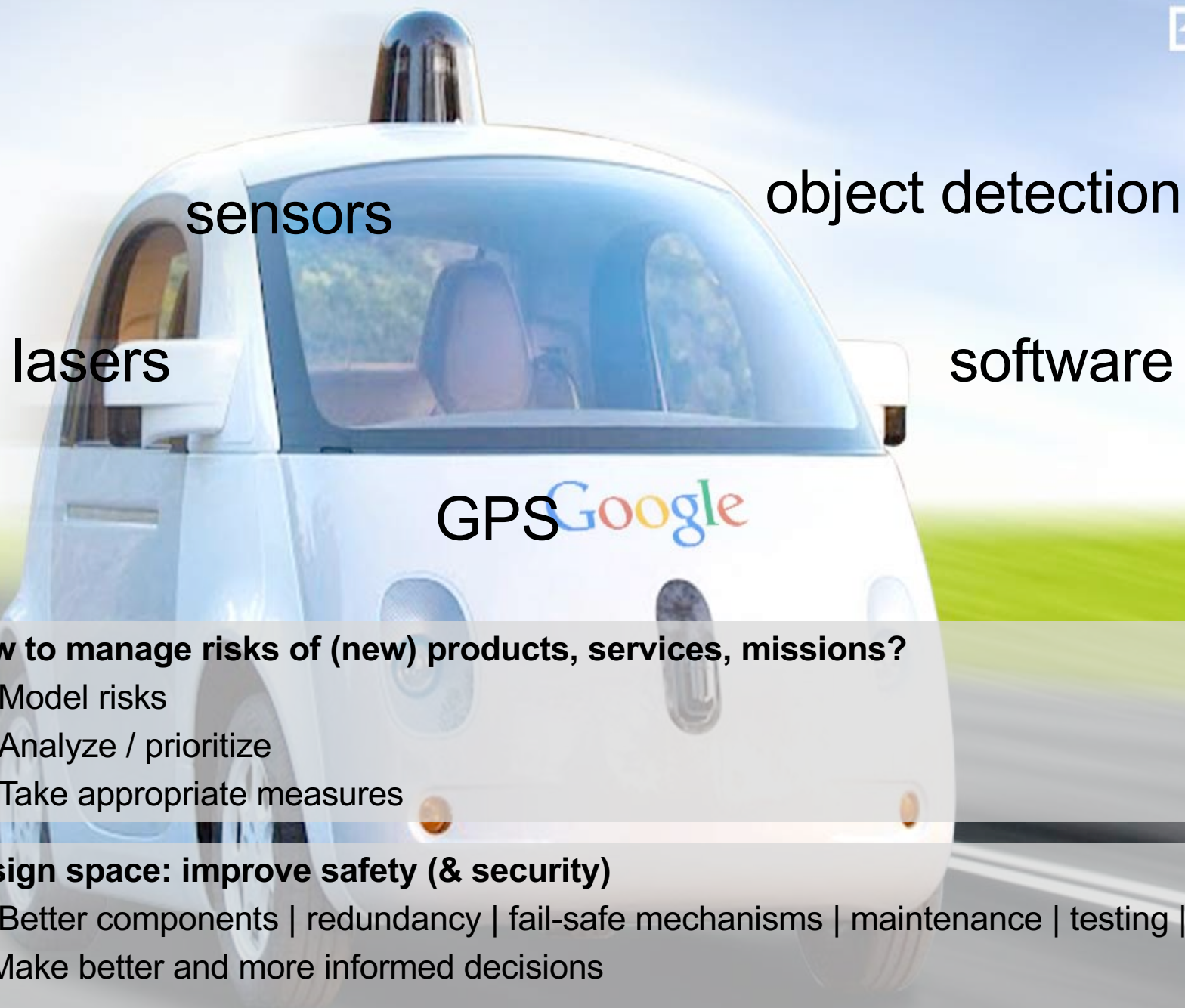


CuriousU

risk management



Prof. dr. Marielle Stoelinga



How to manage risks of (new) products, services, missions?

- Model risks
- Analyze / prioritize
- Take appropriate measures

Design space: improve safety (& security)

- Better components | redundancy | fail-safe mechanisms | maintenance | testing |
- Make better and more informed decisions

Risk management

1. What?
2. When?
3. How?
4. Conclusions

Risks in news media

Former NSA hacker discovers password leak in new version macOS

September 26, 2017 7:24 AM



A former hacker of US intelligence service NSA has found a leak in the latest version of Apple's macOS operating system.

Cyber security

WHEN IS MORE ACTUALLY LESS? SITUATIONAL AWARENESS AND NUCLEAR RISKS

REBECCA HERSMAN AND BERNADETTE STADLER
COMMENTARY

AUGUST 2, 2019



Artificial weapons

Allergy exposure may reduce the risk of asthma

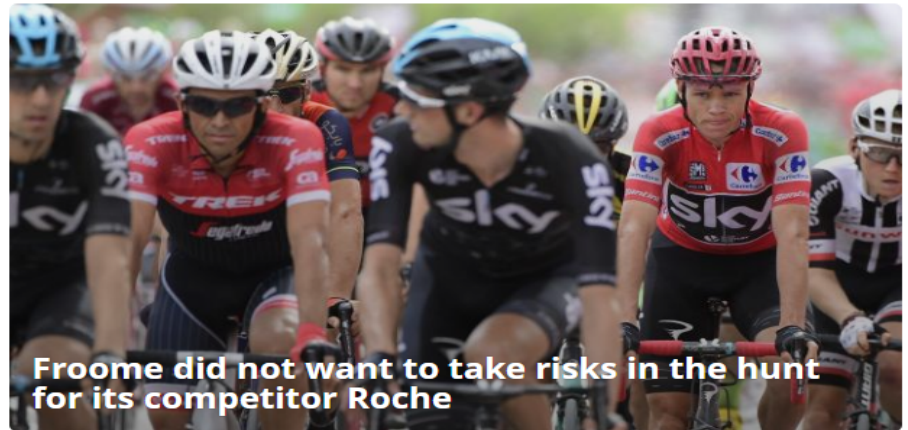
September 19, 2017 6:30 PM

Last update: September 20, 2017 9:21 AM



According to new research, children exposed to allergens in their first years of life may be at a lower risk of developing asthma.

Human health



Froome did not want to take risks in the hunt for its competitor Roche

August 29, 2017 7:58 PM

Last update: August 30, 2017 10:26 AM



Red jersey carrier Chris Froome did not worry Tuesday after the tenth stage after he saw number three Nicolas Roche running into the general classification of the Vuelta a España for almost half a minute.

Sports

What is risk, actually?



Definition of risk

- There are many definitions of risk
 - Some definitions emphasize the chance of losing
 - Some definitions emphasize the variation in effects
 - Some take into account positive aspects
- Risk is also defined as probability \times effect

Let's walk through a number of them

Definitions Risk

- **Haller (1975):** the possibility that positive expectations do not go into reality.
- **Carter (1981):** the degree of variation in the possible effects of an uncertain event.
- **ISO 2002:** *the combination of the probability of an event and its consequences*
- **ISO 31000 (2009):** *the effect of uncertainty on objectives.*
- **Williams & Heins:** *the variation in the outcomes that could occur over a specified period in a given situation.*
- **Claes:** *the possibility that in a given period and situation, positive expectations will not be fulfilled.*
- **Kaplan & Garrick:**
 - What could happen?
 - How likely?
 - If ... what will be the consequences?
- **Quantitative:** probability x effect

Common aspects of these definitions

- **There is a chance ...**
- **... that something does / does not happen ...**
- **... with positive or negative effects**

The risk management world is divided on whether positive effects should be included.

Risks can therefore be divided into positive or negative outcomes

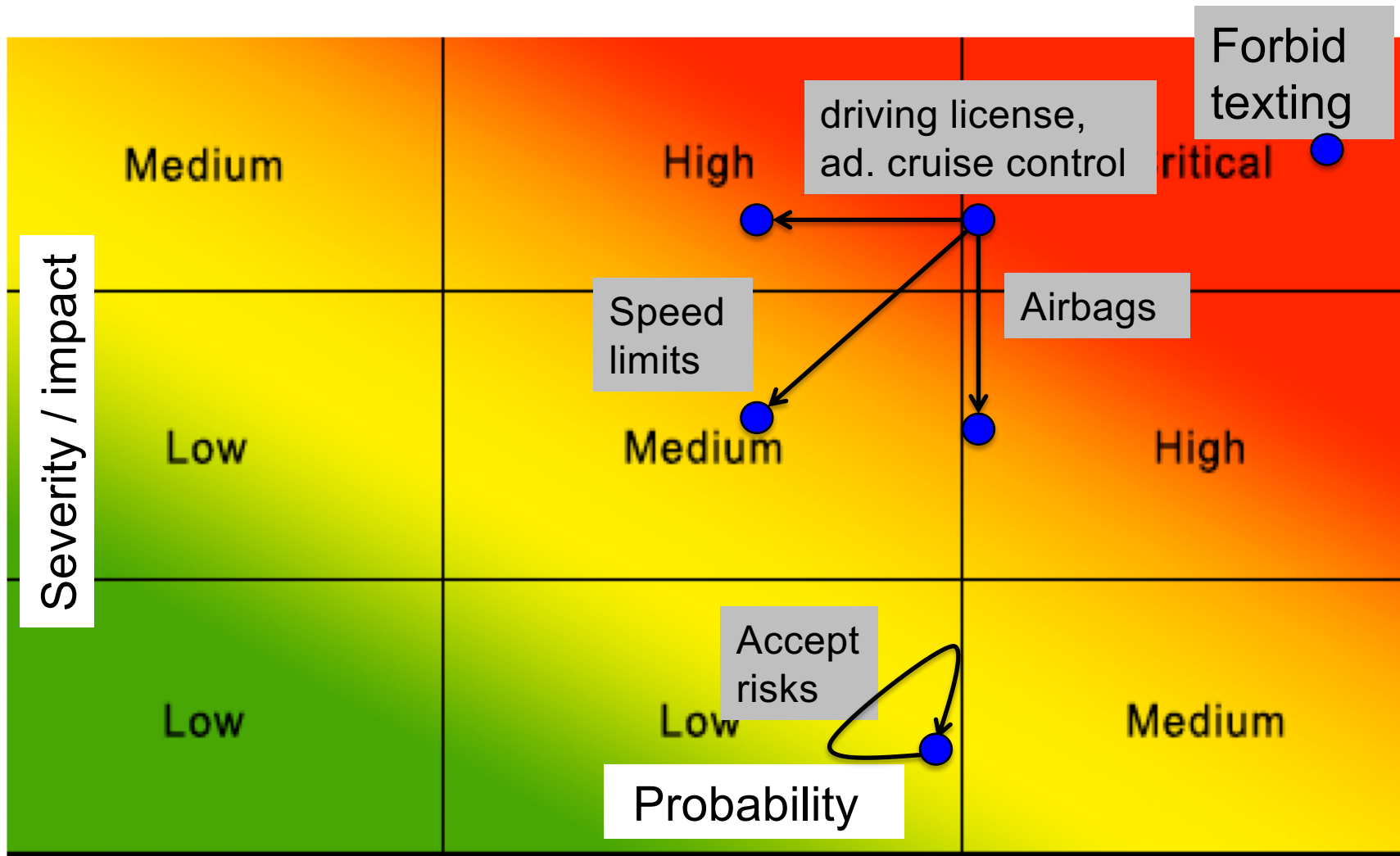
A. probability distribution with possible positive and possible negative outcomes:

- Economic or entrepreneurial risks
- ... E.g. bringing a new product to the market.
- Positive perception of risk (Denney 2004)

B. probability distribution with only negative outcomes:

- Pure risks
- ... E.g. fire
- Negative perception of risk

Visualizing (pure) risks: Risk priority heat map



Risk management = what strategy to deploy, and why

Question

What is better?

A. Reduced probability?

- Prevent failures from happening
 - Often: reduce the root cause
→ One measure per root cause
→ Expensive
- Eg via fault tree analysis

B. Reduce impact?

- Less effect: with airbags still
- But: not all root causes can be eliminated

Combination of A & B needed!

What to do with your risks?

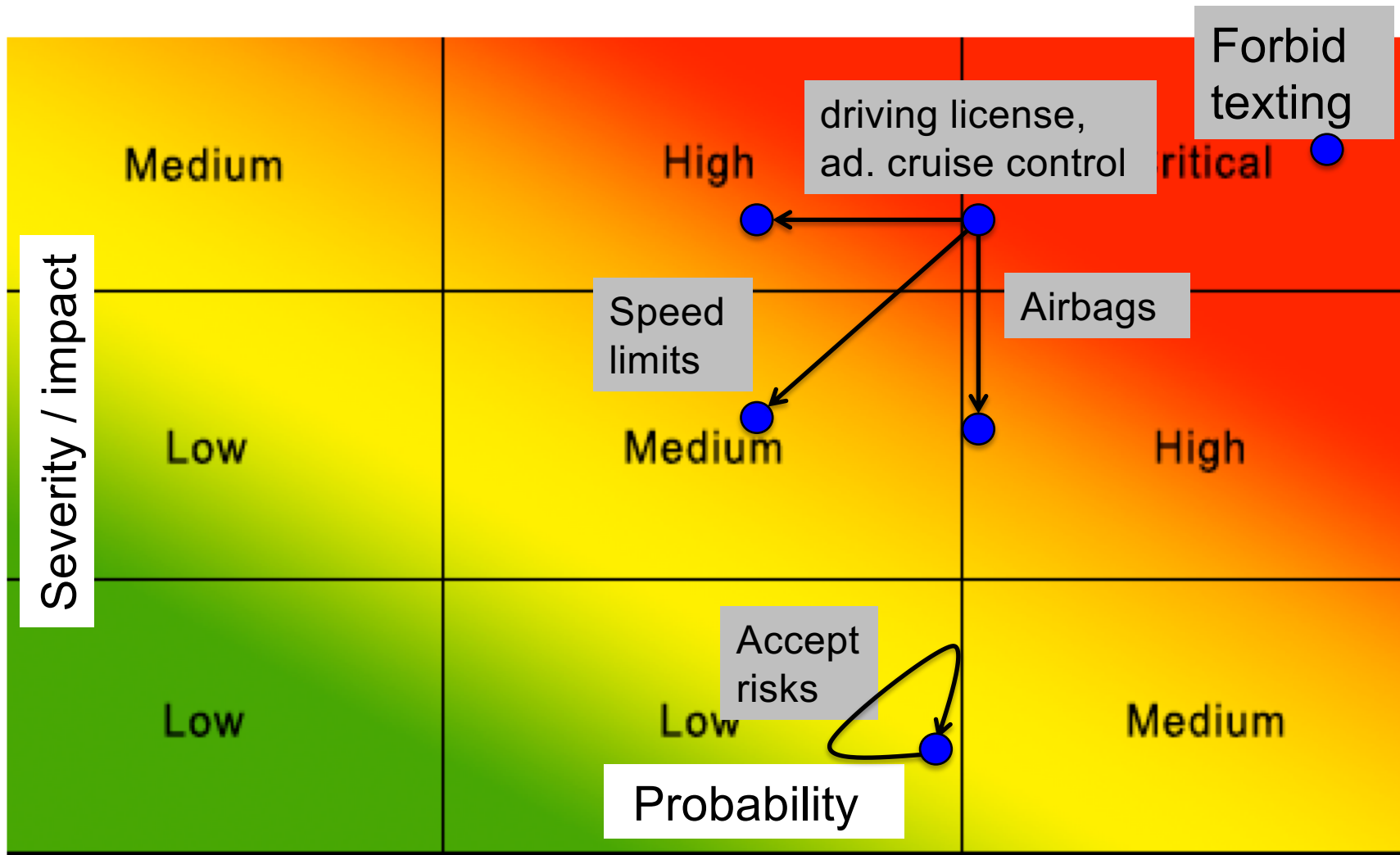


Four strategies

- Terminate
- Treat
 - Reduce impact
 - Reduce effect
- Tolerate
- Transfer

→ Which strategy to take?

Risk strategies



Risk management = what strategy to deploy, and why

How do you categorize these?

- Sprinkler installation
- Health insurance
- Emergency exit
- Four-eyes principle

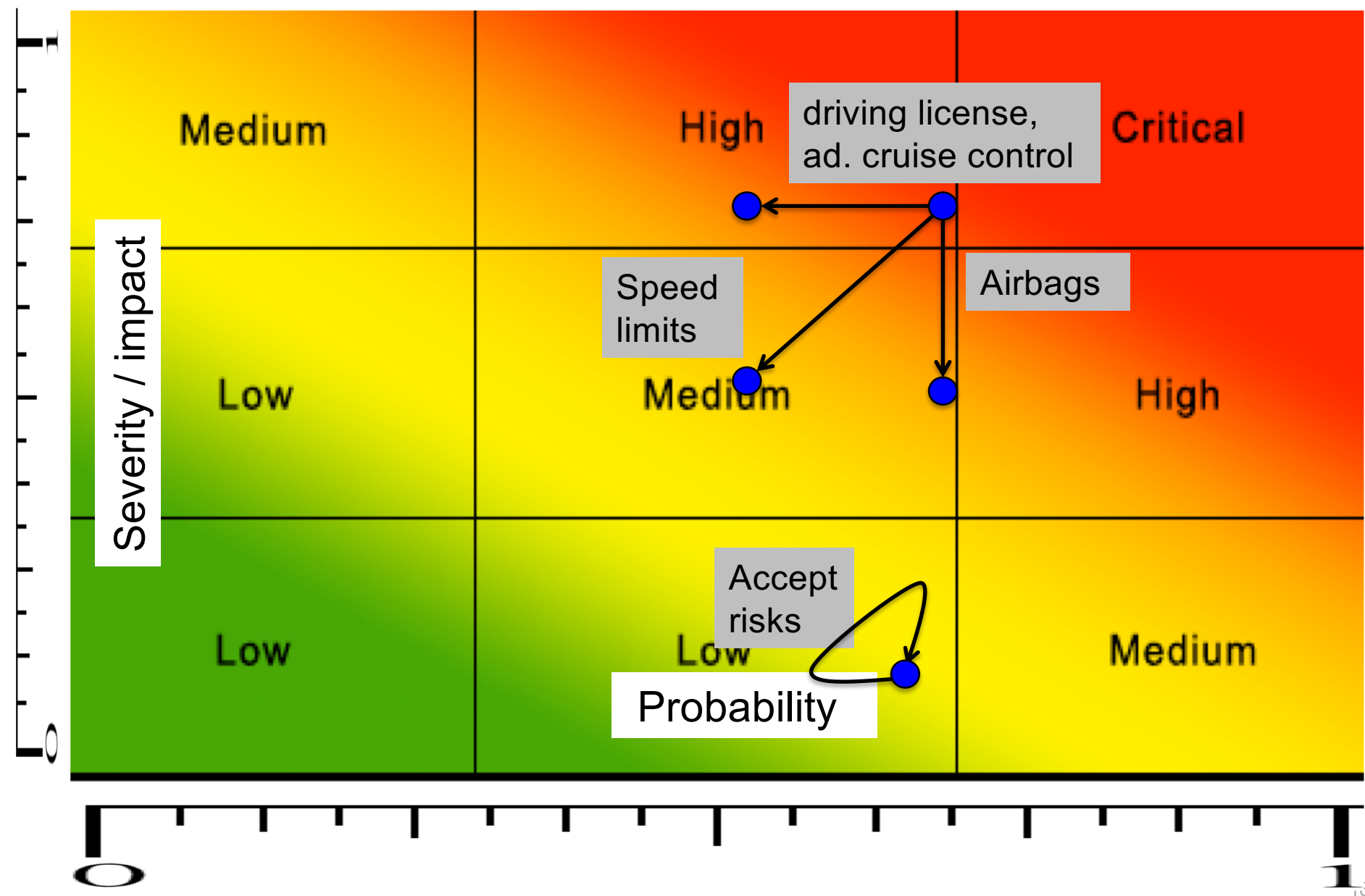
Quiz:

Can you make a list of your most important risks recently?

Can you think of strategies to manage these?



Risk = probability x effect



Advantages

- Quantitative
 - Good to compare risks
- Numbers can be hard to get
 - Probability
 - Impact
- Risks vary with time
 - The probability to die at age 93 is higher than at age 3
 - ... not only for people, but also for batteries, bridges, motors
 - Better definition: $\text{Risk}(t) = \text{Probability}(t) * \text{Impact}(t)$



Which strategy to take?



Risk management

1. What?
2. When?
3. How?
4. Conclusions

Risk treatment strategies

HILP!

Transfer / share

- outsource
- insure

High

Terminate

- eliminate
- withdraw

Low

Medium

Treat

= lower frequency
or impact

Low

Tolerate / Retain

- accept and budget

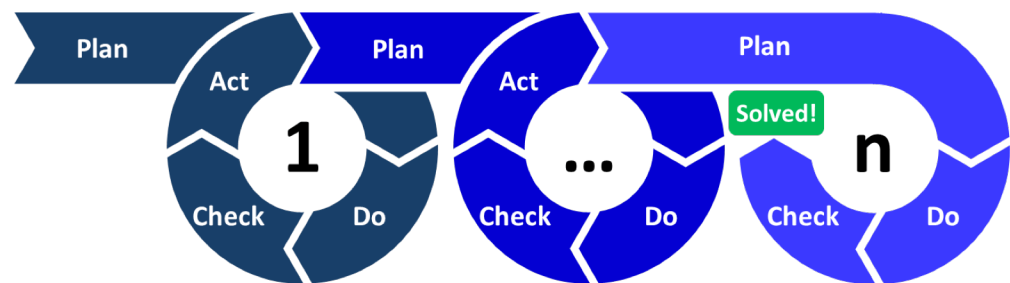
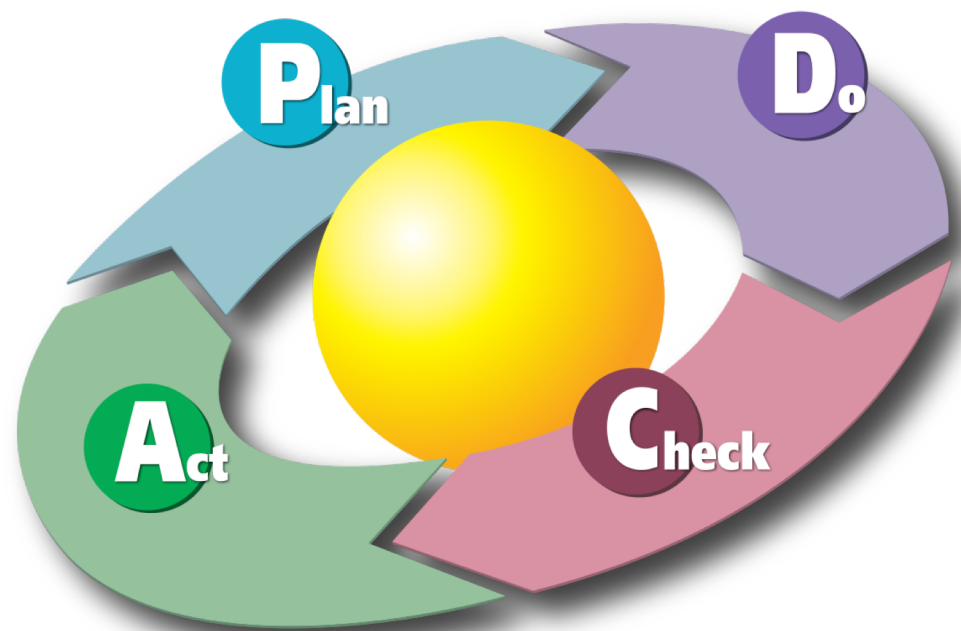
Medium

Risk management cycle

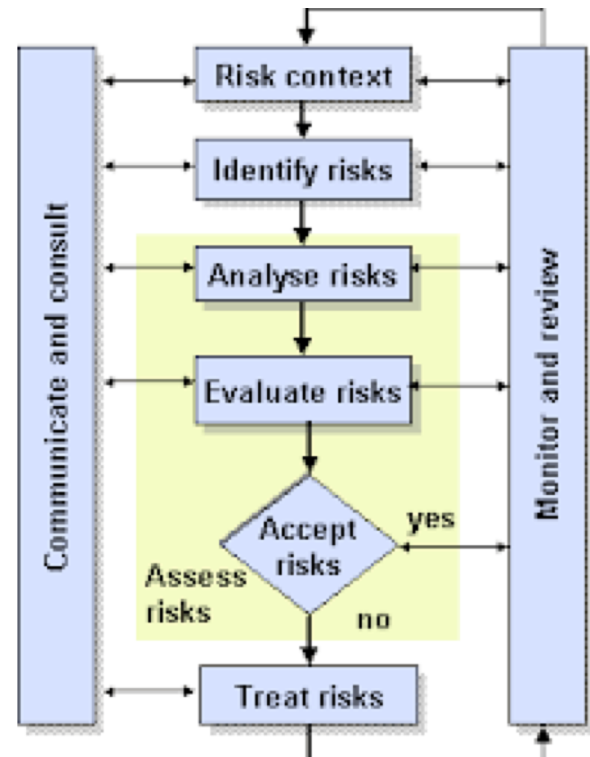
Risk management: the Deming (PDCA) circle



William Deming
(1900 - 1993)



RISK STANDARDS



1. Determine goals
2. Identify risks
3. Classify risks
4. Take measures
5. Evaluate measures effectiveness
6. Document and communicate

← Risk = effect of uncertainty on goals

1. Determine goals

- Risk = the effect of uncertainty on goals
- Goals have to be SMART
Specific, Measurable, Attainable, Realistic, Timely

2. Identify risks

- Identify events that threaten your goal
- For each event: identify causes
- FTA and FMEA are systematic methods

3. Classify risks

- *Impact*: of each event say:
 - quantify low / medium / high
 - Effect on: quality, safety, costs, reputation, time
- *Probability*: for each cause
 - what is the probability? Eg low / medium / high
- More sophisticated quantitative methods

5. Take measures

- Tolerate / Treat / Transfer /

6. Evaluate measures effectiveness

- Very important!
- Measures can have side effects
- Residual risk:
what is the risk after the measures taken?

7. Document and communicate

- Assign actions and responsibilities to people

Example: brew a nice coffee in the morning

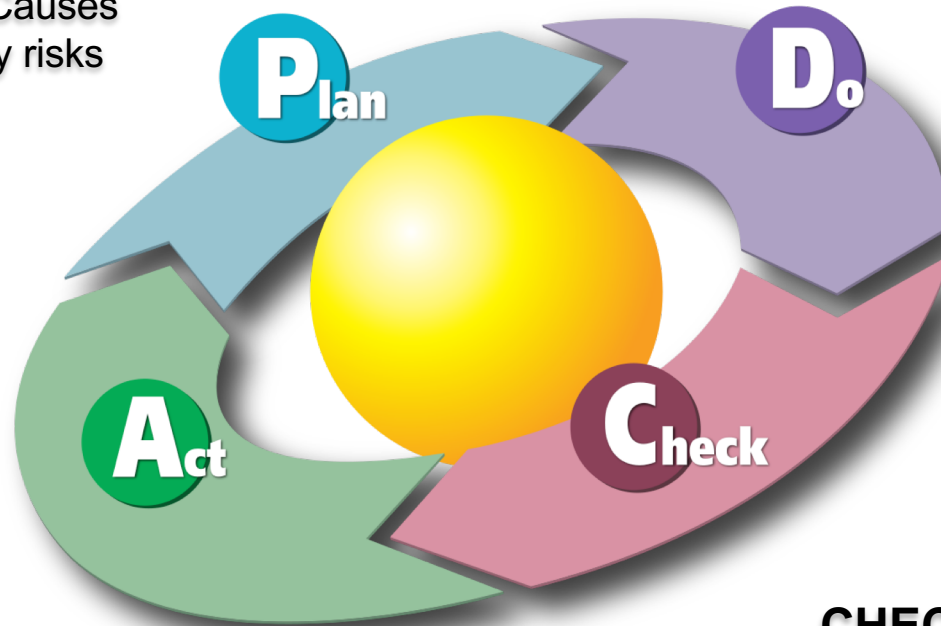
Plan-Do-Check-Act cycle

PLAN

1. set goals
2. identify risks
 - a. Impact / effect
 - b. Causes
3. classify risks
4. select measures

DO

- 4b. implement measures



ACT

- 6 transfer info
- 5b. implement additional measures

CHECK

5. monitor risk

Quiz:

Can you make a list of your most important risks recently?

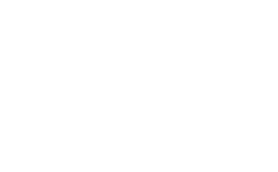
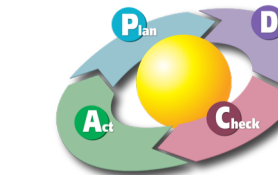
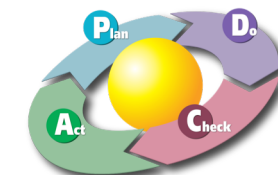
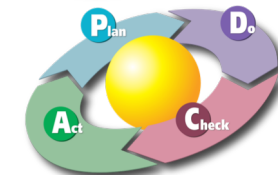
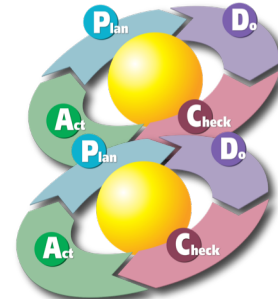
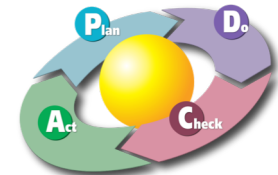
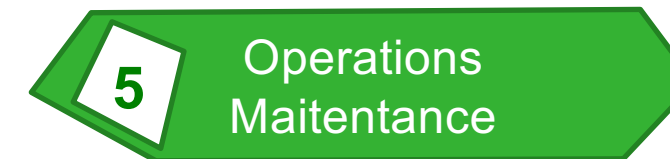
Can you think of strategies to manage these?

Now, use the RM cycle to manage your risks?

Alternative: risks for organizing a birthday party

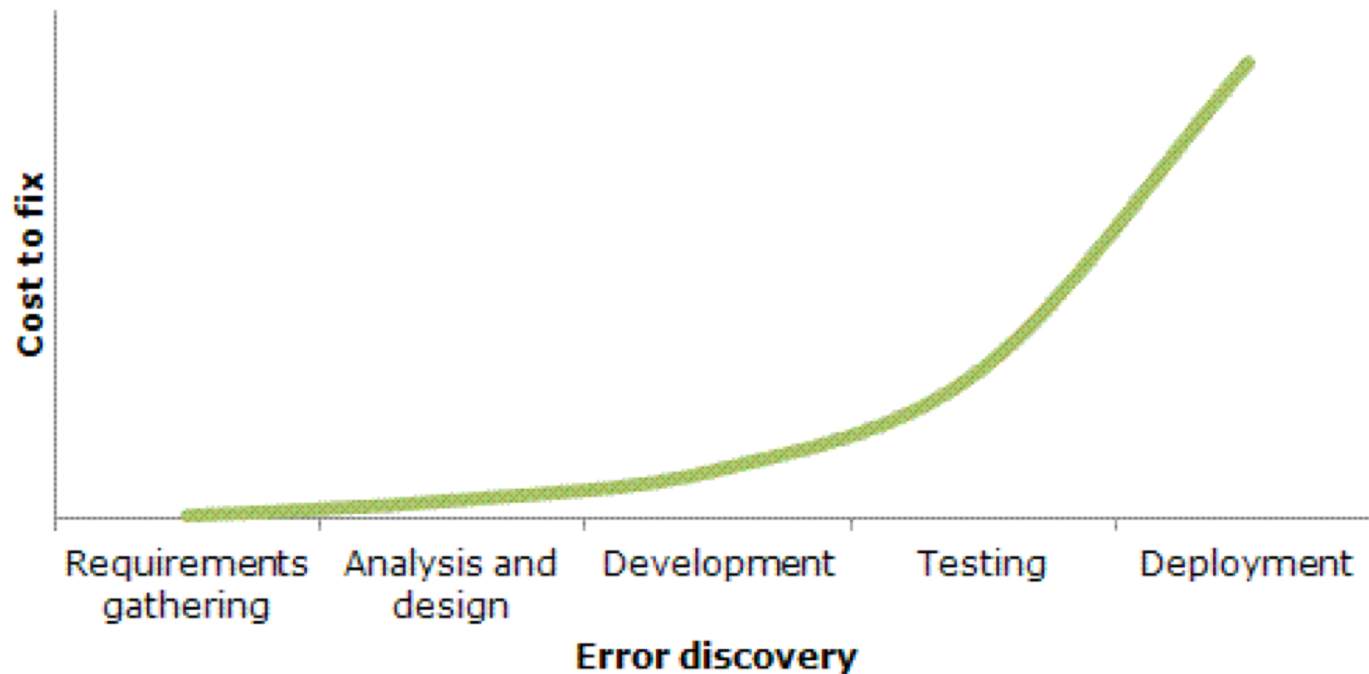
WHEN?

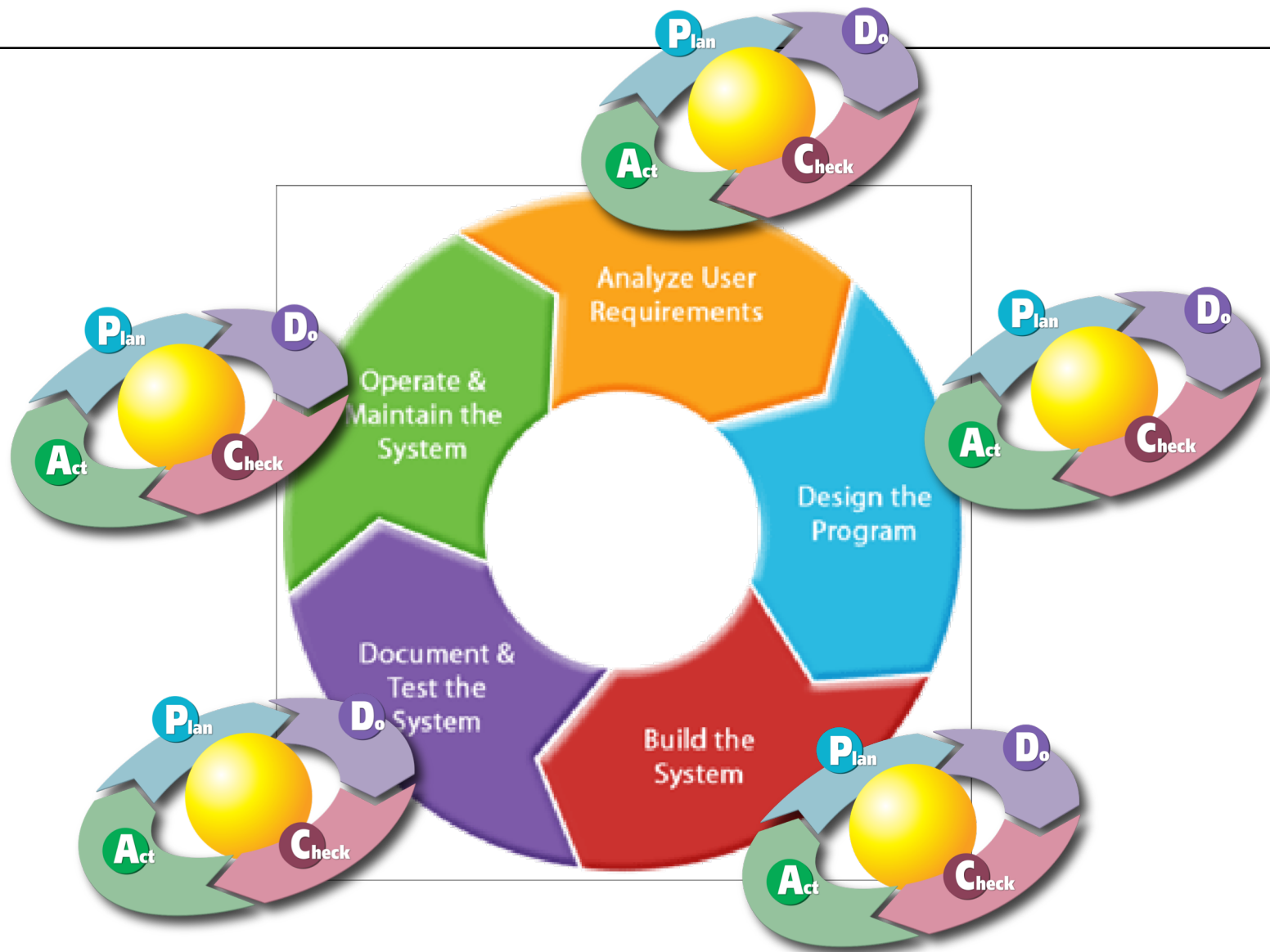
Product / service life cycle



When: Boehm's law of system / product errors

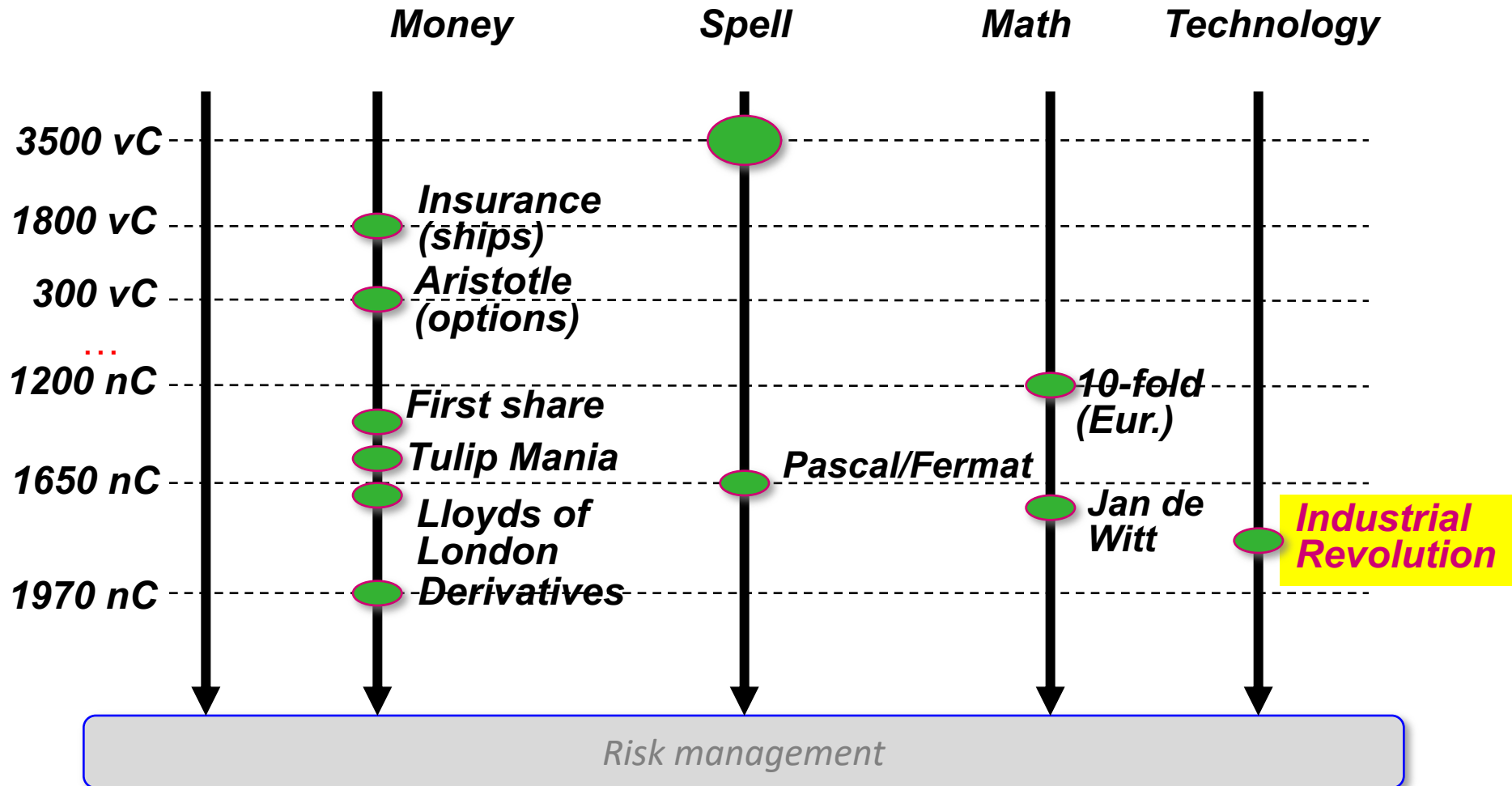
Boehm's law





SOME HISTORY





The development of risk knowledge







The founding fathers of risk and risk management (1)

1921		Frank H. Knight	<i>Risk, Uncertainty and Profit.</i> Risk is measurable, and uncertainty is not (o.a. Milton Friedman was his student)
1921		John Maynard Keynes	<i>A Treatise on Probability.</i> Emphasis on perception and judgment regarding probabilities
1926		John von Neumann	Artikel over de theorie van spellen en strategie. Niet verliezen is een betere strategie
1952		Herbert A. Simon (Nobel Prize in Economics in 1978)	<i>Book: Administrative behavior - a study of decision making processes in administrative organizations. Bounded Rationality</i>






The founding fathers of risk and risk management (2)

1952		Harry Markowitz (later Nobel Prize winner)	<i>Article Portfolio Selection</i>
1955		H. Wayne Snider (Univ. of Pennsylvania)	<i>'the professional insurance manager should be a risk manager'</i>
1956		Russell Gallagher (Philco Corp.)	<i>Risk Management: A New Phase of Cost Control (HBR)</i>
1972		Kenneth Arrow (Nobel Prize in Economics, with John Hicks)	<i>Knowledge is always incomplete and we can best prepare ourselves for risks by assuming "stimulant and penalty"</i>

The founding fathers of risk and risk management (3)

1973		Myron Scholes (Nobel Prize in Economics, 1997)	Article <i>The Pricing of Options and Corporate Liabilities</i> , together with Fischer Black
1982		Paul Slovic	Article, <i>Why Study Risk Perception?</i> Together with Baruch Fischhoff and Sarah Lichtenstein. Perceived risks are measurable
1983		William Ruckelshaus (EPA)	NAS-Speech ' <i>Science, Risk and Public Policy</i> ', in which he launched RM in public policy
1984		Charles Perrow	Book: <i>Normal Accident Theory</i> . Perrow is an organizational sociologist

The founding fathers of risk and risk management (4)

1993	 James Lam (GE Capital)	First mention of title <i>Chief Risk Officer</i>
1994	 John Nash	Mathematician and economist, Game theory (his life was filmed in A beautiful mind)
1996	 Peter Bernstein	Book: <i>'Against the Gods'</i>
2002	 Daniel Kahneman (Nobel Prize in Economics)	Psychologist. Judgment, decision-making, behavioral economics Prospect Theory (1979, with Amos Tversky)
2007	 Nassim N. Taleb	Book: <i>The Black Swan. The impact of the highly improbable.</i>



Exercise (preparing for the afternoon)

- **You are going** on a road trip in the Moroccan desert.
- **You are about to** hire a rental car. Stranding here and getting no help is dangerous. As failures, we consider a flat tire, or a broken car engine. As a preventive measure, you bring your phone, and your car has a spare tire. However, your phone not have connectivity, or be out of power.
- **The car rental company** tries to convince you to take a more expensive car, because it has better tires. Your partner however claims that this is nonsense, and says bringing a satellite phone makes more sense, since it has a better connectivity.
- **If both alternatives** are equally expensive, what would you do: get a car with better tires, or a satellite phone?

Note: for simplicity, we only consider the failures mentioned above



Just play. Have fun. Enjoy the game.

— *Michael Jordan* —

