

## **WIVE workshop**

Managing distributed innovation processes in  
Virtual Organisations by applying the  
Collaborative Network Relationship Analysis

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# Content

- Categories of innovation
- Case study for distributed innovation in VO
- Qualitative and quantitative methods to investigate collaborative relationships in distributed innovation processes
- Collaborative network relationship analysis
- Case study - revisited
- Conclusions

# Categories of Innovationen

Innovation:

Product innovation



I-Phone, IPOD

Process innovation



Global innovation processes (concept in US, manufacturing in China, test cases in several countries, etc.)

Service innovation



Automatic update of Podcasts

Business model innovation



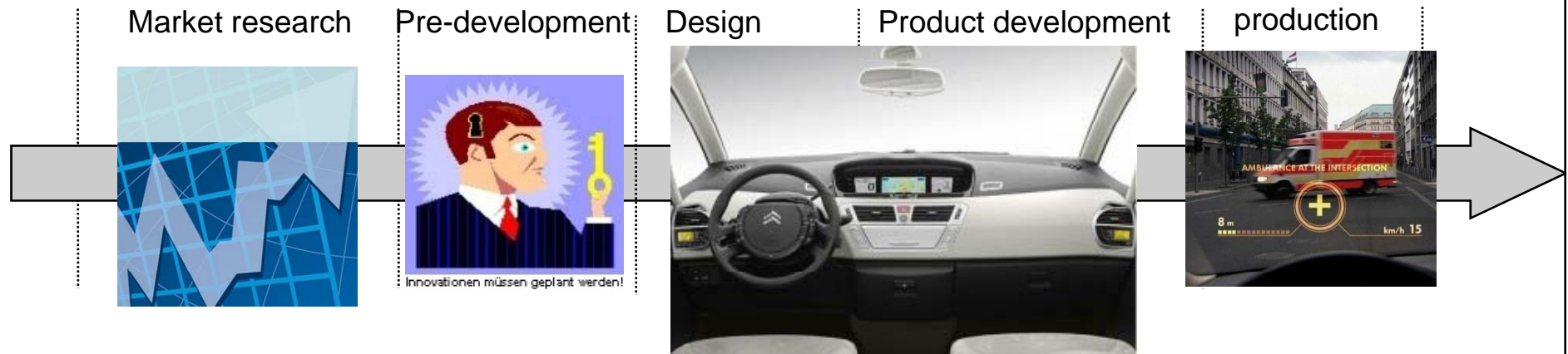
I-Tunes, platform for all types of new business ideas (talking books, radio stations, podcasts, ...)

Further models

technical Innovation, application innovation, empirical innovation, marketing innovation, structural Innovation

(Reference: Granig 2007, S. 197, Geoffrey 2004, S. 62)

# Example innovation project: Intelligent front mirror



## Main innovation:

Multi-touch governance of objects and information on an intelligent front mirror



## Situation:

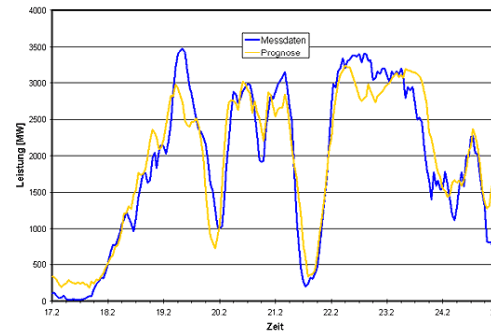
- 4 companies would like to collaborate (VO-oriented),
- Sharing competencies is key,
- Technological and organisational challenges and
- Is there a market for intelligent front mirrors (cost estimate: 1500-2500 Euros) ?

## Objective:

- Definition and analysis of needed, collaborative network relationships

# Analysis of collaborative network relationships

## Quantitative and qualitative methods



### Quantitative-oriented methods-measure

(Ellmann 2007, Rank 2003, Wald 2003, Wührer 1995, Jansen 2006, Abreu and Camarinha-Matos 2008, S. S. Msanjila, H. Afsarmanesh 2008, Wasserman/Faust 1994):

- Density of partner
- Centrality
- Inward-oriented relationships
- Outward oriented relationships
- Closeness to other partner,
- Benefit analysis
- Value systems and trust management

### Qualitative-oriented methods – estimate

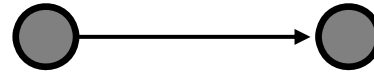
(Hollstein 2006, Eschenbaecher 2009, Jarimo And Korpiaho 2008, Wassermann and Fausst 2008):

- Triangulation
- Field research
- Interpretative procedures
- Open interviews
- Time series analysis
- Relationship analysis (collaborative networks)**
- Etc.

# Quantitative Network Analysis – various Indicators

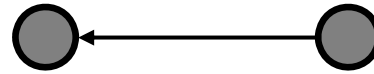
## Outward Orientation

(Rank 1998, Wald 2003,...)



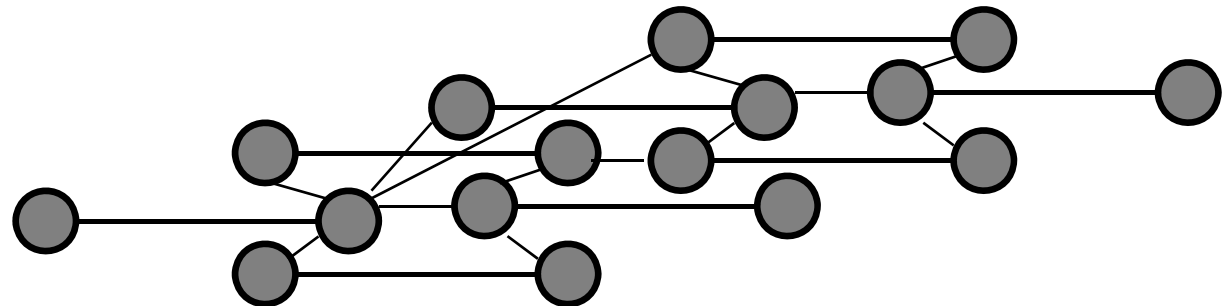
## Inward Orientation

(Renz 1998, Rank 2003, Wald 2003, ...)



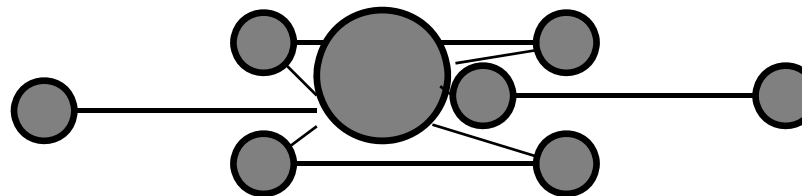
## Network Density

(Ellmann 2008)

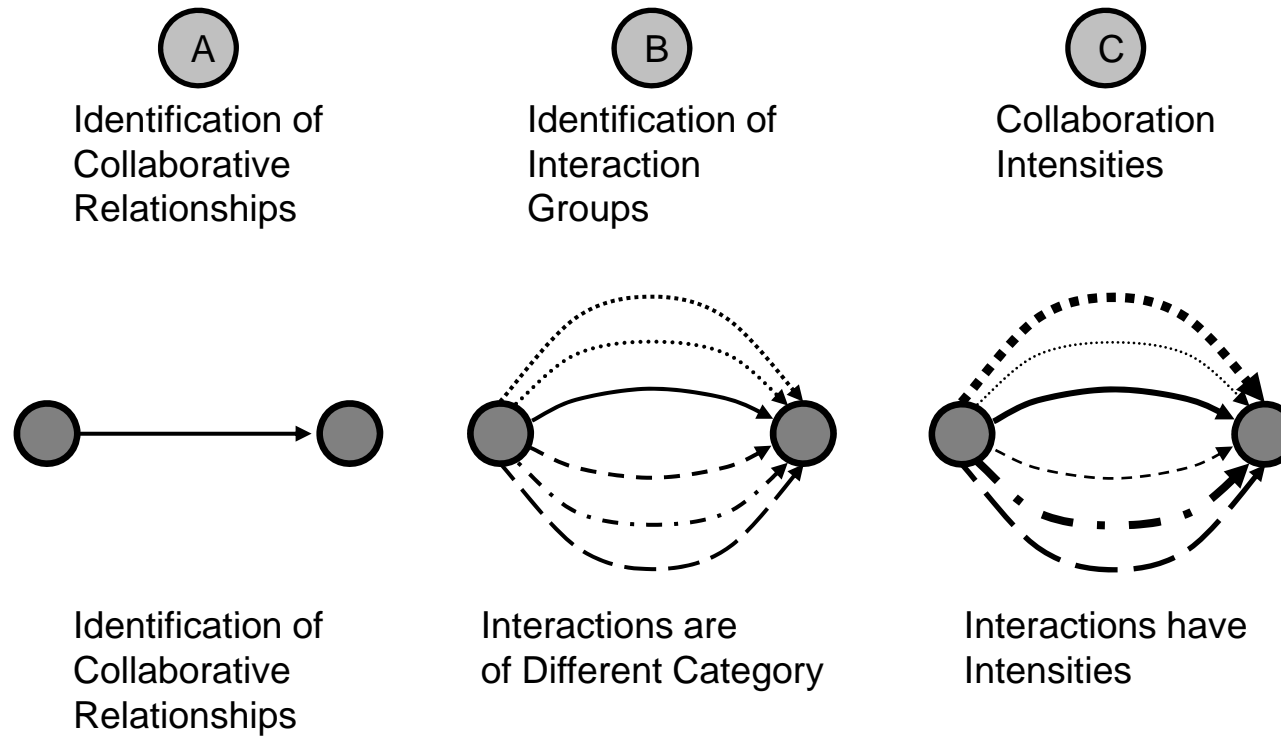


## Network Centrality

(Ellmann 2008)

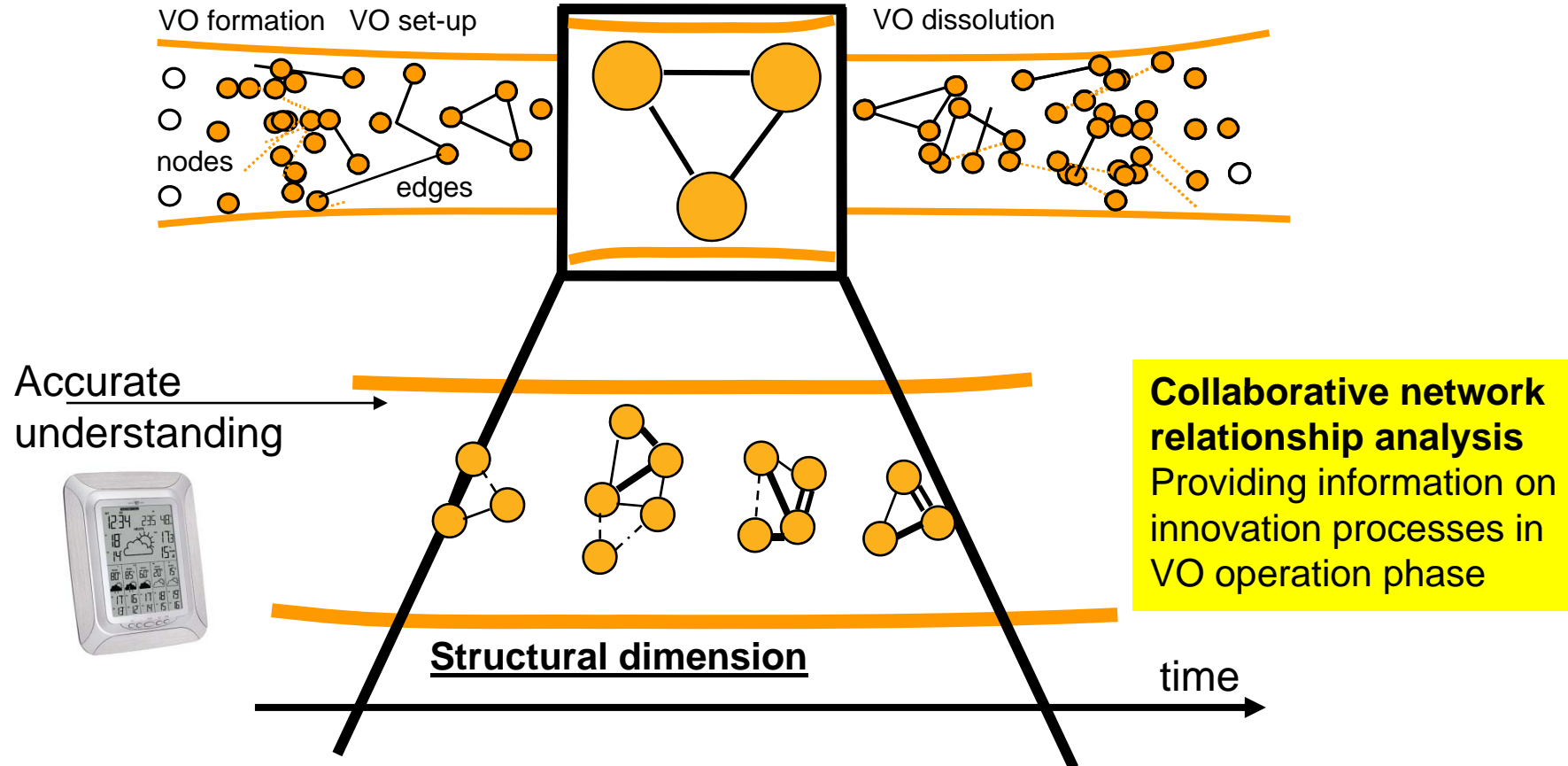


# Qualitative view: Collaborative relationships and intensities



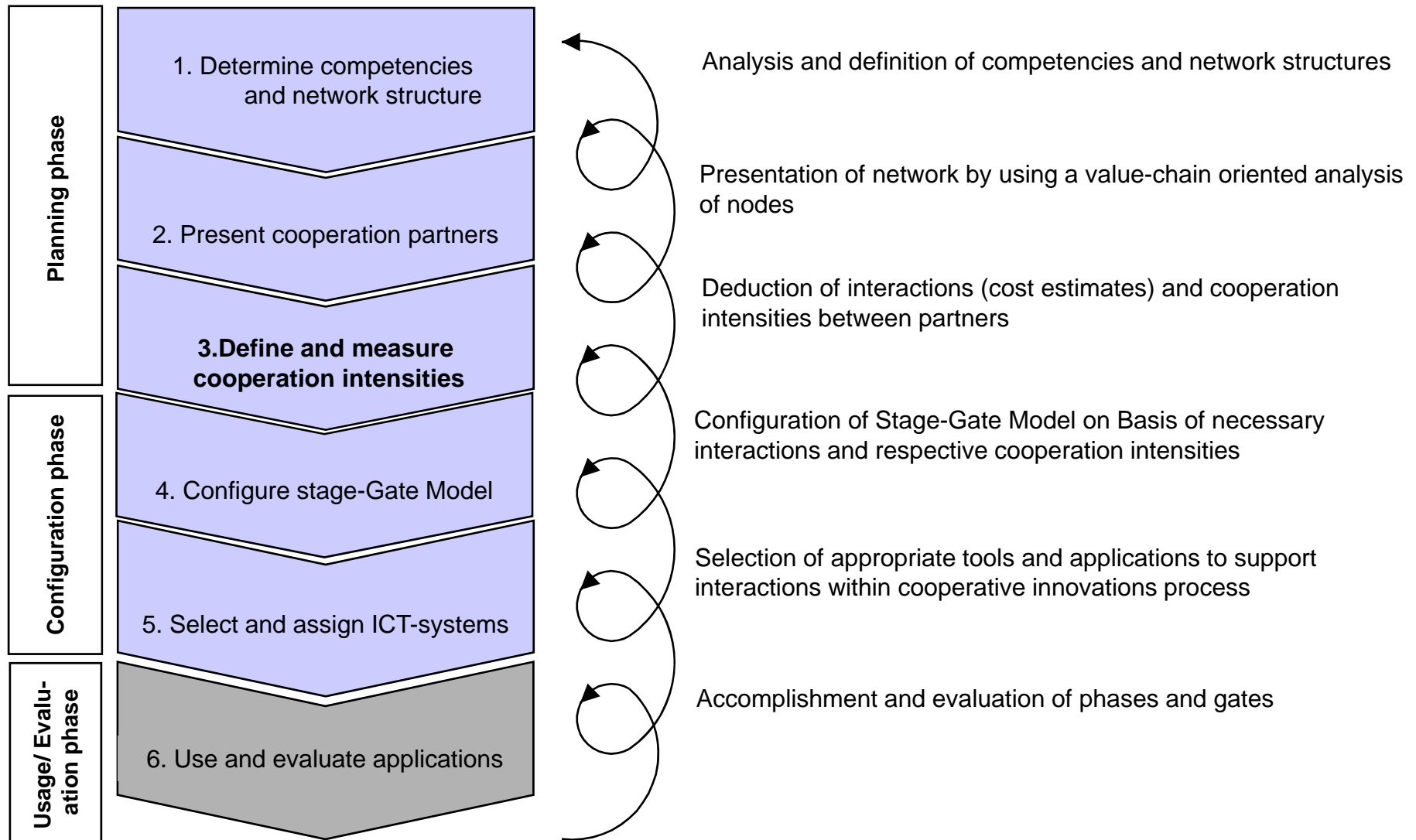
# Collaborative network relationship analysis

## Life-cycle



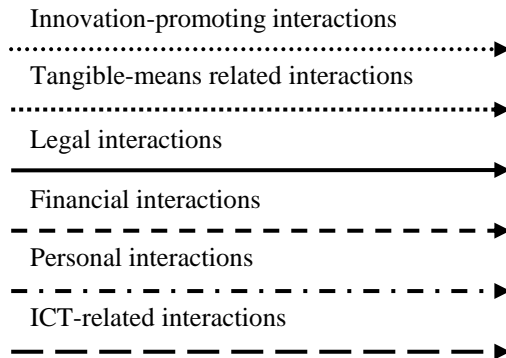


# Collaborative network relationship analysis

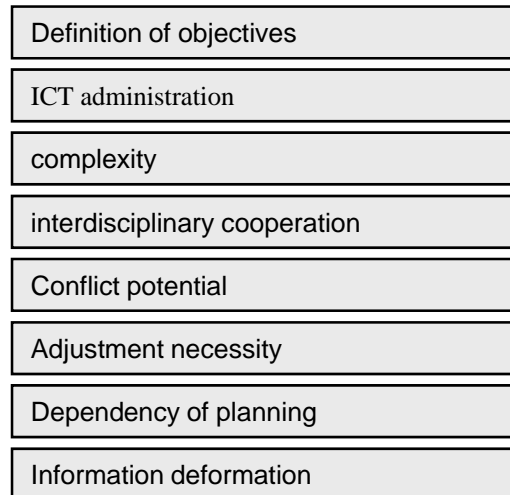


# Step 3: Method to define and measure collaboration intensities

Step 1  
Identification of Interactions and their Categories



Step 2  
Definition of Variables for each Interaction Group

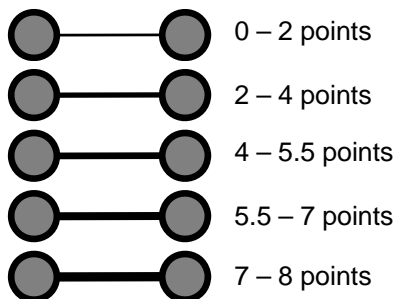


Step 3  
Investigation of the Collaboration Intensity

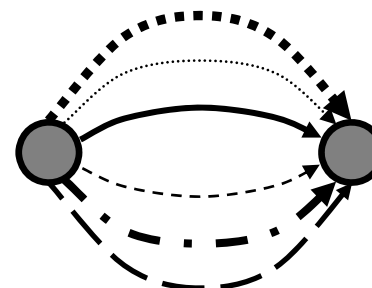
Estimate about cooperation intensity by using a scoring system:  
1 = difficult, 0.5 = medium, 0 = simple

Criteria	Interaction				
	I1	I2	I3	I4	I5
Definition of objectives	0	0,5	0,5	1	0
ICT management	0,5	1	1	0,5	0
Complexity	0,5	0,5	1	1	0,5

Step 4  
Specification of the Collaboration Intensity by application of steps 1-3



Step 5  
Identification of the Collaborative Relationships Based on the Evaluated Interactions



# Case revisited – main interactions

## Innovation-promoting interaction

- I1: Display technology
- I2: display contrast and brightness
- I5: Software concept
- I7: First prototype
- I13: Feedback by living labs

## Tangible means related interactions

- I3: Derating
- I8: pre-series models
- I10: technology test

## Legal interactions

- I14: patent management

## Financial interactions

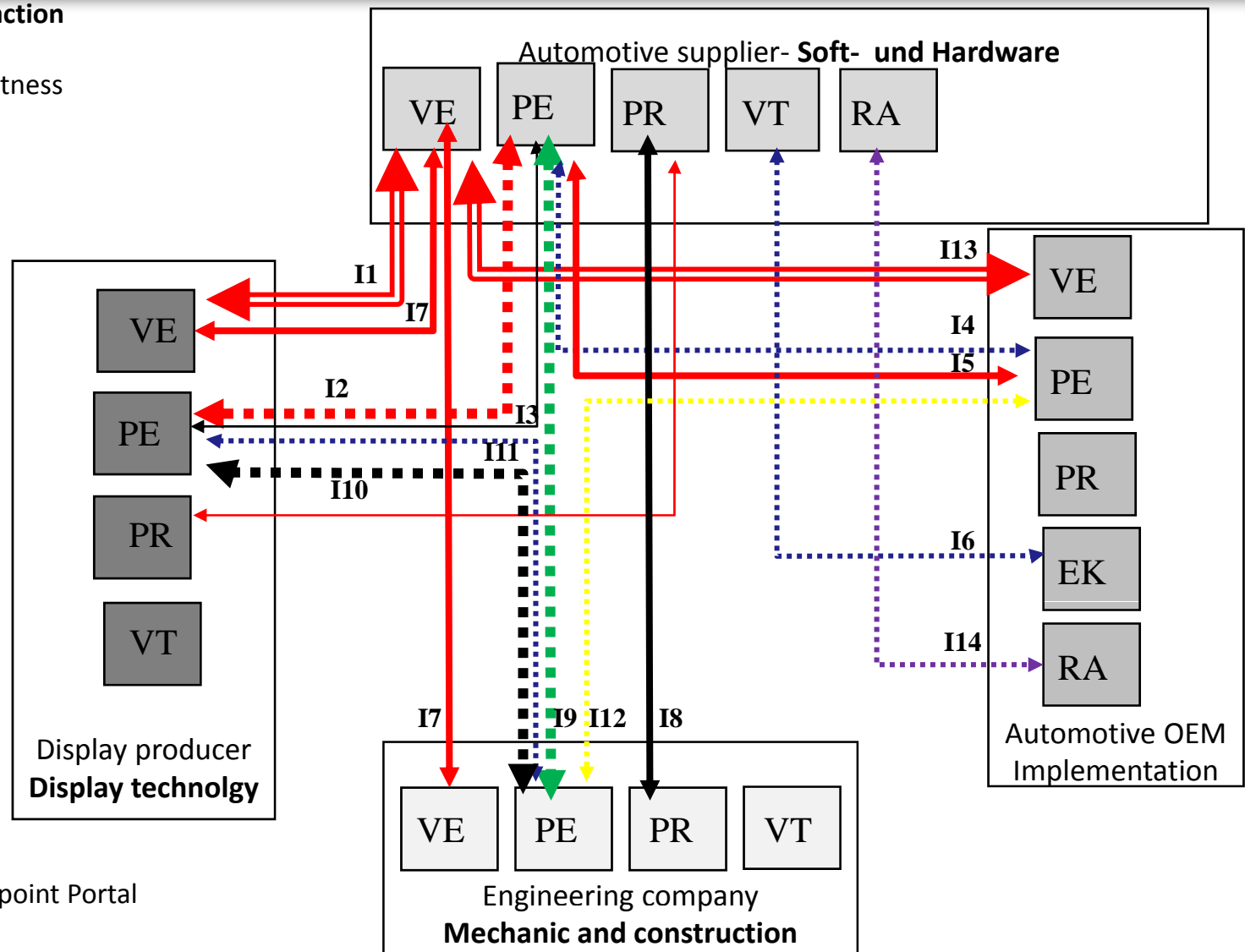
- I4: House Engineer
- I6: sample management
- I11: project controlling

## Personal interactions

- I9: exchange of experts

## ICT related interactions

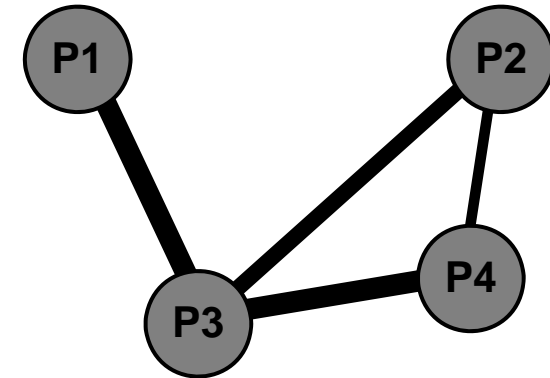
- I12: ICT infrastructure, Sharepoint Portal



# Collaboration Intensity – Example (1)

## Example – Basic Assumptions

- Project with 4 Partners (Nodes)




## Workplan

- 4 Tasks to be performed  
(effort in person-days, time in weeks)

	P1	P2	P3	P4	Totals	Start	Dur.
Task 1	20.0		12.0		32.0	0	4
Task 2		30.0	21.2		51.2	2	8
Task 3		14.0		10.0	24.0	6	6
Task 4			18.0	30.0	48.0	8	6

## Collaboration Intensity – Example (2)

Assuming equally distributed resources over the duration, the collaboration intensity can be calculated by dividing the totals by the duration of the task.



	P1	P2	P3	P4	Totals	Start	Dur.	Intens.
Task 1	20.0		12.0		32.0	0	4	8.0
Task 2		30.0	21.2		51.2	2	8	6.4
Task 3		14.0		10.0	24.0	6	6	4.0
Task 4			18.0	30.0	48.0	8	6	8.0

# Quantitative Network Analysis – Common Indicators

(Wassermann und Faust 1994, 2008, Knoke und Kulinski 2006)

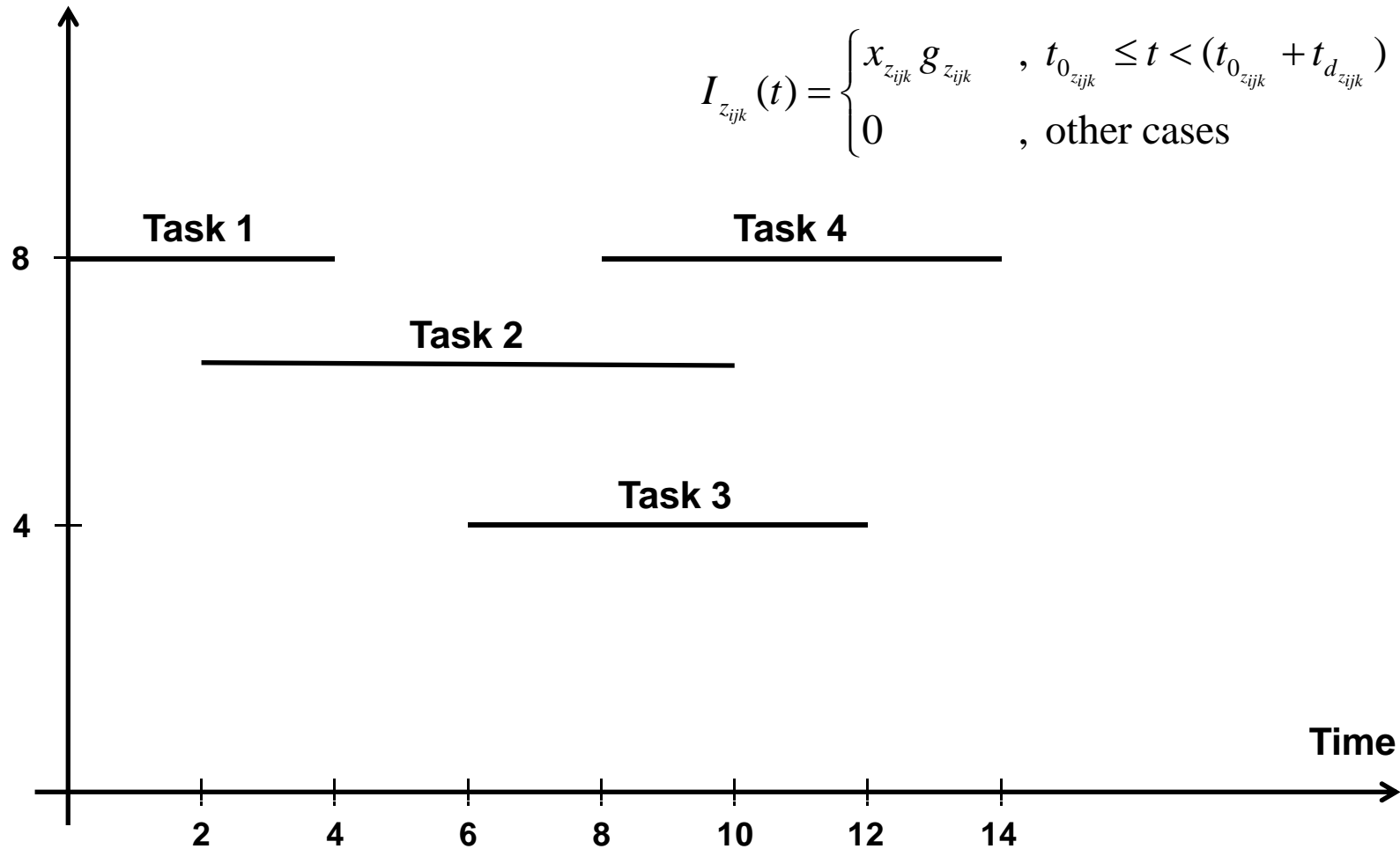
Outward Orientation (Rank 1998, Wald 2003,...)	$O_{Out_i} = \sum_{j=1}^N z_{ijk}, (i \neq j)$	$i$ index of actor $i$ $j$ index of actor $j$ $k$ network $k$ $N$ total number of actors in a network $k$
Inward Orientation (Renz 1998, Rank 2003, Wald 2003, ...)	$O_{In_i} = \sum_{i=1}^N z_{ijk}, (i \neq j)$	
Network Density (Ellmann 2008)	$D_k = \frac{1}{N^2 - N} \cdot \sum_{i=1}^N \sum_{j=1}^N z_{ijk}, (i \neq j)$	
Network Centrality (Ellmann 2008)	$C_i = \frac{\sum_{j=1}^N (z_{ijk} + z_{jik})}{\sum_{i=1}^N \sum_{j=1}^N z_{ijk}}, (i \neq j)$	

# Additional Symbols to develop collaboration intensity indicator

Symbol	Description
$\sum_{i=1}^N \sum_{j=1}^N z_{ijk}, (i \neq j)$	Number of considered Interactions
$z_{ijk}$	interaction $z$ (between the nodes $i$ and $j$ ) of category $k$
$x_{z_{ijk}}$	Collaboration intensity of interaction $z_{ijk}$
$t_{0_{z_{ijk}}}$	Starting point (in time) for interaction $z_{ijk}$
$t_{d_{z_{ijk}}}$	Continuity of interaction $z_{ijk}$
$g_{z_{ijk}}$	Weighting factor of interactions $z_{ijk}$
$x_{z_{ijk}} g_{z_{ijk}}$	Product of collaboration intensity and weighting factor of interaction $z_{ijk}$
$I_{z_{ijk}}(t)$	Intensity of interaction $z_{ijk}$ at point in time $t$
$C_{z_{ijk}}$	Cost of interaction $z_{ijk}$ during the duration $t_{d_{z_{ijk}}}$ of interaction
$c_{z_{ijk}}(t)$	Cost of interaction $z_{ijk}$ at point of time $t$

## Collaboration Intensity – Example (3)

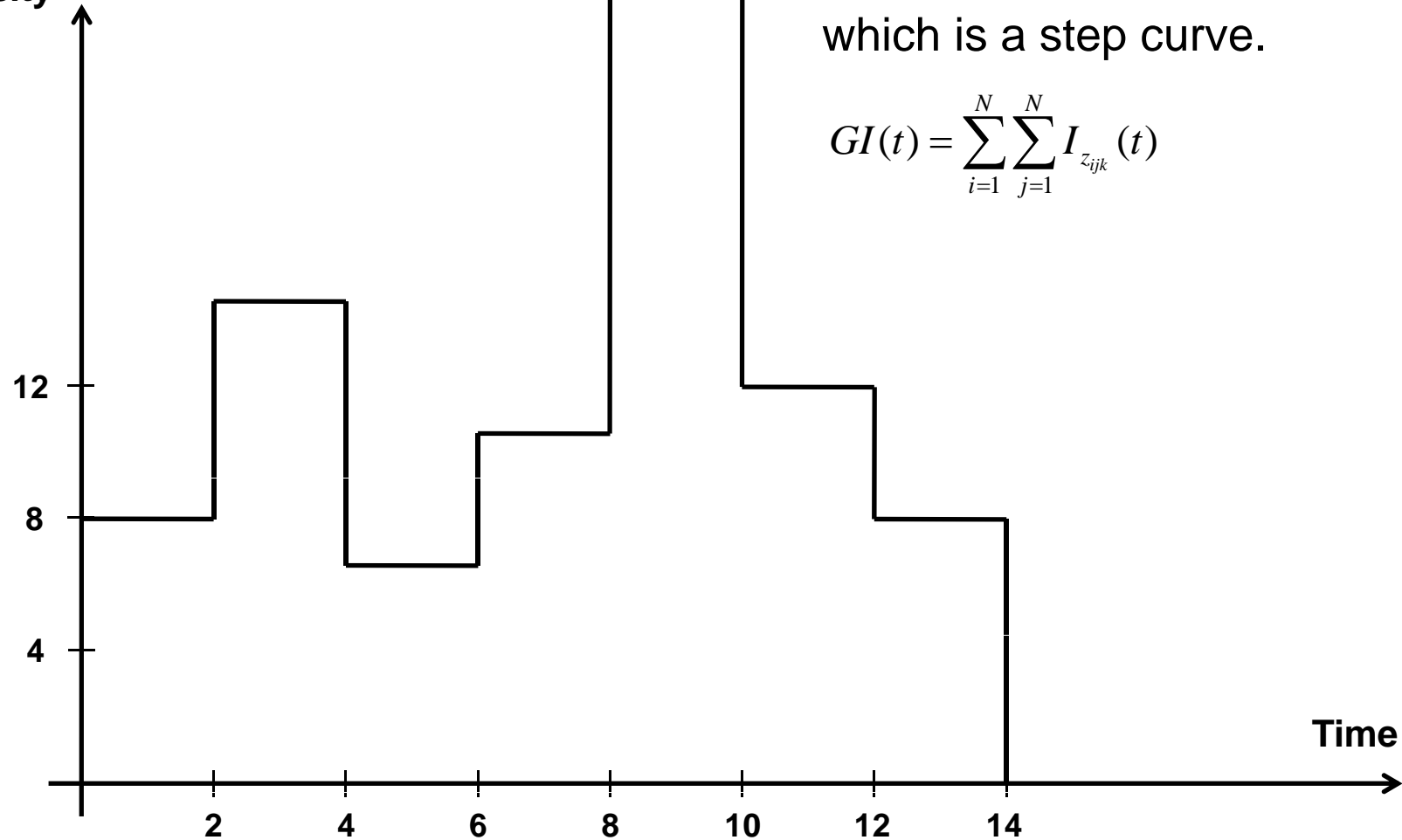
Intensity





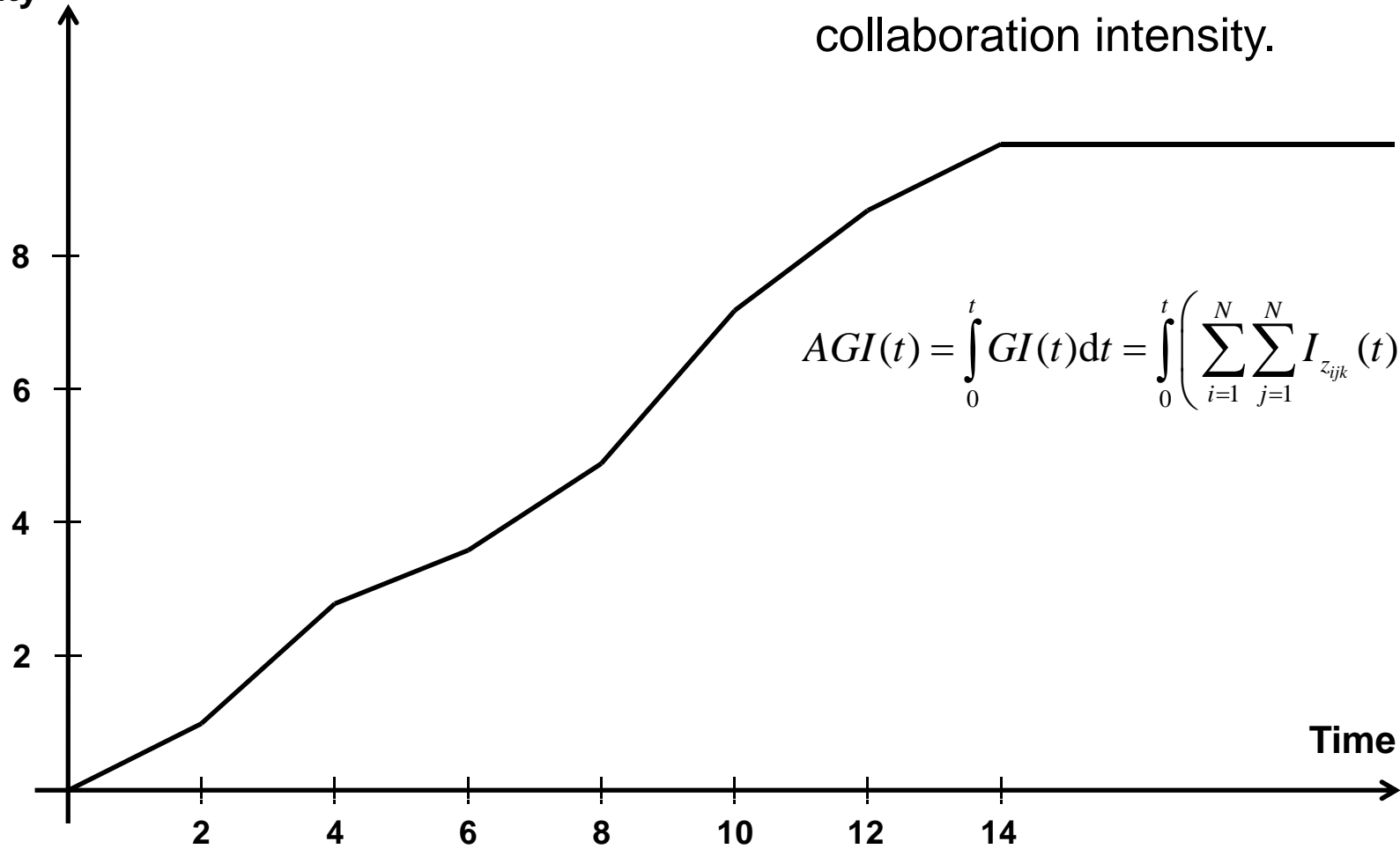
## Collaboration Intensity – Example (4)

Accumulated Intensity

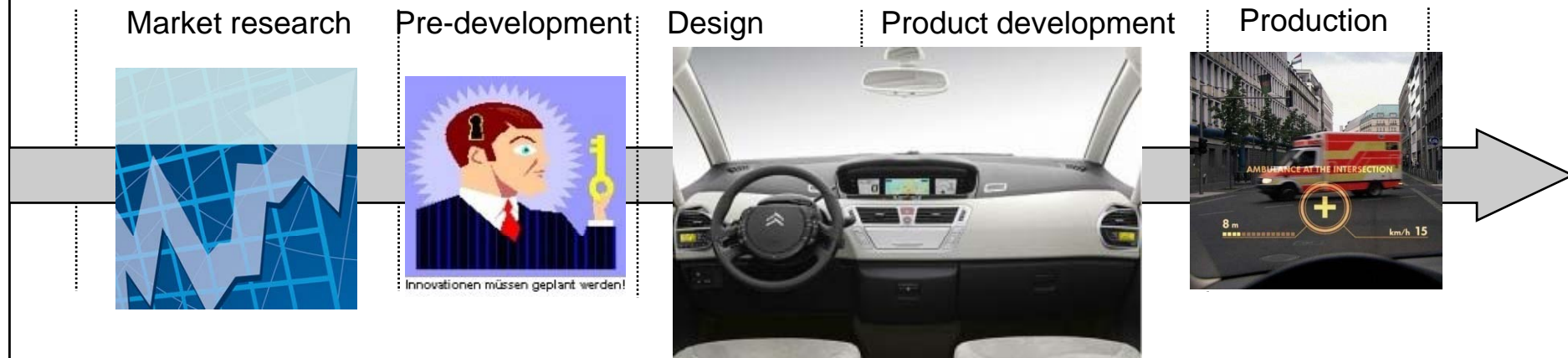


## Collaboration Intensity – Example (5)

Accumulated Intensity



# Example: Intelligent front mirror - revisited



The project **has been started without a collaborative network relationship analysis. Uncorrectly estimated work efforts in project management** led immediately to both cost increase and lead time delays.

Due to economic crises **innovation project is in hold position.**

The innovation project **budget has been substantially underestimated.**

## Conclusions and future outlook

Methods to support a more practical, qualitative **analysis of collaborative network relationships are yet not available in mature state.**

Current Research is focussing on the application of mathematical, quantitative models. These models are often **very static and they also imply a concrete understanding of real processes** which probably remains difficult.

The ideas of an indicator for analyzing collaborative relationships on information's delivered by managers can be seen as an attempt to **combine analytical methods with qualitative information.**

First steps in case studies show that the **specification of collaboration intensities supports analytical thinking**

In a next step the authors will try to **formalize the collaborative network relationship analysis by applying graph theory and media-richness theory.**

Thank you for your attention!

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