CISB Executive Innovation Management Course

A Triple Helix concept conducted by
Linköping University ● Swedish Armed Forces ● Swedish Industry

Open Seminar –
Technology Forecasting in the Industry

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Saab AB

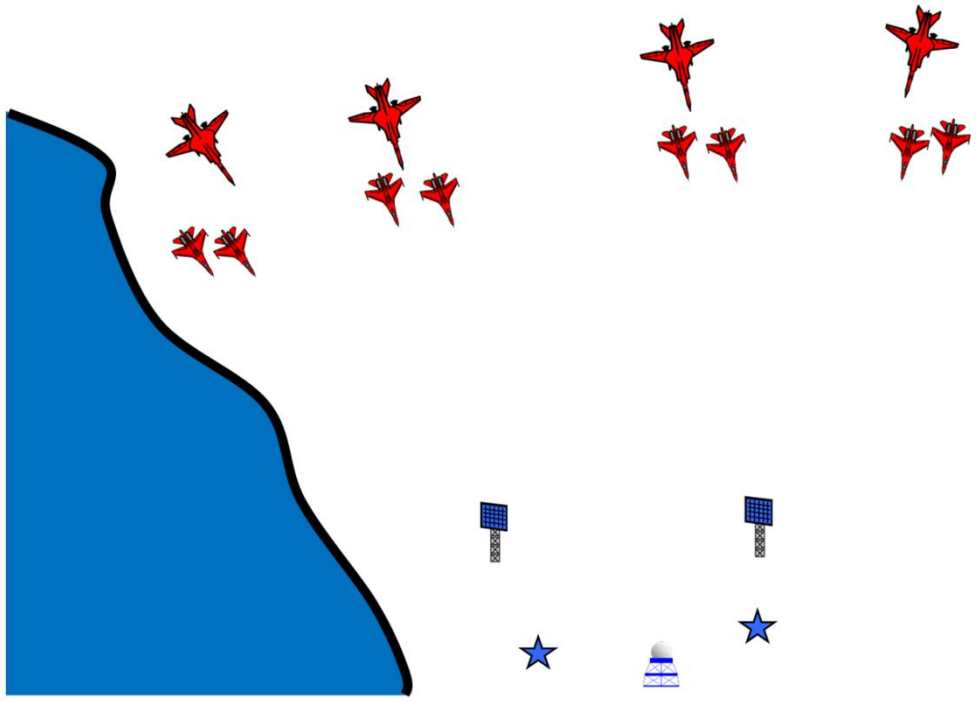
Outline

- **Scenario Prospecting**
- Technology vs Innovation
- From Technology to Capability
- Technology Forecasting
- Putting it all Together

Scenario Prospecting

Predictions / Hypotheses about

- General situation
  - *Political, Economical, Conflicts*
  - *Geography, Climate*
  - *Societal*
- Technology and systems
  - *Own, opponent's, cooperative*
- Doctrines and Tactics
  - *Own, opponent's*
- Mission and goals
  - *Own, opponent's*



Used for needs analysis and concept validation (simulations)

Different Scenarios – Different Threats

Swedish army main battle tank MBT 122B developed by IBD Deisenroth Engineering

Low Tech Threat

Improvised Explosive Device (IED)

High Tech Threat

MMP ATGW

Prepare for new Scenarios

Iran flies final model of RQ-170 the reverse engineering of the US drone

November 11, 2014 - 10:29 AM

Commander of the Islamic Revolution Guards Corps (IRGC) Aerospace Force Brigadier General Amir Ali Hajizadeh announced that the Iranian version of the RQ-170 drone with the capability of conducting

Source : **FNA** News Code : **650664**

Commander of the Islamic Revolution Guards Corps (IRGC) Aerospace Force Brigadier General Amir Ali Hajizadeh

Iran announced on December 4, 2011 that its defense forces had downed a US RQ-170 aircraft **through a sophisticated cyber attack**.

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Technology vs Innovation

- **Innovation**
  - *is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations. (something new and beneficial)*
- **Types of innovation**
  - *Product innovation – New products*
  - *Process innovation – New ways of working*
  - *Marketing innovation – New ways of making business*
  - *Organisational innovation – New ways of organizing*
- **Technology is an enabler for innovation**
  - *Good/dominant products do not necessarily embody the most advanced technology*
  - *Most innovations are "just" new combinations of existing technologies*
  - *Selection of technology is a balance between risks and benefits*

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From Technology to Operational Capability

Capability			**Protect Strategic Area**		
Concept of Operation			**CAP CONOPS**		
Function	**Target Acquisition**	**Pilot Situation Awareness**	**Weapons Guidance**	**Data & Voice Communication**	
Sub-systems	**Navigation**	**Radar**	**Displays & Controls**	**Communication System**	**Weapons System**
Technologies	**Laser Technology**	**T/R Technology**	**OLED Technology**	**S/W Technology**	**S/W Radio Technology**

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Technology Forecasting

- Technology forecasting attempts to predict the future characteristics of useful technological machines, procedures or techniques.

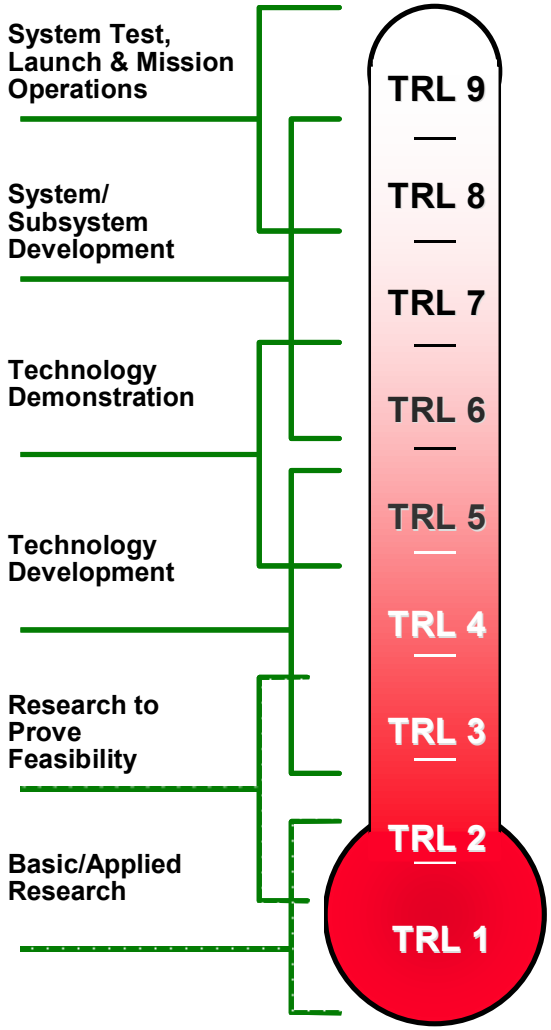
  A technological forecast deals with the characteristics of technology, such as levels of technical performance, like speed of a military aircraft, the power in watts of a particular future engine, the accuracy or precision of a measuring instrument, the number of transistors in a chip in the year 2015, etc.

  The forecast does not have to state how these characteristics will be achieved. (*Wikipedia*)

- The main tools for doing technology forecasting are
  - *Qualitative assessments by a number of (independent) experts/scientists*
  - *Extrapolation of observed trends and/or analogies (similar earlier examples)*

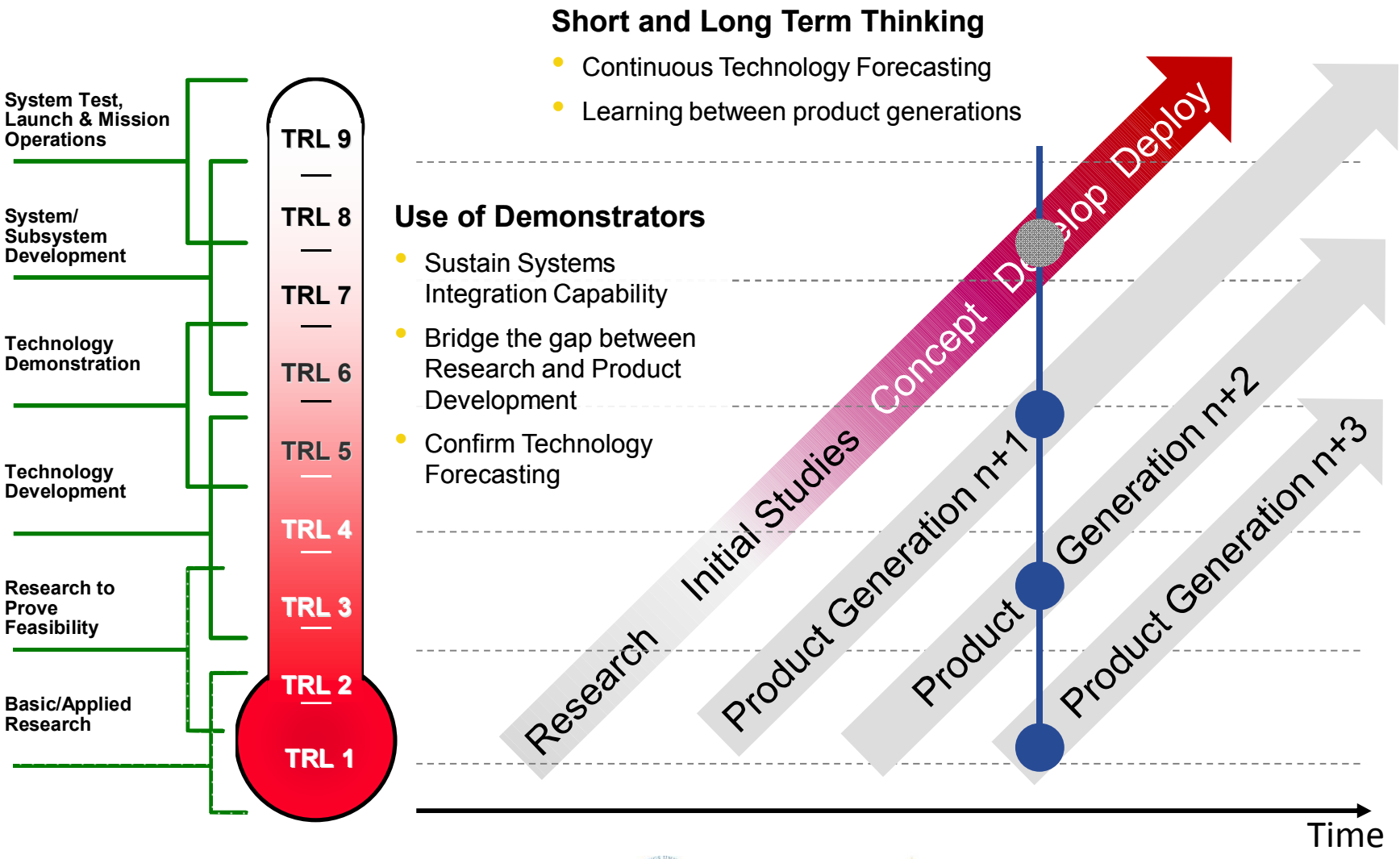
Technology Readiness Level (TRL)

- A framework to assess and compare different technologies
  - *Plan and measure progress in technology development*
  - *Common language for R&D collaborations such as triple helix*
- Each level is defined by the level and type of test and evaluation



MANKINS; J. C., 1995. Technology Readiness Levels: A White Paper. NASA, Office of Space Access and Technology, Advanced Concepts Office

Technology Forecasting and Maturation

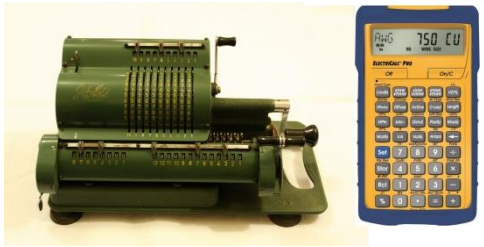


Basic Steps in Technology Forecasting

- **Identify key technologies**
  - *Investigate critical performance and physical limits*
- **For each key technology predict future performance**
  - *Extrapolation of historical data*
  - *Expert assessments*
- **Scan for signs of disruptive technologies. Examples:**
  - *Digital cameras*
  - *Smart Phones*
  - *Electrical Calculator*
  - *Streaming media*
  - *Electrical cars*

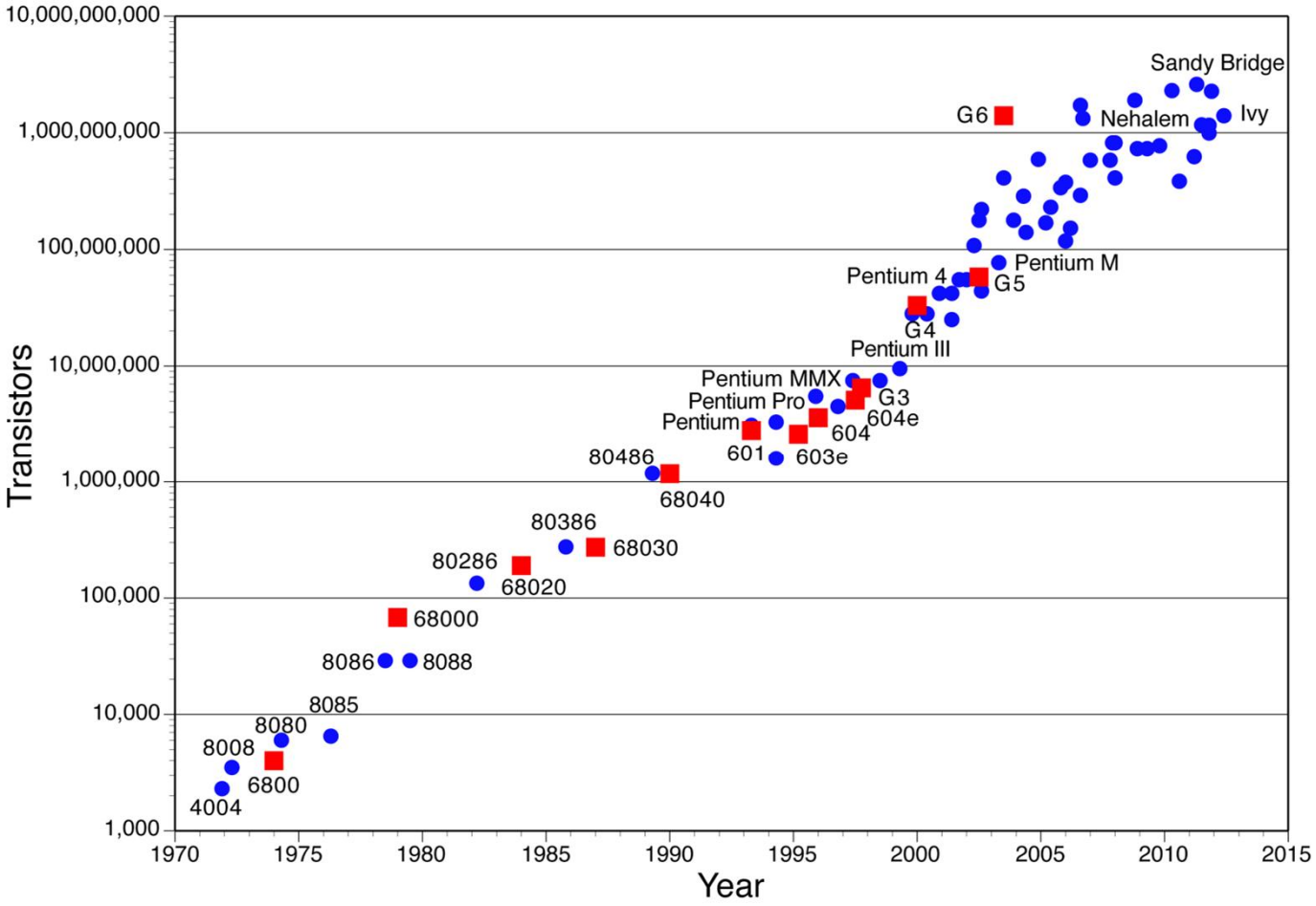




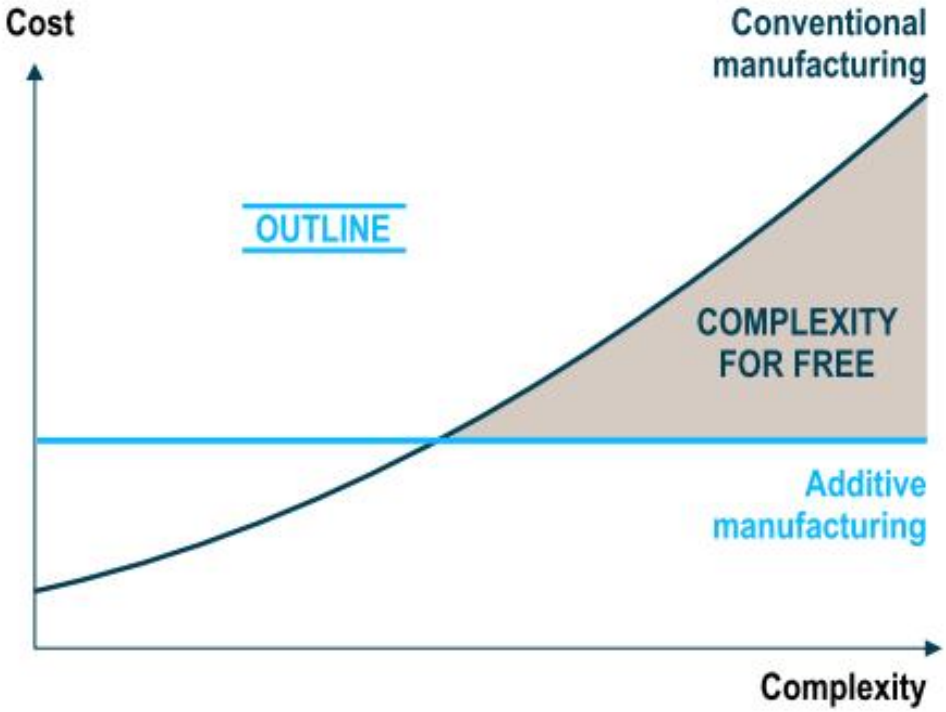



Changes internal and external resource need and/or scope of business.

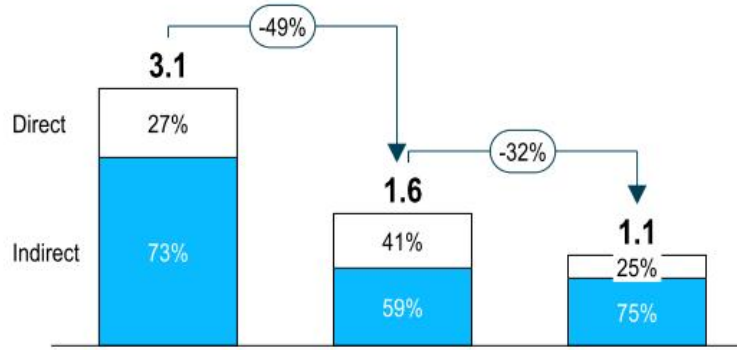
Example: Moore's Law



Example: Additive Manufacturing



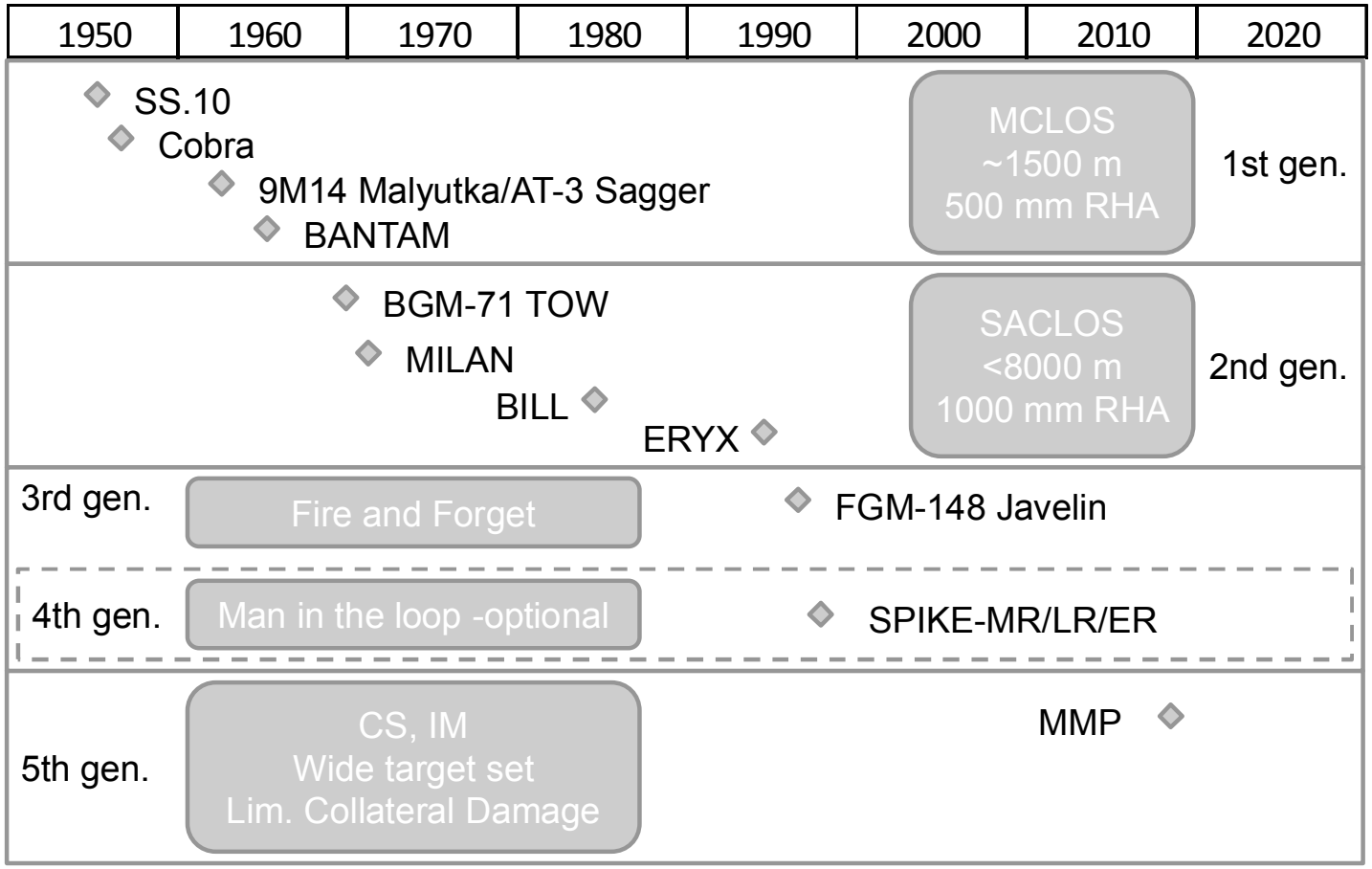
Forecast metal AM costs [EUR/cm³]



PREREQUISITES	2013	2018	2023
Build speed	10 cm³/h	40 cm³/h	80 cm³/h
Machine costs	EUR 500,000	EUR 700,000	EUR 800,000
Share of monitoring	5%	2%	0%
Machine utilization	86%	84%	81%
Powder price	EUR 89/kg	EUR 70/kg	EUR 30/kg
Post-processing effort	1.52 h/kg	1.05 h/kg	0.96 h/kg

Source: Roland Berger;Additive Manufacturing - A game changer for the manufacturing industry?

Example – Medium-Range Anti-Tank Guided Weapon



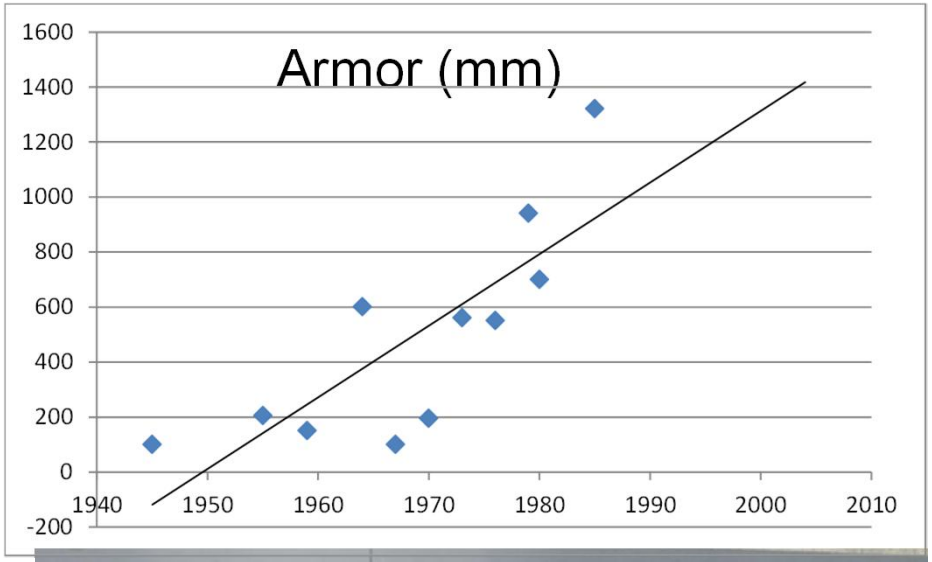
Manual Command to Line of Sight

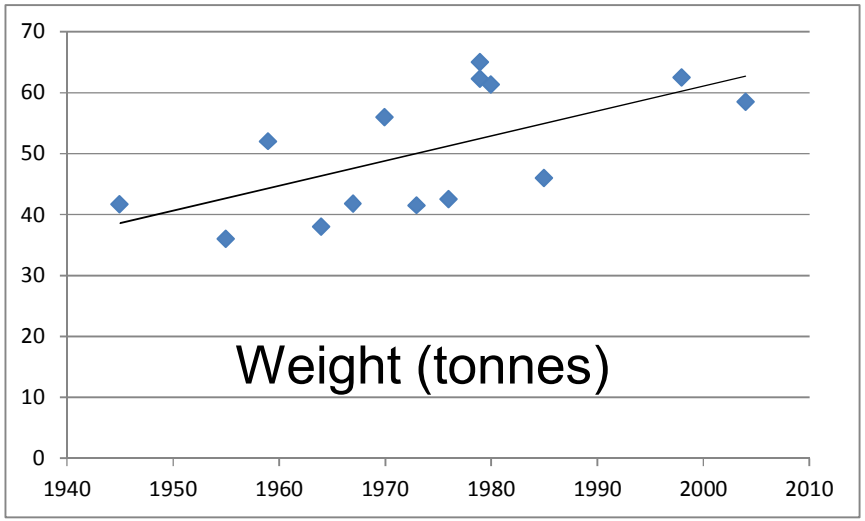
Semi-Automatic Command to Line of Sight

Fire and Forget

Fire and Forget + Man in the loop is optional

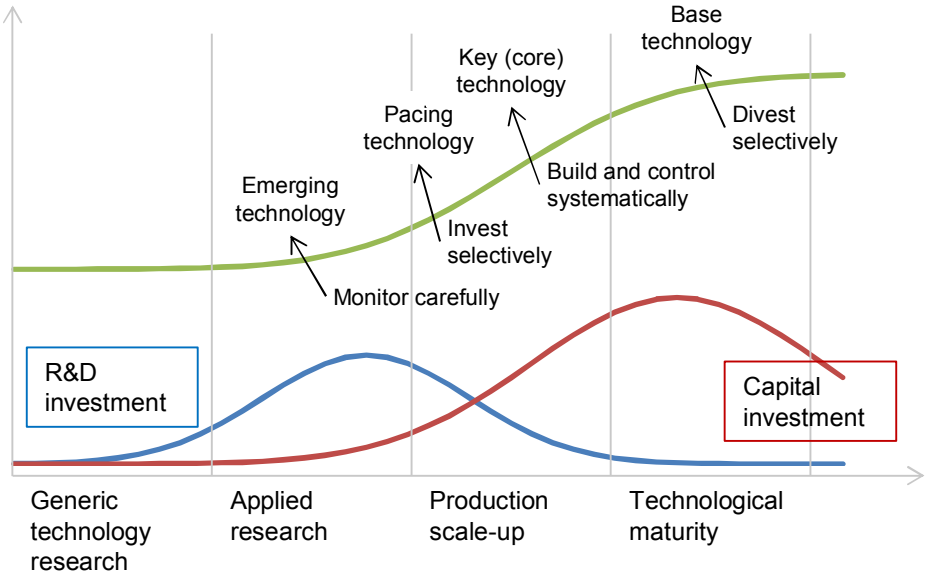
Example – Main Battle Tanks





Use of Technology Forecasting

- Evaluate the impact on product performance and customer benefit (contribution to capabilities)
- Identify strategic technologies
  - *Relevance*
  - *Difficulty to Imitate*
  - *Breadth of Application*
- Part of Technology Roadmaps
  - *Technology Maturity Assessment*
  - *Technology Maturation Planning*
  - *Partnerships for Technology Access:*
    - *Suppliers*
    - *Academia*
    - *Other partners*



Example: Partnership with Universities (Saab)

- Joint research for technology forecasting and access
- Joint development of education for present and future employees
- Mobility between industry and academia for transfer of knowledge

CHALMERS

LINKÖPING UNIVERSITY

SWEDISH DEFENCE UNIVERSITY

KTH VETENSKAP OCH KONST

SWEDISH ARMED FORCES

Linköping University

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Example: Technology Roadmap (Saab)

ID	Systems domain	Functional domain	Issue	Date
FCAS-X-X	X - Y	X - Y		

DESCRIPTION

Short Description

Improvements

WHAT - Describe function/ performance and gain

MAIN PARAMETERS

Parameters	Current	2030	2040

TRL ROADMAP

Current (2020)	Year	Year	Year
TRL1	TRL4	TRL7	2014
TRL2	TRL5	TRL8	2025
TRL3	TRL6	TRL9	

2030	Year	Year	Year
TRL1			
TRL2			
TRL3			2035

2040+	Year	Year	Year
TRL1	TRL4	TRL7	
TRL2	TRL5	TRL8	
TRL3	TRL6	TRL9	

Possible roadmaps

RATIONALES FOR PERFORMANCE LEVELS AND TRL

HOW - Technology

TECHNOLOGY MATURATION TIMEFRAME

From TRL x to TRL x+1

WHEN – Maturation plan

Technology Maturation	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
TRL1->TRL2												
TRL2->TRL3												
TRL3->TRL4												
TRL4->TRL5												
TRL5->TRL6												
TRL6->TRL7												

TECHNOLOGY MATURATION RISK

TBD

TECHNOLOGY MATURATION COST

TBD

INTEGRATION ASPECTS

Parameters		Parameters	
I/O Interface:			
HW requirement:			
SW requirement:			
Considerations :			
Other:			
Power consumption			

Integration aspects

MANUFACTURING ASPECTS

Current (2020)	Year	Year	Year
MRL1	MRL4	MRL7	
MRL2	MRL5	MRL8	
MRL3	MRL6	MRL9	

2030	Year	Year	Year
MRL1	MRL4	MRL7	
MRL2	MRL5	MRL8	

MRL3	MRL6	MRL9	

2040+	Year	Year	Year
MRL1	MRL4	MRL7	
MRL2	MRL5	MRL8	
MRL3	MRL6	MRL9	

DEPENDENCIES WITH OTHER TECHNOLOGIES

ID_tech	Name_tech	Rationale

Dependencies & synergies

Rationale

APPLICATION

Product	Description

CHANGES

Date	Name	Description

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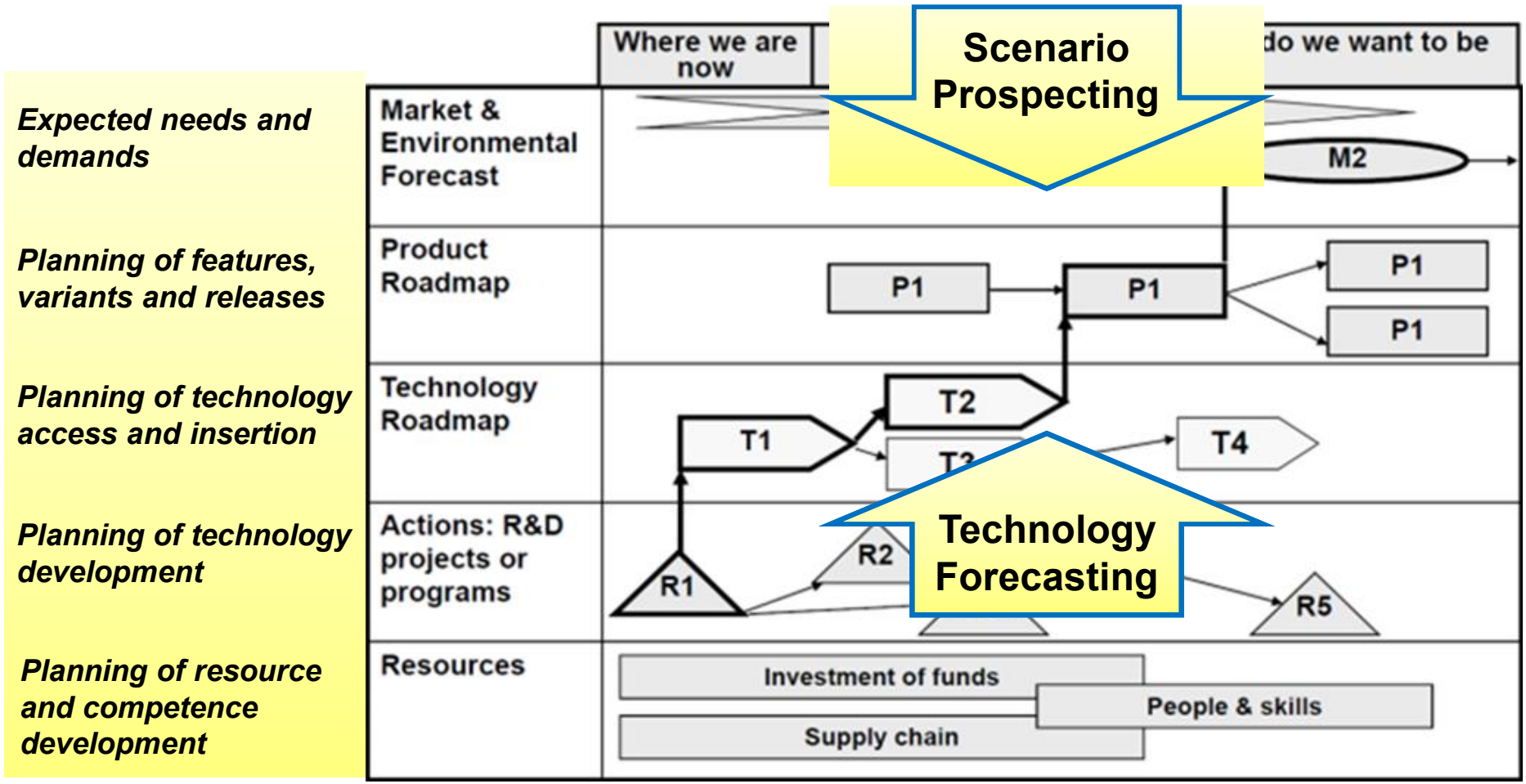
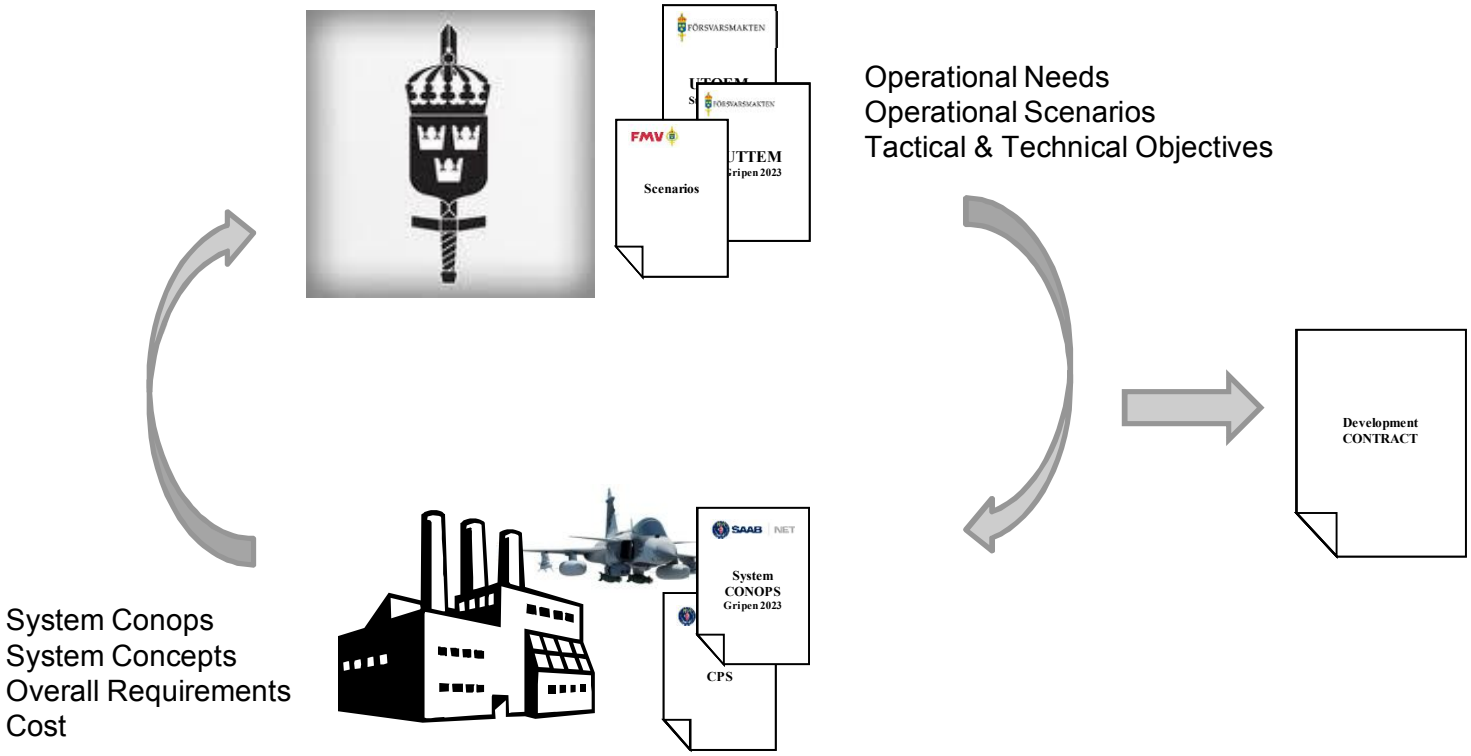
Putting It All Together



Stage-Gate ®, Product Development Institute

Example: Swedish Defence



Example: Saab Future Combat Air System