# Make projects more predictable


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# Why do projects fail
## (and do we mind)

***"People are more used to manage expenses than the behaviour that drives the expenses"***

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- Research numbers, quoted in a recent NAP publication (p.15), mentions a overrun in expenditure and time in a range from 40% till 200% (and even beyond) on approx. 3500 projects over 25 years.

- Stopera (combined townhal and theater within Amsterdam) had an overrun of 50 % of the original budget and a construction time which took roughly double the planned time.

- **Argyris, C. and D.C. Schön (1996). *Organizational Learning II*. New York: Addison-Wesley Publishing Company.**

  **- quote about people -**

- **Bakker, H.L.M. and J.P. de Kleijn (red.) (2014). *Engineering Management of Projects.* Nijkerk: National Association of Process Industry.**

# Research in the Netherlands

- Staveren, van M.T. (2009). **Risk, innovation & change.** TU Twente
- Hertogh, M. and Westerveld, E. (2010). **Playing with Complexity.** Erasmus University
- Bosch-Rekveldt, M.G.C. (2011). **Managing project complexity**. TU Delft
- Kausnik, N.K. (2013). **Prediction of project performance.** TU Delft

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- **Staveren, van M.T. (2009). *Risk, innovation & change. Design Propositions for Implementing Risk Management in Organizations*. Dissertation, Technical University Twente.**

  Auteur designed propositions to implement changes within organizations.

- **Hertogh, M.J.C.M. and E. Westerveld (2010). *Playing with Complexity, Management and organisation of large infrastructure projects.* Dissertation, Erasmus University Rotterdam.**

  Auteurs defined six aspects to approach project complexity: Social-, Technical-, Legal-, Financial-, Organizational-, and Time Complexity.

- **Bosch-Rekveldt, M.G.C. (2011). *Managing project complexity.* Dissertation, Technical University Delft.**

  Auteur collected data from Dutch industry and defined three main items: Technique, Organization en Environment to tackle complexity

- **Kausnik, N.K. (2013). Prediction of project performance. Thesis, Technical University Delft**

  Auteur developed a conceptual model for predicting future project performance, based on 'Early warning indicators'; all being part of Information exchange and Decision making.

# Context

## Make or Buy?


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The concept originated after the US Department of Defense (DoD) consulted researchers at Stanford University. The DoD was searching for a better way to substantiate their 'Make or Buy' decisions (do-it-yourself or outsource).

Researchers at Stanford start comparing all kinds of projects, with the request of DoD as their Context, but were not able to come up with a *one-fits-all* project. Using sociological insights, they established that the way information was processed within the DoD, was particularly crucial.

# A derivative

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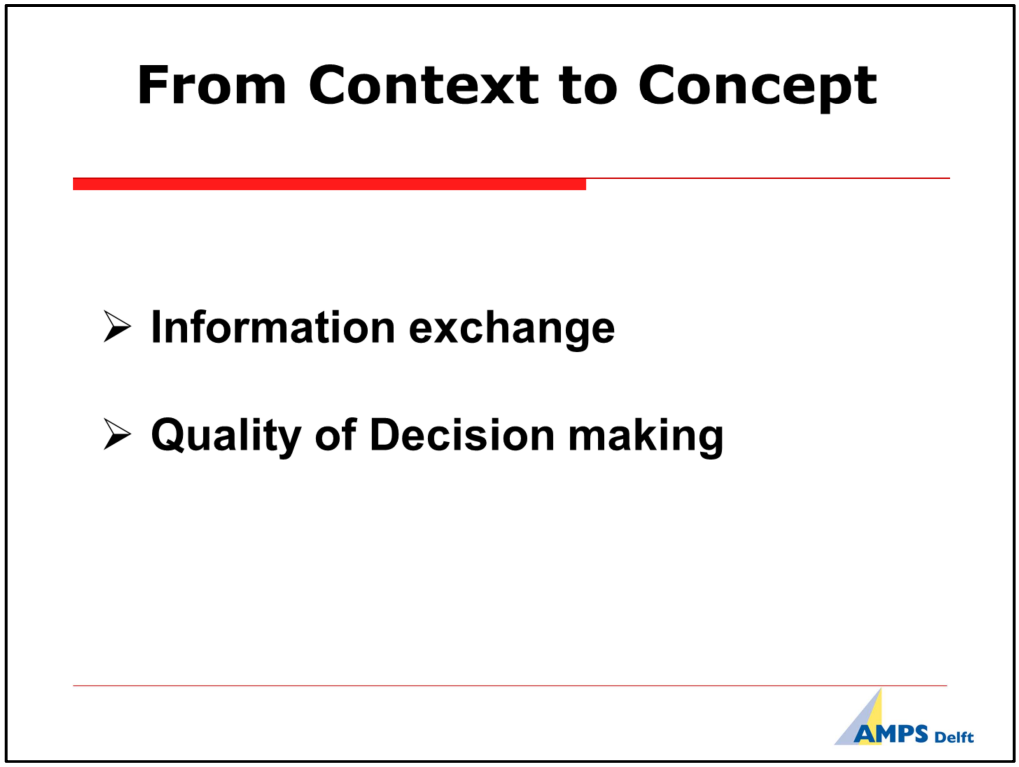
**Concept**

The use of sociological insights on the amount of information people can process, and the way organizations are designed, enabled the researchers at Stanford University to develop a model which could be used on all kind of projects. This model is based on the concept that any work to be delivered, is taken as a derivative of the operational organization.

K**unz, J.C., R.E. Levitt and Y.H. Jin (1998). The Virtual Design Team: A computational simulation model of project organizations.** ***Communications of the Association for Computing Machinery,*** **41(11), 84-92.**




**From Context to Concept (the idea how to operationalize).**

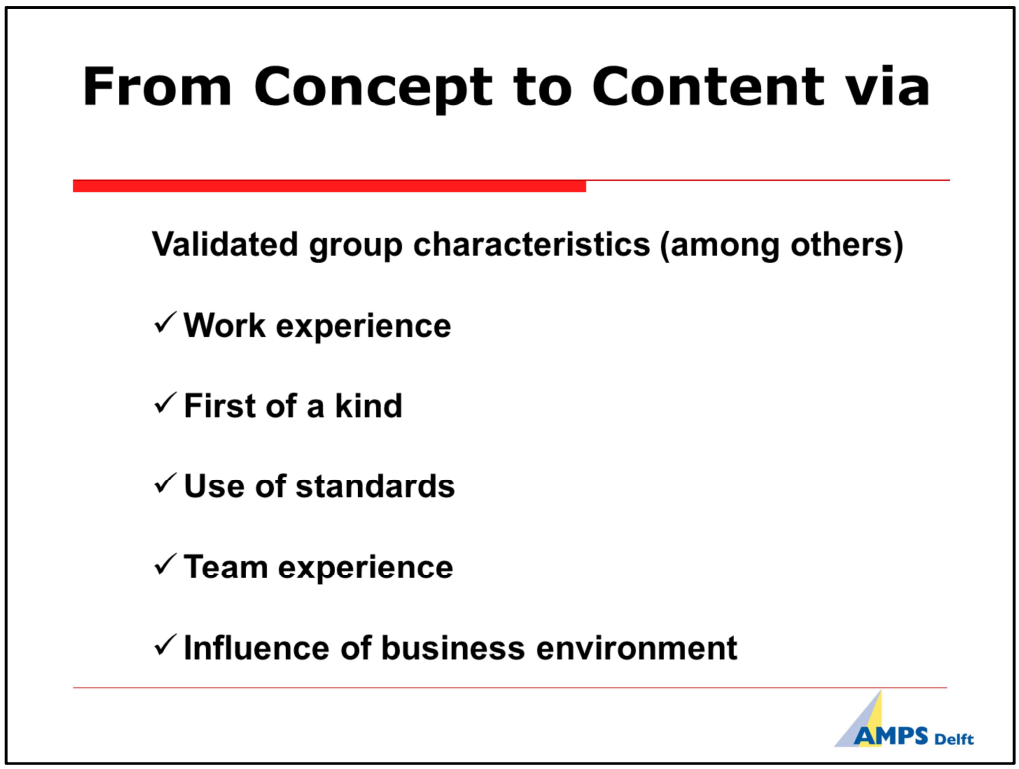
- ❑ **People, Skills, Experience**
- ❑ **Work Processes and Interfaces**
- ❑ **Culture and Leadership**

- Other fields of industry: IT, use same kind of concept: Scrum is one of them. Exchange of limited pieces of information within dedicated groups who are entitled to make decisions.

**Suntherland, J. (2014). Scrum, *The Art of Doing Twice the Work in Half the Time*. New York: Random House.**

- A Dutch govevernemental report advised to put emphasis on decision making to accelerate infrastructural projects.

**Ministerie van Verkeer en Waterstaat (2008). *Versnelling besluitvorming infrastructurele projecten*. Den Haag: Staatsuitgeverij.**




**From Concept to Content (the operationalization) via a simulation machine.**

The simulator model uses a great number of organizational parameters with accessories probabilistic ratios, to come up with a number of relevant reports. Below some examples of those parameters.

***Parameters (with some range examples)***

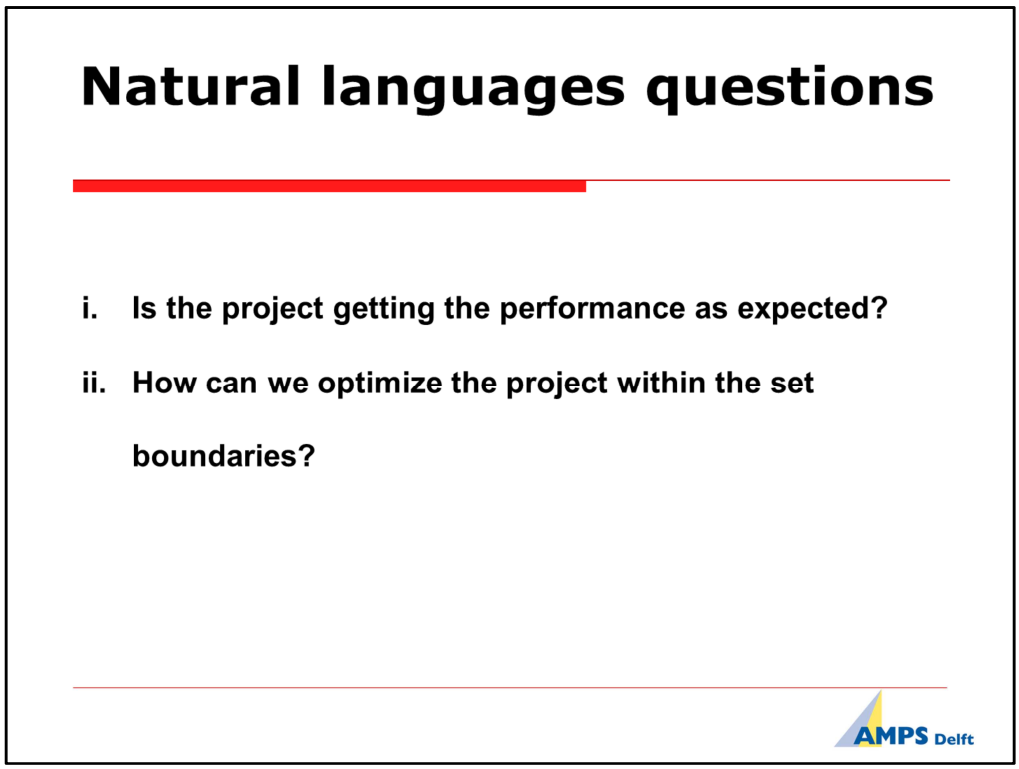
- ***Primary assignment (range: 10% – 100%)*** *allocated to only one assignment*
- ***Uncertainty****:* ***(range: Low, Medium, High)*** *information not available on required moment*
- ***Skills:*** *professional experience*
- ***Project Matrix*****:** Method and quality of information exchange between team members
- ***Centralizaton****: Centralization of decision making resulting in less information exchange.*
- **Formalization:** use of standards to improve decision making process
- **Solution Complexity:** indication of the complexity of a detailed design which requires a great amount of information. The more complicated the required solution, the more information is needed with additional rework
- **Required Complexity:** indication of the complexity of execution and the need to exchange additional information with the chance of mistakes (=rework).
- **Team Experience:** Indication about the experiences of the team with previous work
- **Priority:** indication of the importance of a certain task in comparison with other tasks to the end result of a project
- ***Information exchange probability (range: 0.2 – 0.9):*** *indication about the deviation from required* outcome through a wrong execution caused by lack of information exchange, unuseful meetings, disruptions during office hours and rework..
- **Noise probability (range: 0.01 - 0.2):** indication about time extension of a task caused by multiple distractions during the execution of the task
- **Position role (range: PM, ST, SL):** specification of role
- **Meetings unit (range: day, week, month):** indicator about the sequence of a meeting
- **Functional exchange probability:** indication of the probability that a task fails and requires rework
- **Project error probability (range: 0.05 - 0.2):** indication of the influence of a certain task to other tasks in case of rework.

An example of such a calculation is: if the information exchange probability is set to 0.3 and a 200-day task has one communications link to another task, there will be 60 communications during the task duration.

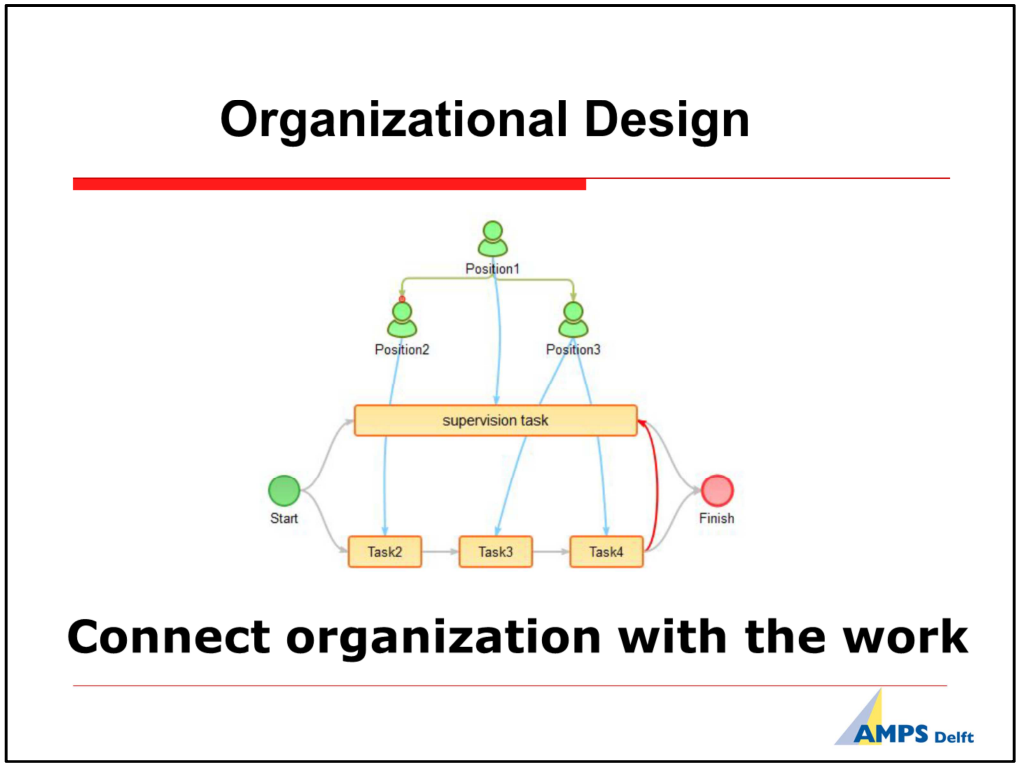
**Robustness test was done on four main characteristics:**

Information Exchange, Noise Probability, Functional Error and Project Error.

http://dare.uva.nl/cgi/arno/show.cgi?fid=225823 , p.65. (in Dutch)




What kind of questions / problems can be processed by the model?




**Organizational design** = Connect the organization with the work.

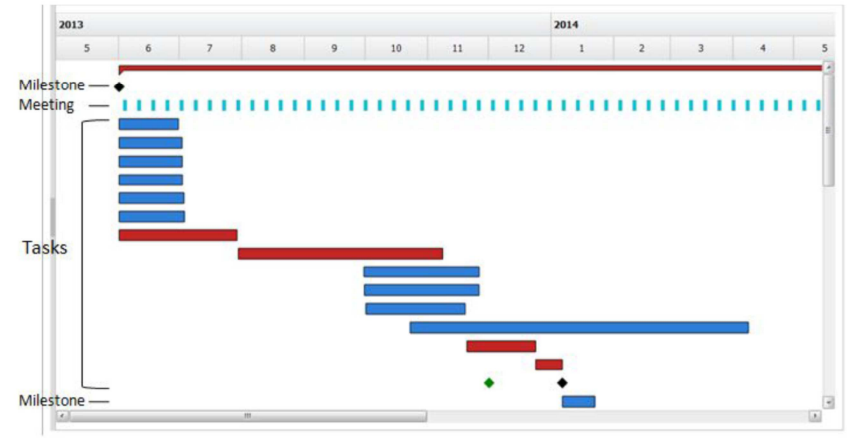
- ✓ Managing organisation (green puppets) with allocated availability
- ✓ Direct reports (black lines)
- ✓ Start and End milestones (green & red)
- ✓ Supervision task (yellow rectangle) with required volume of supervision hours
- ✓ Supervision links (blue lines)
- ✓ Tasks (yellow rectangles) with required volume of execution hours
- ✓ Sequential links between the tasks (black lines)
- ✓ Rework links (red line) with inserted % of time consumption

People have a limited number of hours to process information and make decisions. If there is to much on their plate, they start setting priorities. Resulting in, among others: delays and mistakes. For an extended exploination of the model, see article *'Dealing with completion risk'*

**Kik, A. (2013). Dealing with completion risks. *Controllers Magazine,* October, (22-25).**

http://www.ampsdelft.nl/onderzoek_en_publicatie/ControllersMagazine_ENG.pdf

# Gannt chart

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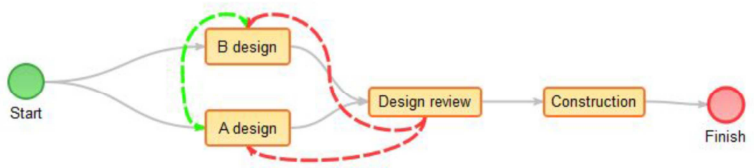
**Gannt chart, showing only limited activities of total:**

A Gannt chart is a graphic view of scheduled activities, each having a specific duration. All activities are shown within a certain sequence to each others and within a specific time period.

- ✓ Time bar (grey)
- ✓ Overall bar of summarized activities (red)
- ✓ Start milestone (black triangle)
- ✓ Regular meetings (light blue)
- ✓ Non critical activities (dark blue)
- ✓ Critical Path (red)
- ✓ original planned milestone (baseline/green triangle)
- ✓ End milestone (black triangle)

# Insert Information links & Rework

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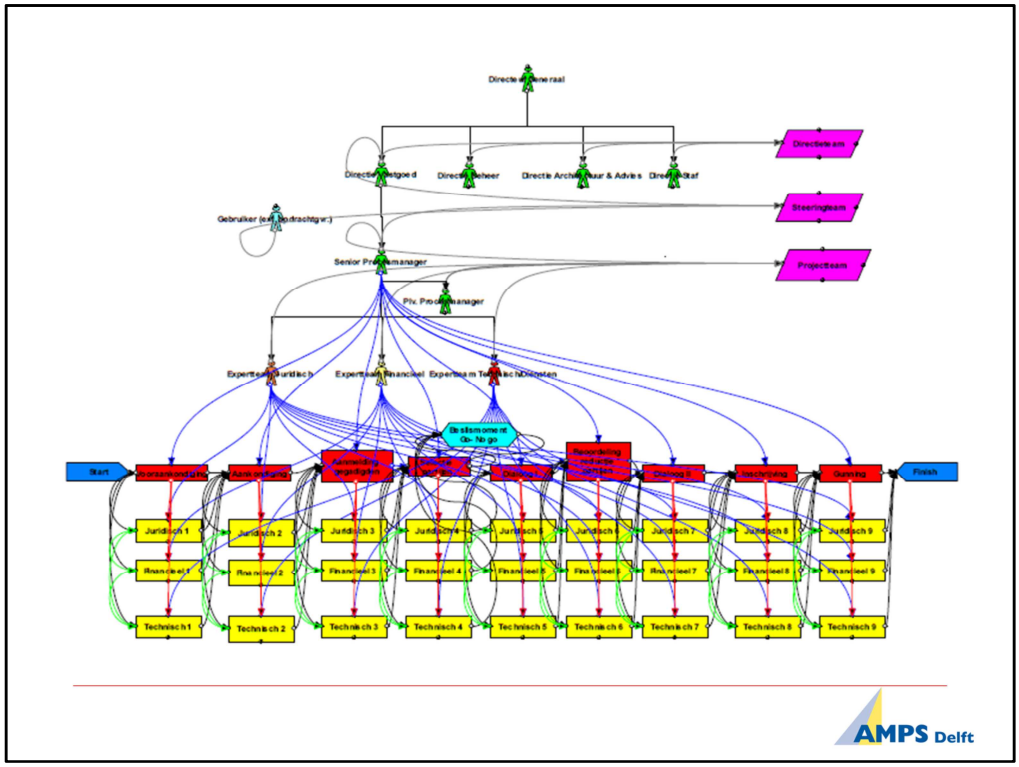
## Information and Rework links

- ✓ Red dotted lines indicate Rework with inserted % of time consumption
- ✓ Green dotted line indicate Information Exchange with inserted % of time consumption

- Start and End milestones (green & red)
- Tasks (yellow rectangles) with required volume of execution hours
- Sequential links between the milestones and tasks (black lines)

During the execution of tasks, there is a continous exchange of information (time consuming) with other tasks. Because of this information flow, some tasks need to be redone (indirect work or Rework)




**A model of the tender phase of a Public Private Partnership project** (used to compare multiple projects because this phase is standarised)

- ❑ On the top: puppets (green, yellow & red); the organization with direct reports, who
- ❑ To the right: attend meetings (purple)
- ❑ Start, intermediate and finish milestone (in blue)
- ❑ First rectangle row; manage the activities (red), and
- ❑ Lower rows: input from different specialists: Financial, Legal & Technical (in yellow)

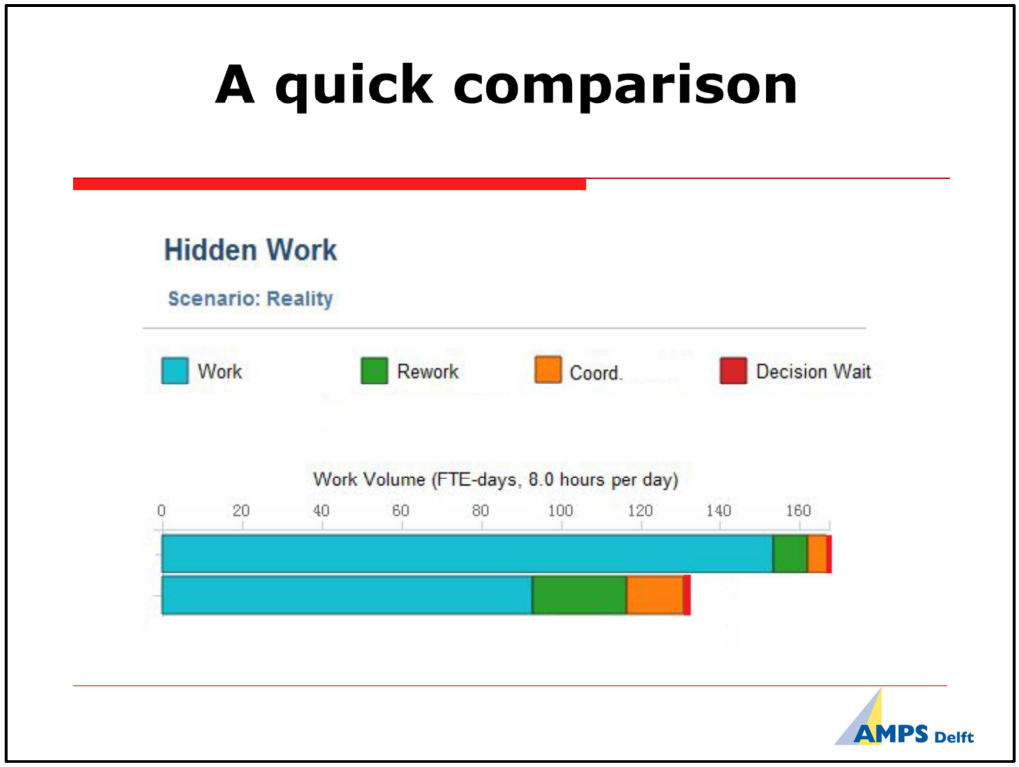
Blue lines indicate: supervision
Black lines indicate: direct reports (on top) and sequence lines between tasks (below)
Red lines indicate: information exchange
Green lines indicate: rework

**Kik, A. (2010).** ***Kwantificering van organisatorische risico's binnen een omgeving met bestuurlijke besluitvorming*****. Scriptie, Universiteit van Amsterdam. (in Dutch)**

http://dare.uva.nl/cgi/arno/show.cgi?fid=225823

**Including Robustness test (p. 65) on four main characteristics**:

- ✓ Information Exchange,
- ✓ Noise Probability,
- ✓ Functional Error and,
- ✓ Project Error.

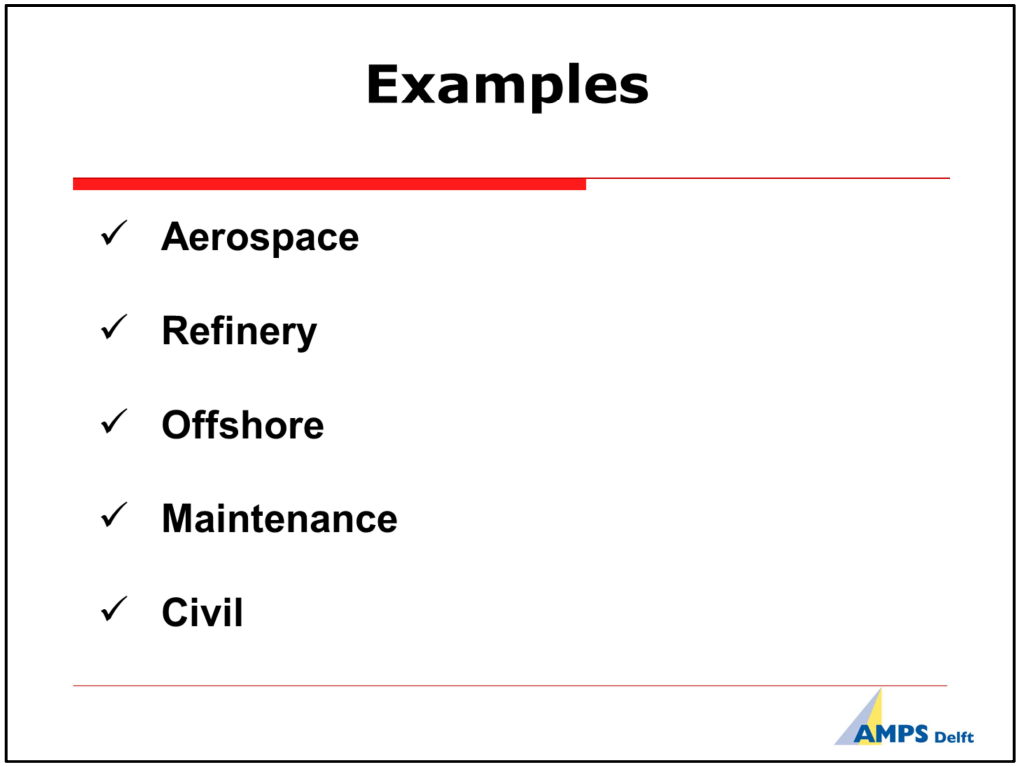



**A quick Comparison of direct and indirect work** (one of the analytic views of the model)

**Two scenarios**

- Top one shows large amount of work volume (direct work) , limited Rework, Coordination and Decision wait (indirect work)
- Bottom one shows less work volume, extended Rework and Coordination and same Decision wait.

Restructuring of the organization (not shown) resulted in a reduced overall work volume. Despite the extended Rework and Coordination on the bottom scenario, overall Work Volume decreased.




**Examples**

**Aerospace:** First of a kind

**Refinery:** Relating Jobsite Organization Structure to Project Performance

**Offshore:** Learning curve on repeating activities

**Maintenance:** Time reduction on maintenance

**Civil:** How to accelerate a project with the same crew.


**Use of simulation technique on a 'first of a kind' project**

The development and launch of the first commercial satellite launcher by Lockheed Martin, resulted in a very accurate predicted launching date (4 months after the planned date) and a controlled departure of the launcher, 30 seconds after take-off.

The controlled departure, the detonation of the launcher (value $ 400 million), was predicted by means of the model through foreseen quality issues on outsourced fabrication of cable trees.

**Levitt, R. and J. Kunz (2002).** ***Design your project organization as engineers design bridges.*** **Stanford University, CIFE Working Paper #73.**

# Jobsite organization structure

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**Relating Jobsite Organization Structure to Project Performance**

- Use a project data
  - $500 million refinery expansion
  - Three-year construction duration
  - 16.3 million craft man-hours

- Simulate different owner-contractor relationships and compare project outcomes and quantify quality risks
  - **Best player**: Jobsite staff is a **hybrid** of Owner and Contractor personnel
  - **Audit**: Owner team **reactively** audits performance and seeks corrections and improvements
  - **Dual player:** Owner team works **proactively** to remove barriers, prevent delays and enable superior outcomes
- Look for advantages under different conditions and contractual arrangements

**Cusimano, R. (2011). *Optimizing Jobsite Organization. Lecture*. Chicago, CII Annual Conference.**

# Repeating activities


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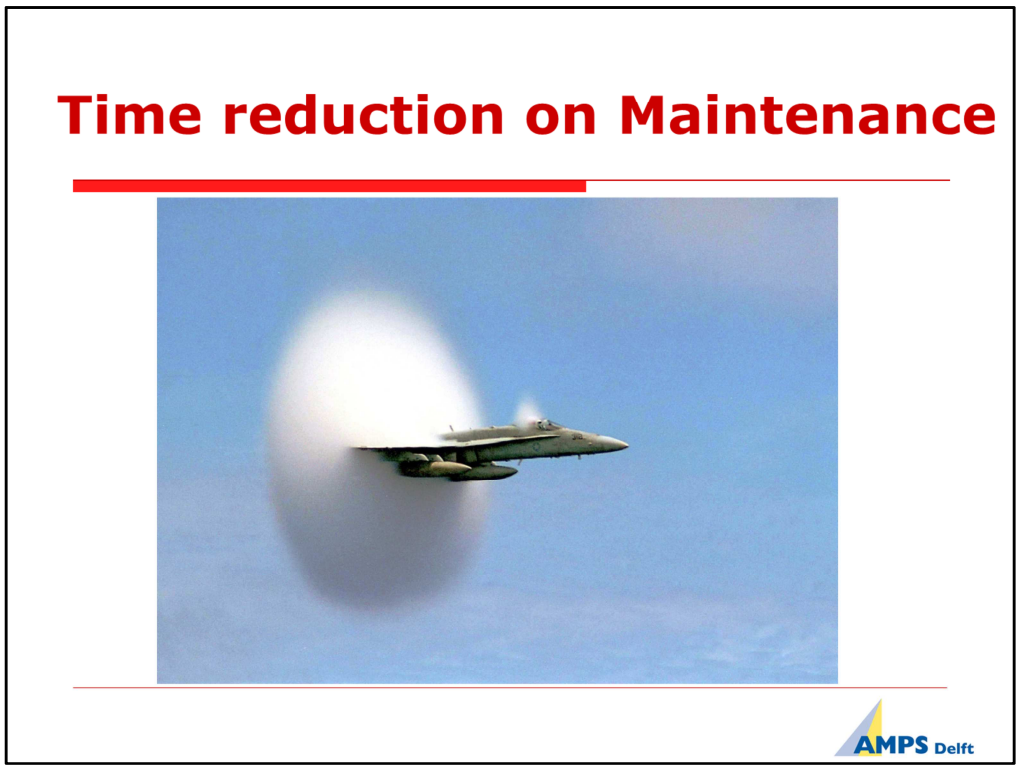
**Learning curve on repeating activities**

Installation of multiple units on offshore accomodation platform; Repeating activities, known as *High Volume Roll out*. In case of multiple repeating activities, it can be profitable to find out what kind of activites brings the most added value.

**Mulva, G.P. (2004). *ARIES – A THEORETICAL FRAMEWORK FOR EVALUATING ASPECTS OF ENTERPRISE SUSTAINABILITY*. Dissertation, Georgia Institute of Technology.**

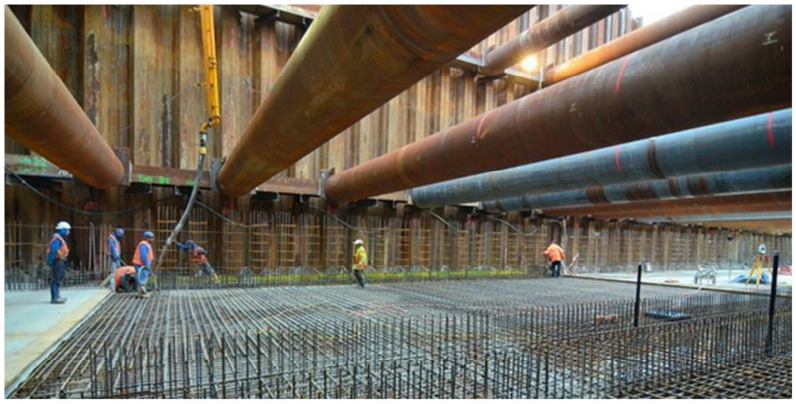



**Time reduction on maintenance**

Research at the Naval Post Graduate School at Monterey, California with the use of the simulation model, showed a possible time reduction of 25%. Main topics where Information exchange and the quality of Decision making.

**Hagan, J.J. and W.G. Slack (2006).** ***Employing Organizational Modeling and Simulation to Reduce F/A-18E/F F414 Engine Maintenance Time*****. Thesis, Naval Postgraduate School, Monterey, California.**

# Accelerated construction



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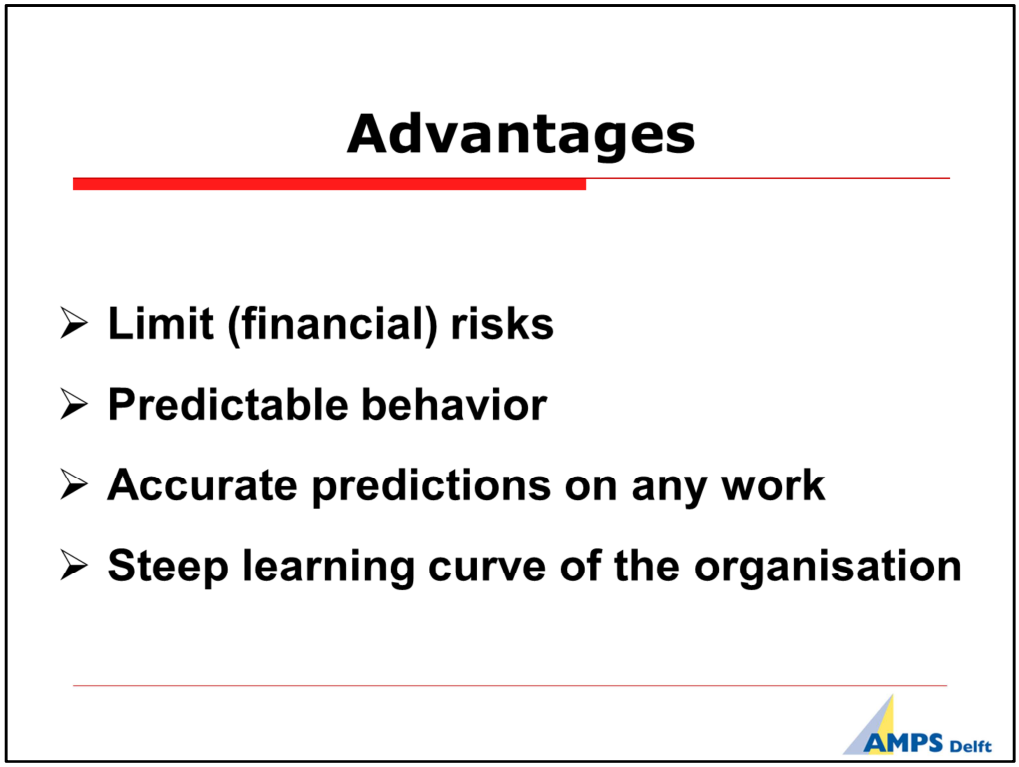
**How to accelerate with the same crew.**

Scenario tests on a major civil project within the Netherlands, showed a possibility to accelerate the construction, resulting in a reduction of approx. 30% of the total construction time. Supervision FTEs from already completed work, being part of the same project, were allocated to the last part of the project which enabled the project to accelerate.




**Steep learning curve enables**:

Possibility to test all kind of scenarios within a very limited time and within a safe environment.

# Any questions?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