.1/4 in the very early stages of development with funding from their founders and/or universities (**RBSU** - Research-Based Startups; cf. 8.7)
- 60% formed within the past 2 years (2001, 2002)
- Chemistry appears as productive as any other discipline.
- Collectively employ ca. 360 people (including over 110 chemists; *range of other disciplines*, bio-scientists – 69%, 38% engineers, 15% materials and IT specialists); 52% of startups ≤10 employees, 16% 11-20 employees

Engagement:	**Orientation:**
75% in research	57% in the bio/pharma sector
25% in services	33% in functional materials and optoelectronics
5% in manufacturing	10% in the conventional (fine) chemicals sector.

 Moustras, M. (2003). RSC. http://www.rsc.org/pdf/indusdiv/spinout.pdf 2.23

Some Findings for Spin-Out Companies from UK Chemistry Departments (2)

- 48% of chemistry spin outs are joint with other disciplines ("multi-disciplinarity")
- Reasons for firm foundation: take a good idea through to market, often in the form of a product that would be *beneficial to society and the economy*; change from academic research; *minority (25%) mentioned making money*
- Two factors inhibiting academics from spinning out companies: pressure of their day job and inexperience.

Funding:	**Collaboration:**
25% founders and/or universities	85% cited strong collaborations with both industry and academe
21% business angels	45% with the pharmaceutical industry and academic groups in chemistry and life sciences
53% venture capital	Reasons: need to develop products with potential customers as fast as possible; to access and exploit world class research groups

 2.24

Technology Entrepreneurship

Entrepreneurship for and in Technology Ventures

MODULE 3
Startup Life Times and Personal Traits of Entrepreneurs

All is needed in this world is a smart idea and a firm decision.

Alles was es braucht auf dieser Welt ist ein gescheiter Einfall und ein fester Entschluss.
(Johann Wolfgang von Goethe)

Why Become an Entrepreneur?

- Experience the satisfaction in *building something* from nothing; *creating something new - innovation*
- Seek *independence* ("be your own boss") and a feeling of being part of the action; *following a "dream"* ("vision")
- Enjoy the *challenge* and *profit* potential

Internal

- See ambitions and progress *blocked in big corporations*
- *Forced* by organizational situation (layoff, closure or selling of the firm/unit, etc. – *necessity entrepreneur*)

External Drive

- *Cultural difference*: A recent EU Green Paper noted that, compared to the EU average of 45%, as many as 67% of U.S. citizens would *prefer to be self-employed*. The problem in Europe is that entrepreneurship is not seen as an appropriate career choice (cf. GEM, slide 2.13)

- "***Success***": *venture growing or being purchased*

3.2

Some Entrepreneurs' Dreams

- For IT: Is there going to be another SAP?
  For biotech: Is there going to be another Amgen (or Genentech)?
- For photovoltaic: Is there going to be another Q-Cells?
  For chemistry: Is there going to be another XXX Corp.? (Few "superstars" in the chem. industry. Probably barriers to entry remain high [Tidd et al.:130])
- But:
  There hasn't been another Amgen since Amgen!

  It is all a little like people who think for software of the next Microsoft.
  But, there wasn't a next Microsoft, but Google.

And note, new ventures do not always require cutting-edge technology or a new product!

 3.3

Founders of Entrepreneurial Growth Companies (EGCs)

- EGCs: a *model of successful entrepreneurship*
- The "***entrepreneurial growth company***" (EGC) has ***high growth and high profitability*** as its primary objectives.
  It develops innovative strategies, practices, and offerings (products).
- But: Massive growth may not be the foremost goal of most small business founders!
- Entrepreneurs in EGCs:
  Audacious goals are at the heart of what they are doing. *Right from the start*, most successful entrepreneurs *aim to create a large, national or multinational company* and intend to *do whatever is required to achieve that objective*."
  (U.S. - (National Commission on Entrepreneurship (2001): Five Myths About Entrepreneurs. Understanding How Businesses Start and Grow. March 2001. http://www.publicforuminstitute.org/nde/sources/reports/2001-five-myths.pdf)
- Often EGCs take advantage from special (unique) events (SAP, Microsoft, Q-Cells, etc.)

 3.4

Typical Offerings of NTBFs

Don't assume people will want it - prove it - as you develop it!

- Products, devices (incl. sensors and diagnostics), systems
- Intellectual Properties (IP), e.g. licenses, knowledge and know-how
- Cooperation
- Contract research; joint development
- Contract manufacturing

Revenue Models:
Sales of Offerings,
Royalties,
Contractual Revenues

- Services, e.g. technical service, analytics, consulting
- Industry-related soft- and hardware offerings (What will be the "SAP for R&D and innovation"?)
  - *For the lab*: lab automation & control, process simulation, devices and instruments, databases for formulations (liquid crystals, ionic liquids), high-throughput screening (HTS)/ combinatorial chemistry
  - *Organizational processes*: research process support (innovation, patent systems), "ecommerce", etc.

Ref. Runge, p. 29, 30, 348-367 3.5

Some Historical Examples of High-Growth Companies

Year	Osmonics Inc. (U.S.)	ProMinent GmbH (DE)	Avery Dennison (U.S.)
1935			Foundation by R. Stanton Avery,
1945			Revenues:$0.5 million (50 employees); Russ Smith as corporate architect (1946) [ca. 2.1 mio RM]
1955			Revenues: $5 mio.
1960		Foundation by V. Dulger, clear visions and ambitions (start as "Chemie & Filter GmbH")	
1969	Foundation by D. Spatz; clear visions and ambitions; business plan		
1965			Revenues: $40 mio. (ca.DM160 mio./€80 mio.)
1971	Revenues: $300,000		
1974			Revenues: $300 (ca.DM1.2 bil./€600 mio.)
1980	Revenues: $5 mio.		
1989	Revenue: $36.2 mio.		
1996	Revenue: $155.9 mio.		
2000		Revenues: DM308 (ca. €150 mio.)	
2002	Revenue: $207 mio., 1,400 employees (ca. €170 mio.)		
2004	Osmonics purchased by General Electric (GE)		$5,341 mil. (€4,400 bil.)
2005		Revenues: €239 mio., 1.659 employees	
Ref.	Runge p. 91, Table I.8	Runge p. 74	Runge p. 476, Table II.32

- High growth - not lasting forever!
- Note economic cycles!

Sales Growth Inflections

Avg. Rate 33%:
- ca. 7 years (4-7 years) 1 million
- ca. 15 years (10-15 yrs) 10 million
- ca. 20 years 40 million

Avg. Rate 15%
- Ca. 30 years 160 million

Avg. Rate 5%
- Ca. 35 Year 200 million

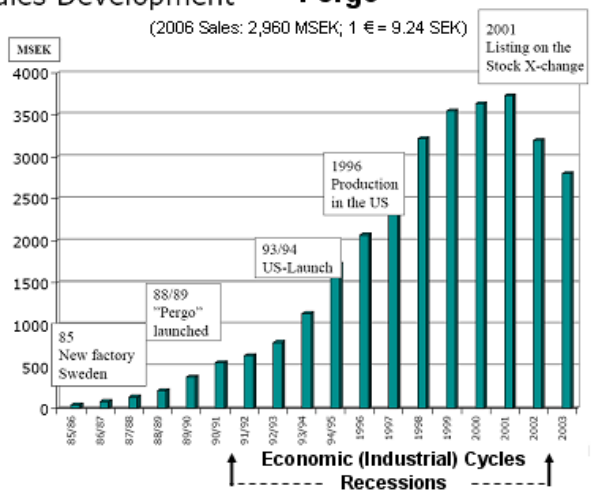
Currently: High-growth NBTFs exhibit ca. 30% rate

Cases, Biographies; Ref.: Runge 3.6

Pergo and Nanogate as Examples of High-Growth NTBFs

Sales Development **Pergo**

(2006 Sales: 2,960 MSEK; 1 € = 9.24 SEK)



- **Nanogate AG:**
- 1999 Operative launch as a spin-out of the Leibniz Institut für Neue Materialien (INM), Saarbrücken
- Revenues: €10.7 mio. (2009)
- Employees: 75 (2009); 29 in 2005
- Profitable since 2004 (firm's own information)
- "Large-firm rooted"; special (not spin-out, but out of project of INM with Bayer)

Laminate innovation by intrapreneurs of Swedisch firm Perstorp; Pergo created as a *spin-off; acquired 2007* (Pfleiderer AG)

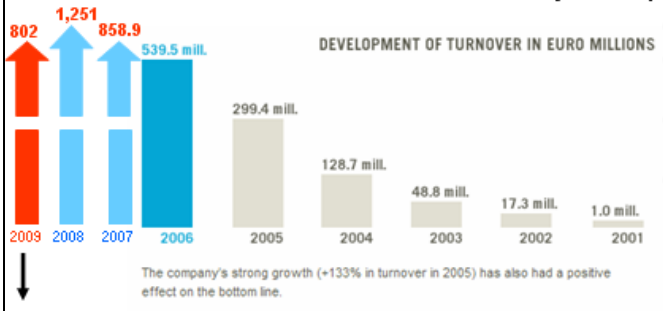
Nanogate Revenues (in mio. €)

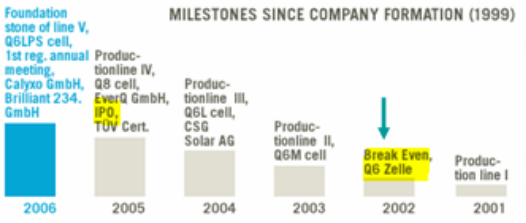
1998	1999	2002	2004	2005	2006	2007	2008
0.125	0.750	ca. 2	2.8	4.8	7.8	10.4	12.2

Ref. Pergo, Annual Report 2003; Runge, p. 290, 462/463 3.7

From a Niche to High Growth and World Leading: Q-Cells in Photovoltaic (PV)

Note: The US owns PV research, Germany and Spain own the production!





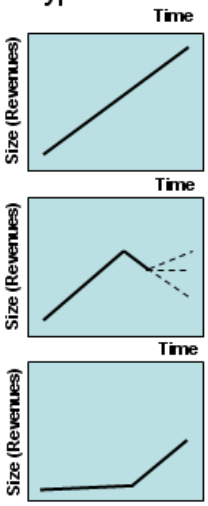
- *Policy-driven (EEG)*!
- Addressing the *consumer* market!
- Founded at the end of *1999* by four persons
- Q-Cells AG began with the production of *silicon solar cells* in the first six months of 2001 with only *19 employees*; in *2007*, *1701 persons* were employed.
- 2007: Q-Cells is *the largest solar cell manufacturer in the world*
- in 2011 No. 10,
- **In 2012 bankcrupt and taken over**

Ref. http://www.q-cells.com/cmadmin_2_478_0.html 3.8

Frameworks for NTBF Growth

Life-cycle stage definitions remain vague and general, making it difficult to apply them to specific cases.

Typical Growth Patterns of NTBF:



Continuous Growth

Exponential

Growth Setback

Back to growth
Plateauing
Declining

Delayed growth
(Nanofilm LLC and Closure Medical cases)

Much arguing about the keys to success of young firms.

No commonly agreed framework or theory for company growth.

Frameworks attempting to explain company growth do exist, but not mutually compatible or consistent.

No agreement on what *(endogenous and/or exogenous) variables* relate to company growth.

At the start-up stage founders' ambitions, skills and abilities are crucial to company growth, as are financial and business resources.

Note: simply considering increase/decrease may not account for *recession effects*, change of business etc.

Ref. Runge, p. 39, Box I.7; pp. 98

3.9

Growth Models: Fundamental Views

- There are many growth models and life-cycle definitions
- Growth models differentiate the
  - "*stage-based view*" and
  - "*resources-based view*"
- *Stage models* presume that growth is achieved *by initiating change* (cf. Osmonics – 3.6)
- The basic logic of the resource-based view assumes that a *company has a unique resource or a bundle of resources (or competencies).* Growth and expansion of the firm is primarily determined by the availability of *firm-specific leadership (and management) capability.*

3.10

Tangible and Intangible Assets/Resources

- ***Tangibles Assets***: "financials", land, buildings, machines, instruments, computers, production plants etc. (which can be "monetarized")
- **Intangible Assets** - Broad Classification:
  - Related to *discovery, innovation* (e.g., new products and patents) and *human resources* (e.g. corporate culture, employees' competencies, knowledge, skills, learning and work practices, competitive and technology intelligence; networking);
  - "*Organizational capital*", which is unique organizational designs and work processes ("systems of activities") or strategy formation, leadership; reputation

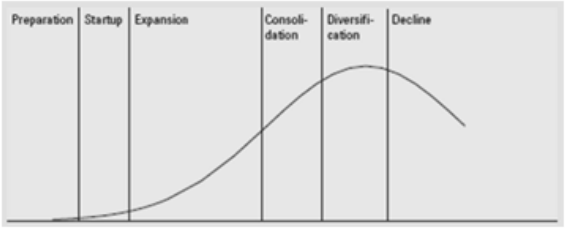
Intellectual Capital (IA)	Intellectual Property (IP)
- Human capital (productive qualities of people and organizational conditions that support these - business processes, information handling, communication, coordination, firm culture, etc.) - Corporate knowledge, competencies - Enterprise innovativeness - Enterprise relationships (including contractual rights, customer loyalty, permits, franchises, distribution rights, non-compete covenants)	- Patents (including inventions and business processes) - Trade secrets and confidential information - Designs - Trade marks (including Web domain, company and business names) - Copyright

Ref. Runge, pp. 233; p. 234/235, Table II.16, II.17
3.11

More About NTBF Life Cycle Stages

A Full Life Stage Model

- Preparation (Pre-Startup):
  there is an *innovative idea* and *identified opportunity* to set up an enterprise (there is already time and money involved – *pre-startup*)
- Emerging - Startup:
  the enterprise is established
- Growing
  - Expansion:
    offering(s) adoption resulting in growth and development
  - Consolidation:
    there is still growth, but the growth is more structured



- Diversifying - Maturing:
  the size of the enterprise stabilizes; growth may mature
- Declining:
  sometimes shrinkage or even obsolescence of the firm

3.12

Entrepreneurs...Key Traits or/and Skills

- **Entrepreneurs require basic *attributes* and *capabilities* that shape their behavior and it is this behavior that sets them apart from others.**
- **Traits** (attributes) comprise intellectual and emotional qualities, individual and social qualities, contemplative and action-oriented qualities.
- **Skills** refer, e.g., to *communication and negotiation skills, teaming up*

Many studies, many traits!

- Knowledgeable of technologies and markets
- Self-confident and optimistic; belief in self and ability
- Opportunity recognition
- **Judgement**; firm decision making
- Feeling for timing ("*window of opportunity*")
- (Internal) **Locus of control**
- Able to **take calculated risk**, matches risks and rewards
- Respond positively to changes, flexible and able to adapt
- Perceptive with foresight
- Patient
- Intention to start a venture and doing it; a sense of **mission, values**
- Take initiative, energetic and diligent
- **Achievement** oriented, creative and persistent
- Dynamic leader
- Appropriate social interactions; able to get along well with others
- Responsive to suggestions, listening
- Accessing and controlling resources
- Exploitation of opportunity and/or people
- Learning capabilities

Ref. Runge, p. 70, 438, p. 441, Table II.29 3.13

The Gender Factor: Women as Entrepreneurs

- Female entrepreneurship – some sketchy observations and perceptions (Gender issues concerning management style is rather controversial!)

- **The female entrepreneur** - one of the most profound developments
- At least in the U.S., by every conceivable measurement, women comprise one of the fastest growing segments in entrepreneurship *)
- Women show up as the most educated percentage of the population; more qualified women than ever both in terms of education and work experience

Female Entrepreneurs' Uniqueness

- Emphasis on *values*, think about what values their company will stand for even before they know what the company will do
- Comfortable with the degree of *improvisation* that entrepreneurship demands
- *Culture* is the most important part of business; understand building value by *developing people*
- For most men, their mental model of a company is a machine. Women's mental model is a living organism
- *Power is about orchestration*, being the conductor of the symphony; very different from the military model of leadership of issuing orders
- Far from following the ego mode of leadership

*) Does not apply to NTBF; cf. example of Dr. Hanna von Hoerner in Runge and slide 11.4

Ref. Runge, p. 444, Table II.29; pp. 437, 482 3.14

Psychometric Approaches to Entrepreneurs

- Apart from the exogenous also endogenous factors are important. *Family background* is an important factor for entrepreneurship (e.g. role models of parents or self-employed parents), with possible effects on motivation
- In the focused debate on "nature ("*genes*") versus nurture" the pendulum has swung again: "*nurture is out, nature is back*".
- Traits and particularly "*highly developed problem-solving skills*" are measured, e.g., by the Kirton Adaptive-Innovative (KAI) instrument that has thirty-three questions, and can be completed in around 15 minutes. KAI measures whether one is *an adaptive or innovative problem solver*.
- Traits are also assessed using common employment screening tests, especially the Myers-Briggs Type Indicator (MBTI®).

- *"360° Feedback Assessment":*
  In firms the 360° Development tool is an instrument developed to provide feedback and development focus and recommendations to employees about their management skill, strengths and development needs for employee development
- For to-be-entrepreneurs a "360° Feedback Assessment" involving relatives and friends, colleagues, "bosses" would be helpful for *personal self-assessment*

 Ref. Runge p. 390, 446-449 3.15

Some MBTI Fundamental Types

MBTI®: *Entrepreneurs are most often profiled as ENTP*

Identifying 16 possible patterns of 4 pairs of preferences that follow the theory of Carl Jung:

- Extroverts and introverts ("E" and "I" on the MBTI grid)
- Sensers and intuitives ("S" and "N")
- Thinkers and feelers ("T" and "F")
- Judgers and perceivers ("J" and "P")

- Ref. http://www.myersbriggs.org/my-mbti-personality-type/mbti-basics/the-16-mbti-types.asp

ENTP
Quick, ingenious, stimulating, alert, and outspoken. Resourceful in solving new and challenging problems. Adept at generating conceptual possibilities and then analyzing them strategically. Good at reading other people. Bored by routine, will seldom do the same thing the same way, apt to turn to one new interest after another.

ISTJ
Quiet, serious, earn success by thoroughness and dependability. Practical, matter-of-fact, realistic, and responsible. Decide logically what should be done and work toward it steadily, regardless of distractions. Take pleasure in making everything orderly and organized – their work, their home, their life. Value traditions and loyalty.

INTP
Seek to develop logical explanations for everything that interests them. Theoretical and abstract, interested more in ideas than in social interaction. Quiet, contained, flexible, and adaptable. Have unusual ability to focus in depth to solve problems in their area of interest. Skeptical, sometimes critical, always analytical.

ESTJ
Practical, realistic, matter-of-fact. Decisive, quickly move to implement decisions. Organize projects and people to get things done, focus on getting results in the most efficient way possible. Take care of routine details. Have a clear set of logical standards, systematically follow them and want others to also. Forceful in implementing their plans.

 Ref. Dorf & Byers p. 38 3.16

MBTI® and KAI Results for Intrapreneurs

From a **study** of former **corporate innovation champions ("intrapreneurs") from chemical and pharmaceutical firms**:
Individuals were also asked for information about their Myers-Briggs Type Indicators (MTBIs) and Kirton Adaption–Innovation (KAI) profiles
(Ref. Hipple, J.; Hardy, D.; Wilson, S. A. Michalski, J. (2001): Can corporate innovation champions survive? Chemical Innovation 31 (11), pp 14-22.
http://pubs.acs.org/subscribe/journals/ci/31/i11/html/11hipple.html)

- **The MBTI profiles of the 15 *innovators* varied greatly. Six of the individuals were INTP or ENTP, the two largest four-factor combinations. In all, 13 were intuitives and 12 were extroverts. The *NT combination was present in 10 of the individuals*, the largest two-attribute combination.**
  The split between judging and perceptive was approximately 50:50.
- **INTPs are ca. 1% of the general population, making this one of the rarest of types.**
- **Up to 95% of *senior corporate managers* are STJs.**
  The *great difference between the innovation champions (intrapreneurs)* and managers sets up some *potential conflicts*.
- **A change will always seem greater to an ST than an NT because STs are typically comfortable only with *continuous change* and *very uncomfortable with discontinuous change*.**
  An NT, however, may actually enjoy *discontinuous change*.
- The KAI profiles revealed something even more dramatic. Business and engineering managers typically scoring 95–105. The scores for the innovation champions ranged from ~95 to 155; one-third of the group scored ~135, and the average score was ~125.

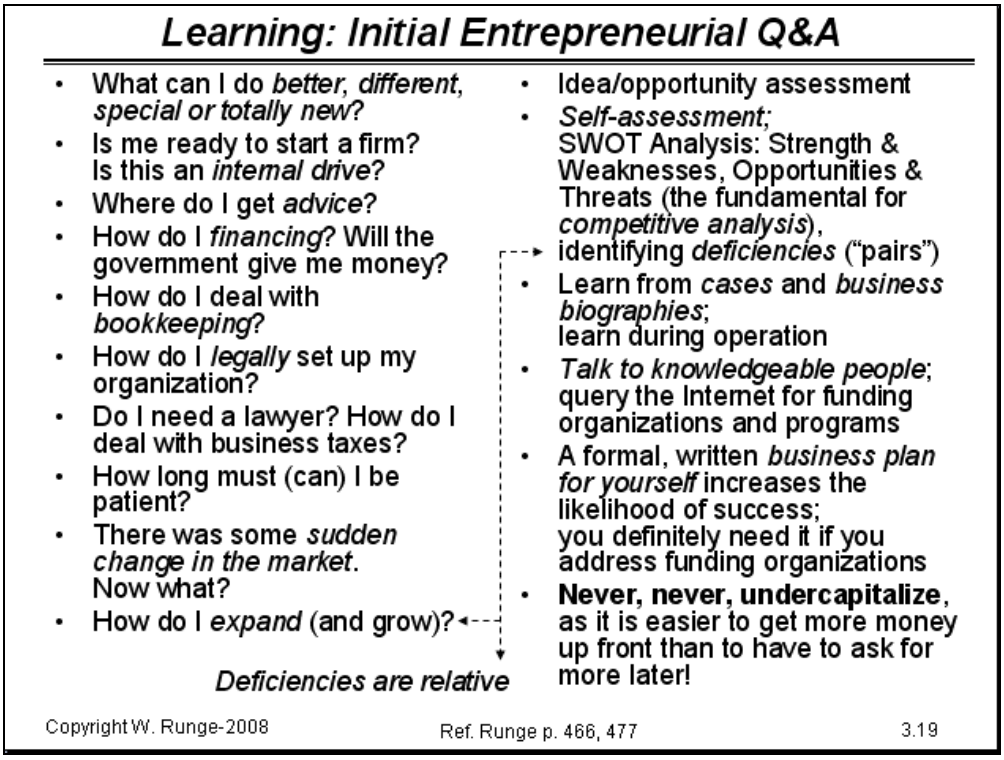
 3.17

"Entrepreneurial Capital"
(The Intangible Asset of Entrepreneurs)

- "A combination of entrepreneurial competency and entrepreneurial commitment"
- EC ~ Ecomp ⊗ Ecomm

- *Entrepreneurial Competency*: The ability (1) to recognize and envision taking advantage of opportunity and (2) to access and manage the necessary resources to take advantage from the opportunity
- *Entrepreneurial Commitment*: A dedication of the time and energy necessary to bring the enterprise to initiation and fruition.
- Key is: **Qualities AND Execution**

 Ref. Dorf & Byers p. 11, 643 3.18


Learning: Initial Entrepreneurial Q&A
What can I do better, different, special or totally new?
Is me ready to start a firm? Is this an internal drive?
Where do I get advice?
How do I financing? Will the government give me money?
How do I deal with bookkeeping?
How do I legally set up my organization?
Do I need a lawyer? How do I deal with business taxes?
How long must (can) I be patient?
There was some sudden change in the market. Now what?
How do I expand (and grow)?
Deficiencies are relative
Idea/opportunity assessment
Self-assessment; SWOT Analysis: Strength & Weaknesses, Opportunities & Threats (the fundamental for competitive analysis), identifying deficiencies ("pairs")
Learn from cases and business biographies; learn during operation
Talk to knowledgeable people; query the Internet for funding organizations and programs
A formal, written business plan for yourself increases the likelihood of success; you definitely need it if you address funding organizations
Never, never, undercapitalize, as it is easier to get more money up front than to have to ask for more later!
Copyright W. Runge-2008
Ref. Runge p. 466, 477
3.19

Technology Entrepreneurship

Entrepreneurship for and in Technology Ventures

Everything intelligent has already been thought before,
you must only attempt to think it again.

Alles Gescheite ist schon gedacht worden, man muss nur versuchen, es noch einmal zu denken.
(Johann Wolfgang von Goethe)

MODULE 4
Ideas, Opportunities and Strategy

The Entrepreneurial Vision and Mission

- Above all *it is the entrepreneur who has an ambition* to succeed ("grow"?), and the entrepreneur has (must have) a *clear vision* of how to make this ambition come true.
- Generally, a *mission* statement answers the questions:
  Why does our organization exist?
  What *business* are we in? What *values* will guide us?
- Organization follows mission!
- A *vision* is more encompassing. It answers the question, "*What will success look like?*" It is the pursuit of this image of success that really motivates people to work together. A vision should *challenge and inspire the group to achieve its mission* through explicit statements:
  - It should be unique, special to the enterprise
  - It should be consistent with the organization's values.
  - It should be realistic and credible, well articulated and easily understood, appropriate, ambitious, and responsive to change.
  - It should orient the group's energies and serve as a guide to action.

Entrepreneurs' Visions and Missions

- Entrepreneurs often strive to contribute to the betterments of our world (cf. Slide 2.24).
- Viktor Dulger (founder of *Prominent GmbH*; Slide 3.6) was caught by the vision to *develop new components to improve provision of drinking water worldwide and simultaneously to make sure to use the environmental resource water sparingly*.
  And his wife shared his visions. He was so possessed by this idea that during the early commercialization phase he always re-invested everything he earned.
- Dean Spatz was early on engaged in how to create potable drinking water from brackish South Dakota groundwater. He founded *Osmonics* (Slide 3.6) and said "I made the decision to start the business myself because I was totally committed to *building this technology … and applying it to all sorts of different areas*."
- *AgraQuest's* (Slides 11.4, 11.11) mission: AgraQuest's mission is to be the best and most efficient at discovery and development of environmentally friendly natural products for pest management (Dorf & Byers, p. 53)
  [AgraQuest's mission from 1995 in Dorf & Byers (p. 77), but cf. the firm's current Web site (http://www.agraquest.com/about-agraquest/ourvision.html)]

 Ref. Runge, p. 76, p. 91, Table I.8 4.3

Entrepreneurs and Innovation: Definitions

"Innovation is a *process* whereby new ideas are put into *practice* ...
"*needs* + *means* = *innovation*"

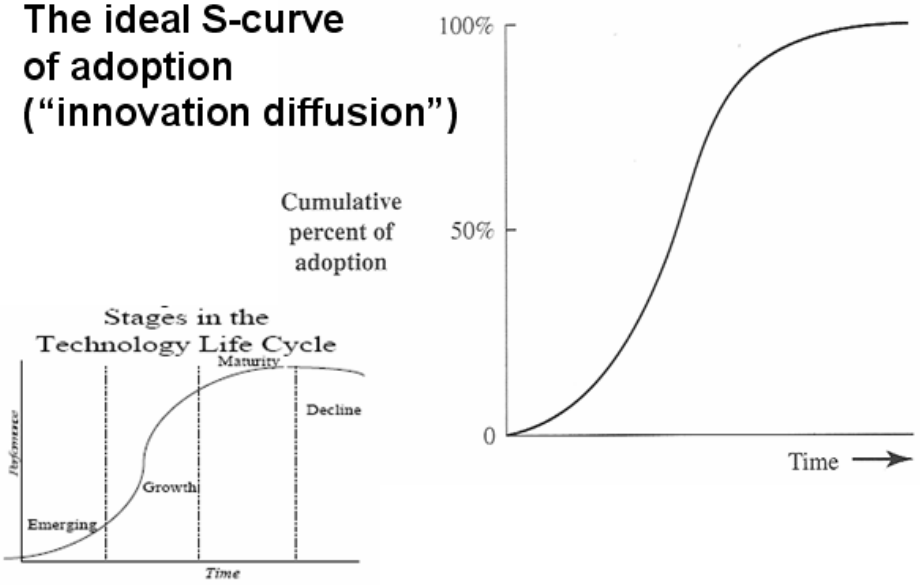
Notion	Generic	Commercial (Marketing)
Innovation	An innovation is an idea, practice, or object perceived as new by an individual or other unit of adoption in a specific (geographical or sociological) domain or category	An innovation is an idea, practice, or object *perceived as new with a value* and acquired by an individual or other unit of adoption in a specific (geographical or sociological) domain
Invention	A new idea with the *potential* to provide value (→ innovation)	To have a new idea for providing *anticipated value to customers*
Innovative Actions	**Innovator**	**Adopter/Buyer**
Innovativeness Innovation Potential	The power to capture ideas or opportunities or respond to "events" and commercialize value to customer time and again and again, continually for years	Innovativeness is the degree to which an individual or other unit of adoption is relatively earlier in adopting novelty than other members of a social system

- Differentiate innovation and invention via "*value creation*" – *market value*, *technical value* (cf. 9.7).
  Innovation: a *binary relationship* between supplier/provider (innovator) and buyer/customer(adopter) (different perspectives?)
- Differentiate an *inventor* and an *entrepreneur*.

 Ref. Runge, p. 49, 18; Table I.1; pp. 612/613 4.4

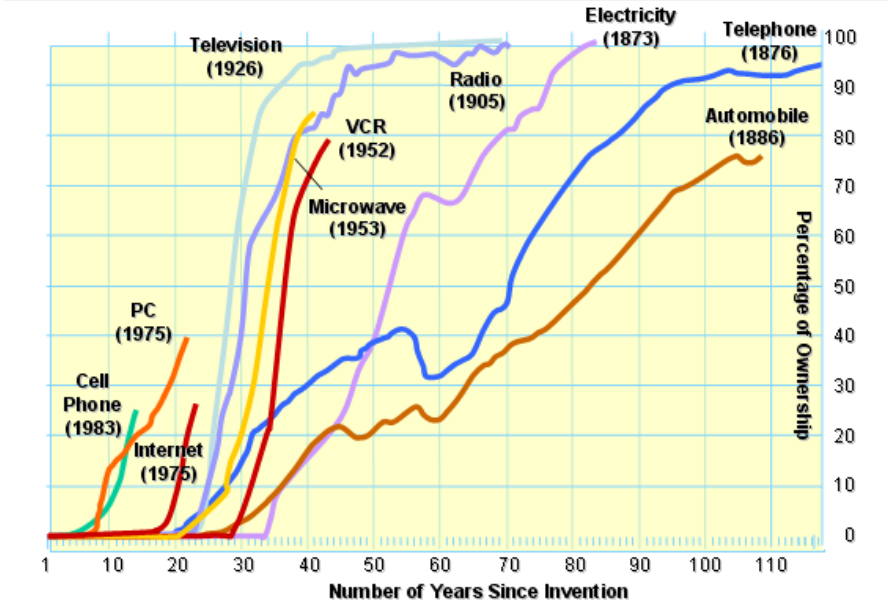
Innovation (Technology) Adoption

The ideal S-curve of adoption ("innovation diffusion")



 4.5

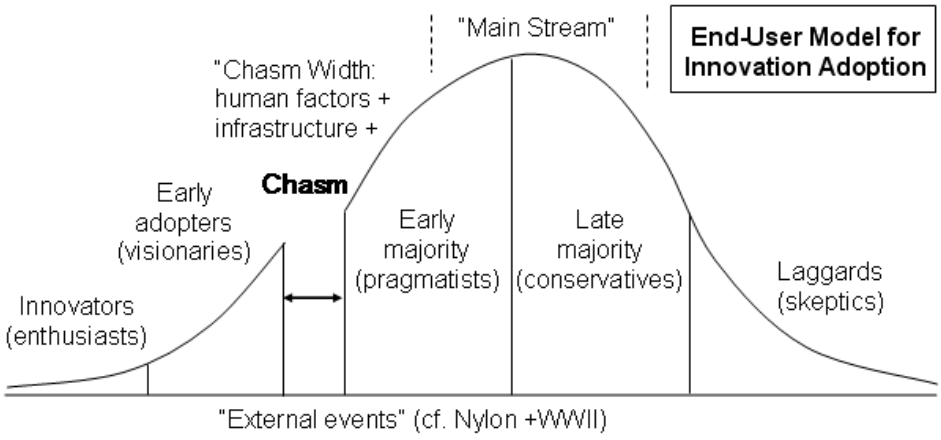
Historical Technology Adoptions



 Ref. Bill Aulet, HCT MIT Entrepreneurship Conference, Dubai, 2006) 4.6

Adopter/Customer Types and Roles

- (Industrial) customers (→ customers-of-customers)
- Professional customers
- End-users/consumers



Ref. Dorf & Byers, p. 263
4.7

Educating/Training the User

1908 (Problem: reduce grounds of coffee)

- Housewife Melitta Bentz invents the first usable filter for preparing grounds-free coffee (experiments with blotting-paper/can)
- First usable filter for preparing grounds-free coffee receives protection as a registered utility model for "coffee filter with curved and indented bottom and slanting extraction holes", together with its corresponding "filtration paper"
- Melitta Bentz also receives a patent for the above-mentioned "coffee filter"

Melitta Group:

- Founded 1908
- Sales 2007: €1.24 bil.

Melitta shows, how to filter good coffee ...

4.8

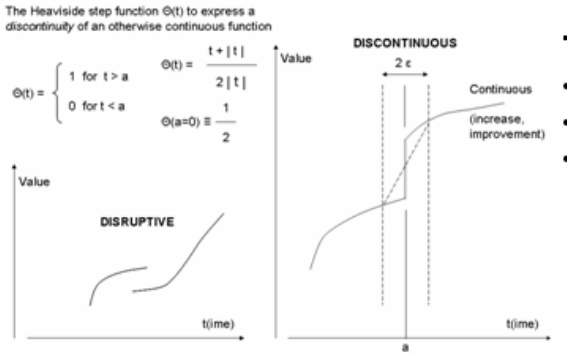
Technology Adaptation and Appropriateness

- Rarely is the same technological solution optimal everywhere.
  The value of an innovation depends on socio-economic, cultural, regional (e.g. climatic), and ecological specifics
- Important innovative activities *adapt technological solutions to specific conditions* (for marketing)
  - Export of technologies across regions without adaptation may lead to negative environmental side effects and waste
- A technology may have several versions or extensions to meet needs and capabilities of users in various regions, e.g. Western World vs. China

 4.9

Innovation Types

Innovation is about *change*! Technical - Behavioral



Types of Innovation:

- ***Incremental*** Innovation
- ***Discontinuous*** Innovation
- ***Disruptive*** ("Radical") Innovation ("*New-to-the-World*")

Discontinuity or "Breakthrough":
Generally needs at least *an order of magnitude value added or improvement over current technology* at the systems level.

- 5 – 10x (or >10x) **value addition** or **performance** improvement
- 30 – 50% (or >50%) **reduction in cost**

 Ref. Runge, p. 14 4.10

Innovation: Demand Pull vs. Technology Push

- Many cross-industry studies have shown that innovation of firms stimulated by *market needs or technical opportunities* (demand pull or market pull versus technology push) show a rather constant proportion of about 70:30.
- Currently, innovation in *bio- and nanotechnology* are *largely science-driven* ("technology push"). Academic research is driving the industry.

 Ref. Runge, p. 619, 758 4.11

Technology and Techniques

- History has shown that human beings have, in relative terms, been more concerned with understanding *how things work* rather than *why they work* (technology vs. science) - devices, processes, tools, methods, materials
- The classical example of technology being used before the availability of the scientific foundations is the *steam engine*. In the early 19th century, when S. Carnot worked, the steam engine was the leading edge of technology.
- *There was plastics before polymer science (Bakelite)!*
- *Technique* represents an applicable element of a technology. Technology often comprises a set of techniques. *Implementation of technology* means selecting techniques to target a given goal.

Consequently, entrepreneurs do not have to know what they are doing to be successful, but they do *have to be able to deliver reproducible and demonstrative results*.

 Ref. Runge, p. 619 4.12

Technology Class – For Portfolios and More

"**Platform Technology**" – a core competency and basis for "exploitation strategies"

Base	A set of technologies, usually associated with a set of standards, that are used by an industry or industry segment and which does not per se provides a competitive advantage for a firm; base technology is available externally.
Key	A crucial element in the research and innovation process. It may involve the creation of fundamentally new capabilities (developing, designing, manufacturing and evaluating properties) in areas perceived as value creating currently or in the future. It may lead to competitive advantage and differentiation.
Generic	Defined with regard to an end, a particular product, process or system, and therefore allows implementation through different technologies. For instance, membranes or ion exchange resin technology may be used for water treatment or using nails or screws versus adhesives may be used for "fastening" parts; batteries or fuel cells for mobile energy provision. They are usually competitive as they are associated with different cost structures and may substitute each other.

Enhancing	Focusing on only incremental shifts in product performance of existing materials; for instance, chemical nanotechnology may occur as only an "enhancing technology" for coatings or CMP
Enabling	A subset of technologies which is essential for a specific phase of (chemical) science, product or process development, or manufacturing. Chemical analysis is a critically important enabling technology. Biotechnology is an enabling technology for the conversion of biomass to bioproducts, biomaterials or bioenergy.
Pacing	A technological area which represents a limiting factor (step) in the progress of a particular program (project or innovation). Pacing technology is currently not applied but can potentially "change the game". Currently lignocellulose feedstock (LCF) conversion is pacing for a biobased chemical industry.
Emerging	A technology anticipated (or proven) to grow and expand and become important and valuable for an industry or industry segment (e.g. solar cells/photovoltaic, fuel cells)

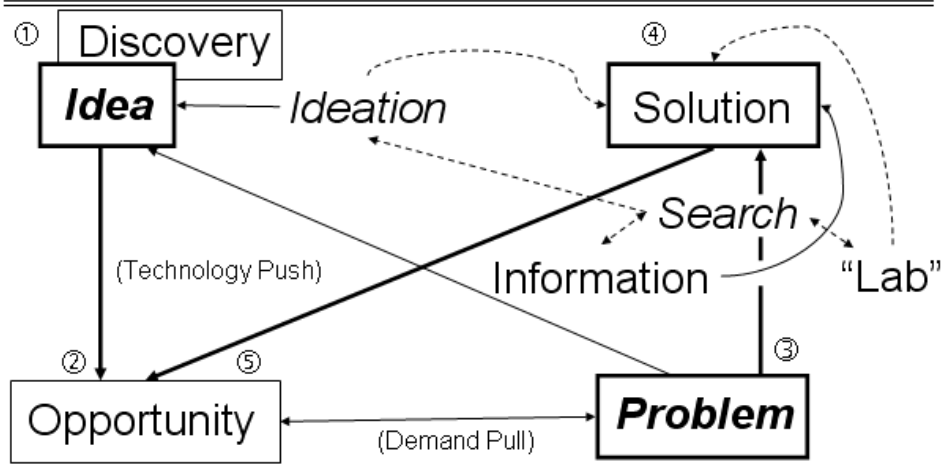
Ref. Runge, p. 621, 622, Table III.16 4.13

Ideas and Findings

- *Ideas: Imagination, inspiration, creativity*
  An important element of creativity:
  the ability to identify *new connections between seemingly unrelated objects or events* or the unification of seemingly unrelated data, facts or ideas and concepts. Outstanding drivers of creativity are "to *make things differently*".
- *Problem solving* as a root for ideas (cf. KAI instrument; Slides 3.15, 3.17; personal problem solving styles)
- In forming ideas there is a central requirement for *synthesis of information* (about needs and solutions)
- Structured process to idea generation: "*Ideation*"
- Apart from a *structured idea generation* process also the "unpredictable events" of novelty of a *discovery or invention* are essential to innovation:
  c*hance discovery or serendipity* (for NTBFs)
- Serendipity is central for many key (chemical) innovations!

Ref. Runge, p. 215, p. 430, Box II.22, p. 716, pp. 750 4.14

Ideation and Problem Solving: Matching Opportunities



Is there any related information about solving the problem; has it (almost) been solved earlier – 30, 50, 100, … years ago?

 4.15

"Ideation" - Structured Idea Generation

- **Basic principles for "ideation":** the "new" idea" generation process is driven largely by "*borrowing*" (*analogies, metaphors* etc.) and generalizations, modifying, linking, combining and re-examining "old" ideas and facts or transferring known solutions to new applications.
- Often ideas are simply "*stolen from Nature*" (Lotus effect; biomimetic).
- Combining domains – e.g. chemistry + biotechnology ("white biotechnology"); nutraceuticals, cosmeceuticals;
- A particular method to *form (unintentionally or intentionally) ideas is based on social interaction* ("communication"; group discussions), for instance, through one-to-one discussion or organized "*brainstorming*" sessions
- *Computer-supported ideation*: TRIZ ("Theory of Solving Problems Inventively") – Leibniz: Ars Inveniendi (1666)

 Ref. Runge, p. 215, p. 430, Box II.22, p. 716, pp. 750; p. 669, pp.775 4.16

More on Entrepreneurial Ideas for NTBFs

Problems or issues into profits

- Listen to spelled out specific problems, grasp societal attitudes and moves ("*megatrends*"); react fast to regulatory change; the "holy grail" of an industry
- *Eco* industry (e.g. "renewable energy"/biofuels, biomaterials, biopesticides (AgraQuest, slides 11.4, 11.11); "green chemistry")

What if,

- *it is* longer or smaller, different material; thinner, lighter, faster etc.; *it is not, does not* …; it is applied to another substrate (e.g. coatings on metal, glass, plastics, paper, textiles); valuable for *other types of users/applications*

Combinations ("*architectural innovation*" - incremental or discontinuous)

- Mobile phone ("handy"): phone → phone + photo → phone + photo + MP3 player → … + Web browser + "pocket office software" …
- Energy generators: wind, water – combined? (→ sea wave energy!)
- Product: Surfmers (polymerizable surfactant; function = surfactant + crosslinker) for PSA; BASF Ecoflex (biodegradable and polyester performing like polyethylene via combining aliphatic and aromatic polyesters)
- Process: reactive distillation (reaction + purification/separation); membrane reactor (chemical reaction + membrane separation of products) → + separation of (additional) solids

 Ref. Runge, p. 189; pp. 262; pp. 532; p. 568-596; p. 717 4.17

The New Wave for Startups: CleanTech

- *Europe's leading role; Environmental Entrepreneurs* (E2) movement (in the U.S.)
- *CleanTech* has **five top-level segments**: (renewable) energy, water, air, waste and sustainability
- Untapped opportunities persist also for *process technologies* (energy reduction, waste reduction/avoidance, cost reduction for production, scale-up for mass manufacturing, e.g. batteries)
- Drivers: Long-term societal trends are driving investments in clean technologies from corporations and investors; grants, funding and tax incentives by government
- CleanTech is venture capital's new "darling"!
- It is a *global* market; *many new players* are emerging
- Startup leaders should gain competitive intelligence, track venture and government funding, and review innovation and financing activities!
- Favorable constellation: "CleanTech Clusters" (cf. 8.9)

 4.18

CleanTech Ideation – Wind Energy/Turbines

WHAT IF

- There is too little sunshine to allow *local* (*standalone*) power generation (via photovoltaic - PV or solar thermal technologies)?
- There is enough wind energy, but there is *no appropriate product for local energy*, e.g in the *urban environment*, where wind speeds, however, are lower and wind directions change frequently?
- There is tremendous demand (for smaller, less volumenous products)?

WHAT IF

Customers are different?

- Industrial Customers
- Professional Customers; End-Users

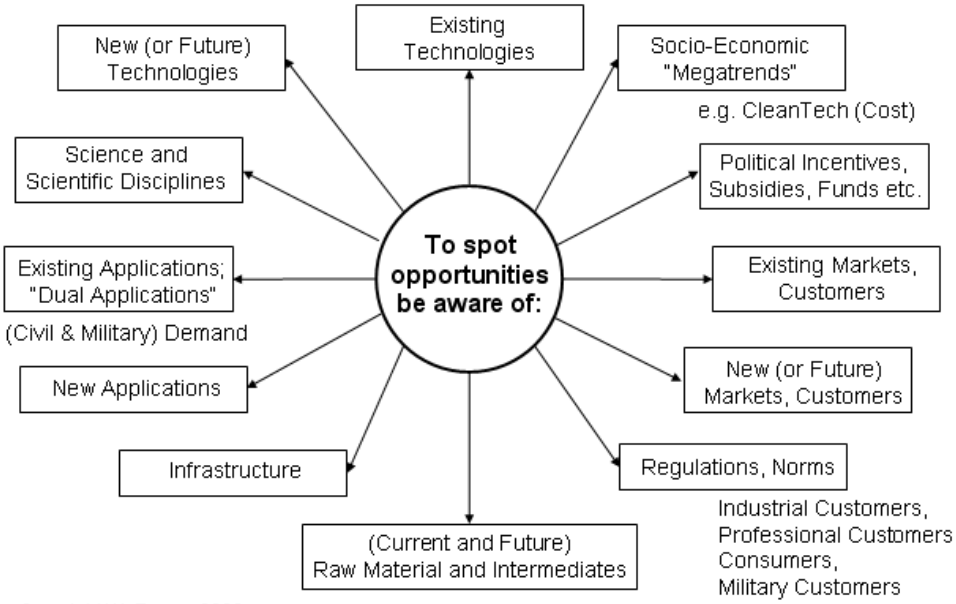
The type of "windmill" is different?

- Horizontal Axis Wind Turbine
- Vertical Axis Wind Turbine

A basic design from ca. 1930 only requires some modifications, the Darrieus wind turbine? → **Quiet Revolution, Ltd.**

4.19

Spotting Opportunities for NTBFs: Exogenous Conditions ("Parameters")



 Ref. Runge, p. 533, Table III.3; p. 590, Figure III.10; p. 598, Figure III.13 4.20

Innovation-Oriented Chemical Sub-Segments

Petrochemicals & Plastics
- High capital intensity; large economies of scale;
- Dominant: feedstock costs; can offer substantial competitive advantage;
- Global, cost-based competition; significant inter-regional trade;
- Relatively low R&D expenditures (as percentage of sales); process research
- Globalization of company activities and markets.

Functional Polymers, Specialty Resins
(Epoxy Resins, Superabsorbers, Ion Exchange Resins)

Specialty Chemicals
(Market-Directed (paper, plastics additives) vs. Function-Directed (adhesives, flame retardants)
- Emphasis on low volume – high value;
- Sold for functionality;
- Important brand recognition;
- Few standardized specifications;
- High technical service requirements;
- Highly market and application focused;
- High research cost for formulations and applications;
- Key buying influences are in Engineering or R&D.

DIFFERENTIATED PRODUCTS
1. Commodities (high volume – low value)
2. Differentiated Commodities
3. Large Volume Specialties
4. Specialties (low volume – high value)

Examples:
Polyolefins (1, 2, 3; Metallocene catalysts); Epoxies (2); Specialty Plastics (3)

(Economy, Industries)

COMMODITIES ⟷ CYCLICALITY
(Issue: pace of commodization)

Fine (incl. Chiral) Chemicals
Often building blocks of drugs (APIs), for Ag
- Substantial "Capital Intensity" (capital expenditures (capex) as the percentage of sales; often >10%; specialties: ca. 6%)
- Not cyclical, but swings in profitability related to the success or failure of individual products
- Mainly competition on quality of product and cost of production
- Innovations in product technology always have been central to competitiveness, but process innovation is also important.
- Little information between supplier and customer concerning production method and use (R&D! Complexity of molecules)

Ref. Runge, p. 125; 148, 151, 157/158 4.21

Chemistry and Co-Evolutions

- Chemistry is dispersed into many fields (through co-developments and co-evolutions with other industries) where it is not labeled as chemistry or where the contribution of chemistry is not obvious or even hidden.
- Some Co-Evolutions ("Materials"):
  - Textiles ("dyes"; "protections", feeling)
  - Automobile/Transportation – Rail, Road, Air ("coatings", adhesives, materials – energy reduction, alternative energy)
  - Oil ("petrochemicals"; vegetable oil – "oleochemicals")
  - IT and Electronics ("electronic chemicals"; OLED)
  - Energy (photovoltaic, fuel cells; hydrogen sources/storage)
- The many specific co-evolutions make chemistry a discipline that has an identity problem.
- Communication about chemistry suffers from the dichotomy of "*pure and applied chemistry*". Applications of chemistry have a "contribution" problem. *Chemistry's roles in all areas of human life* do not show up.

Ref. Runge, pp. 21, p. 219, 282, pp. 324, pp. 424 4.22

NTBF Opportunity Analysis

- The basis for making a decision on *whether to act,* after opportunity identification, include
  - Ask the right questions
  - A description of the *offering*, such as the product or service
  - A specification of required *activities and operational resources* (incl. team, "soul mates")
  - An assessment of the entrepreneur (Do I have what it takes; personal traits, operational competencies; SWOT) and the opportunity (Do I have the *right* offering?)
  - *Financial resources*; other resources

 4.23

NTBF Opportunity – Related Questions

- What market need does my idea fill? What personal observations have I experienced or recorded with regard to that market need?
- What social (or societal) condition underlies this market need?
- What market research data can be marshaled to describe this market need?
- What patents might be available to fulfill this need?
- What is my technology position as the basis for my offerings?
- Will I (have to) produce on my own?
- What competition exists in this market?
  How would I describe the behavior of this competition?
- What does the international market look like? Should (can) I go global?
- What does the international competition look like?
- Do it requires more people (filling the gaps I have)?
- Where is the money to be made in this activity
- Is there an (analogous) historical case of firm foundation I can learn from?

 4.24

The SWOT Quadrant

The SWOT quadrant

- is a *descriptive representation* to make the firm's strengths, weaknesses, opportunities and threats explicit,
- creates awareness about them and
- helps to build on and exploit strengths, avoids, fixes or improves weaknesses, size attractive opportunities and deal with or mitigate its threats.

• STRENGHTS	• OPPORTUNITIES
• WEAKNESSES	• THREATS

 4.25

Strategy and Planning: Operational Views

Plan:

When you know what you want to do and exactly how to do it.
A plan is characterized by *knowing what the next step will be*. Each step is designed by taking into account the next step.

Strategy:

When you *know what goal you want to achieve*, but you are not sure exactly how to do it.
A strategy is characterized by not knowing what to do at the next step until you have results from the previous step. Each step of a strategy is realistically influenced by what was learned from the previous step.
The quality of a strategy cannot be fully assessed until it is tried!
A successful strategy requires considerable information. In effect it is *based on various intelligence processes*.

Plans are for execution, strategies are for *learning* what plans to use.
Strategic planning means *changing minds*, not making plans.

Trade-Offs:

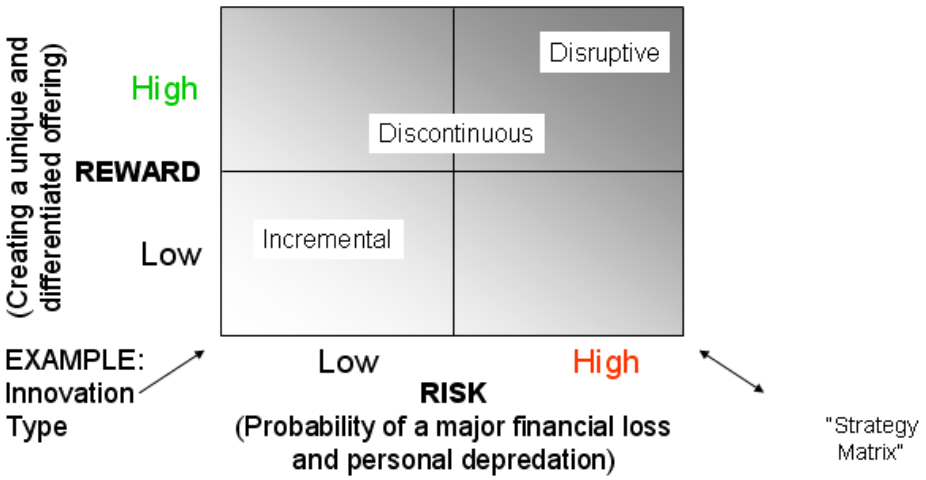
The intrinsic companions of strategic positioning through "either – or, but not both" constraints (either quality or cheap/low price, but not both;
lift trade-offs to catch markets, e.g. Toyota – high quality and low price
(another example, choosing not to serve all customers or offer all services)

 Ref. Runge, p. 703, 705 4.26

The Entrepreneurial Basic Strategic Orientations

A (growing) firm needs a "*strategy*" *(strategic planning)* for

- It is the way in which leaders or managers (in a firm) *conceptualize the business* and make critical *resource allocations* decisions.



4.27

Strategies and Plans for Startup Visibility

- Participation
  - Business Plan Contests
  - Government/Universities/Research Institutes/Industry Networks
  - "Competency Networks"
- Getting "Foundation Award" or other prizes
- Getting Attention
  - Own Web site
  - Notice in corresponding technical journals (Nachrichten aus der Chemie, C&EN), magazines, newspapers (or radio or TV)
  - Investor-oriented magazines and Web sites
  - Brand recognition (company/product name, logo)
- Exposure (and Personal Contacts; Customers)
  - Fairs and Exhibitions ("Venture Fairs"), Conferences

4.28

Emergence of Strategy

- The task of **entrepreneurship** is the *creation of a new business, organization or even economy (industry)*, whereas **growth venturing** is to *run the small business into a big business* (like a project).
  (Cf. new business units *in firms*: develop (NBD) vs. run)

History suggests that *ventures do not initially need a business model or even a business plan*

- The venture needs a viable idea and opportunity about the new business (that may be formalized – later – into a business model and plan)
- New ventures seem to need *business intelligence*, "*strategy logic*" *and action* rather than analyses and plans,
- "*Strategy logic*": the subjective logic representing the thinking of key person(s) in the firm (often the founder); the "*what and why, when and how, where and who*"

 4.29

Concept Summary and Business Story

Expressing strategy logic and laying the foundations for a company vision, business model and business plan

Concept Summary:

- A short description of the new business

Concept Summary Elements:

1. Explain the problem or need and identify the customer.
2. Explain the proposed solution and the uniqueness of the solution.
3. Tell why the customer will pay for the solution.

Business Story:

- A narrative of factual or imaginative events
- Usually *to communicate verbally* the business idea and the profitable solution of the problem

Business Story Elements:

1. Background – Describe the current situation, characters and problem.
2. Challenge – Describe the challenges and conflicts that impede a coherent plan to solve the problem
3. Resolution – Portray a solution to the challenges and the problem and how the venture will succeed by resolving the problem

 Ref. Dorf & Byers, p. 50, 51 4.30

Strategy Formation in NTBF

- The formation of a *technology strategy* as part of the venture's overall strategy plays an *important role for every NTBF*, even though the strategy formation and implementation process varies widely
- Technology strategy deals with technical competencies, assessment of technology class (slide 4.13), applications, competitive technologies, technology protection, technology regulations, development and/or access to technologies and (potential) commercialization paths
- If the new venture does not create a new industry or offers a new(-to-the-world) technology, it is an "*entrant*" into an existing industry (and has to expect *competition* and *competitive responses*).
- There are many (technical) hurdles
- Experience shows that those who do best stand out through their *ability to handle setbacks*.
  Instead of giving up, they *re-think*, *regroup and often find new solutions based on the original idea*

Ref. Runge, p. 609, 610
4.32

Potential Barriers to Entry into an (Existing) Industry

- Economies of scale
- Cost advantages independent of scale
  (incumbents may have proprietary technology, know how, long-term contracts with government/military, etc.)
- Product differentiation and positioning (cf. Slide 9.16)
- Government regulation; industry standards; (national) infrastructure
- Contrived deterrence
  (incumbent firms strive to throw up unnatural barriers at a cost to them)
- Switching costs
  (cost to customers to switch from one product of an incumbent company to the product of the new entrant)

4.31

Strategy Emergence in NTBF: Stages

- At the *start-up stage*, the new firm begins *setting boundaries* around the business idea, operational competencies and related "activities".
- Strategy making is more or less informal and focuses on the critical points and the boundary conditions. *Often, a strategy emerges as actions are taken and tested.*
- After the initiation of a company, strategy occurs at the moment when it has reached a *state when it is attractive to the formal venture capital of the financing community or to another, big firm for takeover*. This is the *first cross-roads* for the NTBF (usually after ca. 3-5 years).
  And a conscious decision to grow must be made and how to do it (- or not to grow).
- Strategy logic changes to a *formalized "strategy process" after the firm's first cross-roads* or after a change of the business model (or change of leadership/management structure), if already existed.
- Remember: a strategy must be executed to be tested!

 4.33

Strategy Formation in NTBFs: An Example

A Semi-Formalized Process:
monthly *business strategy meeting* covering e.g.

- Dissemination of *technology (competitive) intelligence* as an input into strategic decision making (→ technology & business decisions)
- Making *decisions and preparing action* ("activities"); *allocating* financial and human *resources*
- Self-Assessment: Do we have or can we create a "cash cow" for survival and investment in further development and growth?

- Apart from the "CEO" (the founder, the "managers") such strategy meetings may be open to other employees provided they contribute actively. This makes *business strategy a participative ("more democratic") affair*.
- Prepare to enable quick and effective action should an opportunity appear!
- In the daily business process, emergent strategies play an important role in *realizing new opportunities*. Because of the short communication paths in NTBFs, emergent decisions can be taken with very little delay. As soon as the strategic issue is recognized and considered valuable, resources are allocated and deployed.

 4.34

Developing Strategy for Growth Venturing

A Management Process (cf. Business Plan):

1. Have the vision and mission statements, and a Business Model
2. Describe the firm's core competencies, its customers, and its competitive advantage
3. Describe the industry and context for the firm and its competitors
4. Perform a SWOT Analysis
   - Determine the firm's strengths and weaknesses in the context of the industry and the "environment"
   - Describe the opportunities and threats for the venture
5. Identify the key factors for success, using e.g. the six forces model ("industry analysis"; evaluate competitive forces)
6. Have a "Profit Model" (Slide 4.36)
7. Formulate strategic options, select the appropriate one considering trade-offs
8. Translate the strategy into action plans with suitable measures and controls (to track execution)

Ref. Dorf & Byers, p. 82

The Profit Model

- Managing *revenue growth* seeks positive cash flow (uncontrolled growth can lead to negative cash flow)
- Approach (based on Revenue Model, Slide 3.5 - Sales of Offerings, Royalties, Contractual Revenues)
  - Reducing costs (incl. administration) while maintaining or increasing value of the offering
  - Examine all activities on the value chain (research, development, analytics, production, marketing, sales)
- It pays to hold the largest "value-added" steps in the value chain (and core competencies) – cf. 11.18, 11.19
- Consequence: *outsourcing* (via marketing and sales agreement, (bulk) production agreement etc.)?
- Key to profit capture is ownership of the unique, value-added element of the value-chain or the product makeup
- A *profit metric*: *profit margin* – profit divided by revenues (Others: profit divided by employees or customers)

Scott Rickert, Founder, President and CEO, Nanofilm LLC

- **A role model (and inspiration) for nano entrepreneurs?**
- **There were nano-particles and -effects before nanotechnology!** ◄
- The value of *partnering and alliances* is vital for companies seeking to *enhance existing products* with nanotechnology. ◄
- ***Business biography* as a driver:** From the first time Dr. Rickert glanced through "The Dow Story"; he wanted to be like Herbert Henry Dow, who nurtured the business from its humble beginnings in Midland, Mich., into one of the biggest chemical companies in the world (cf. Runge, pp. 467) ◄
- As a Professor of Macromolecular Chemistry (at CWRU) Rickert spent most of his spare time in welding shops, where he worked to *build equipment to make the thin film coatings he was working with*. It was in those shops that he discovered *how to make materials at the nano level that could not be mass-produced before* (cf. Avery (PSA) and Baekeland (Bakelite) in Runge) ◄
- With a liquid solution that bonded to surfaces to protect against dirt, scratches and glare, he finally had *a product he could mass-produce*. ***"I didn't know how it worked, it just did,"*** he said. ◄
- He **met Donald McClusky**, a retired vice chairman of the board at B.F. Goodrich. **McClusky *taught him business practices*** and **invested** money in the Nanofilm company which was founded in 1985 to develop and commercialize ultra-thin films (coatings), called nanofilms, to *enhance the durability, clarity, ease of use and performance (scratch resistance)* of *transparent materials*. ◄ ◄
  Customers of Nanofilm offerings are in most cases *consumers*.
- **Nanofilm: *one of the few profitable companies in the nanotech area***, it currently has 70 employees and revenues between $15 mio. and $20 mio.

 Ref. http://www.nanofilmtechnology.com/news/pdf/05AU01.pdf 4.37