



# **Benefit-Cost-Calculation for increased bus interior material cost with respect to casualty reduction**

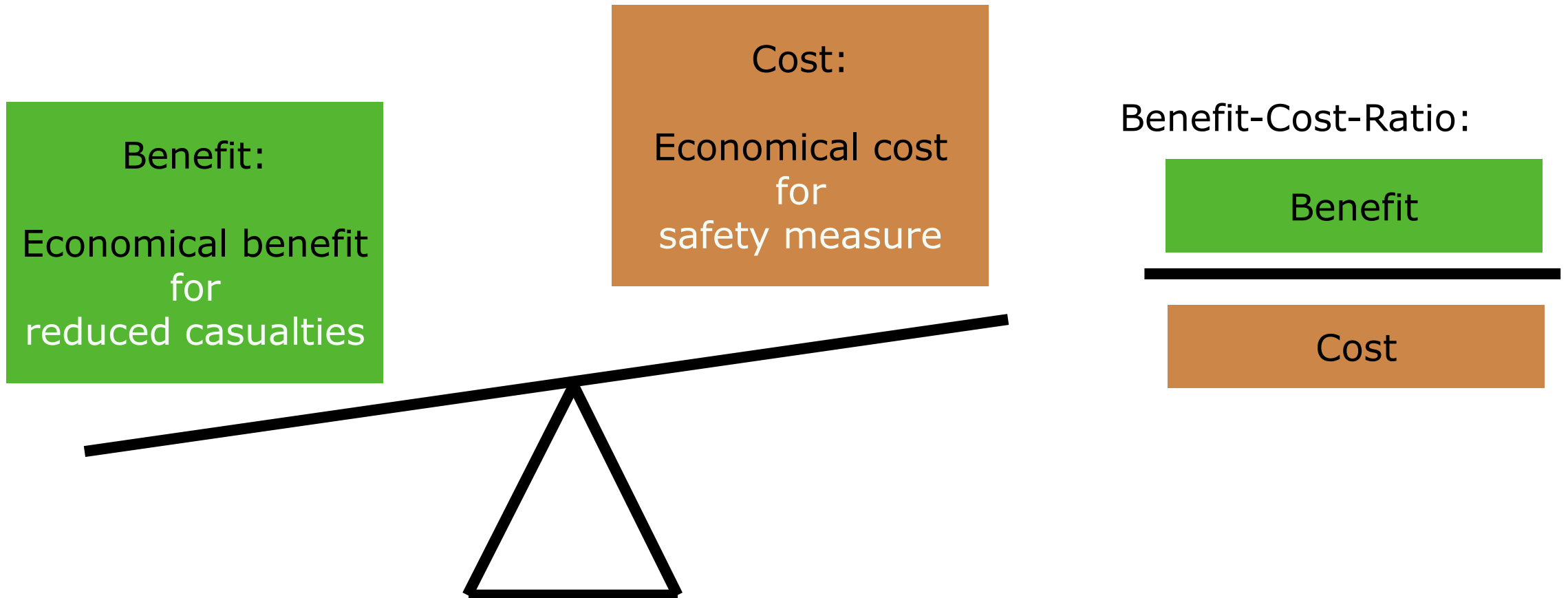
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# Structure of Presentation

- ➔ Concept of Benefit-Cost-Ratio calculation
- ➔ Benefit calculation: Costs per casualty
- ➔ Cost calculation: first assumptions
- ➔ Procedure for calculation
- ➔ BCR for increased material price
- ➔ Discussion and Incertainties

# Benefit-Cost-Ratio - Concept





# Benefit – Cost Values Per Casualty

## Total cost for accidents (Germany)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Kosten der Personenschäden	15,23	14,73	14,88	14,04	13,29	12,36	14,08	13,54	13,42	13,97	14,31	13,93	13,19
davon: Kosten für													
Getötete	5,46	5,16	5,08	4,64	4,14	3,73	4,72	4,18	3,95	4,03	4,13	3,74	3,66
Schwerverletzte	8,15	7,98	8,16	7,83	7,61	7,17	7,81	7,73	7,83	8,23	8,40	8,40	7,77
Leichtverletzte	1,62	1,59	1,64	1,57	1,54	1,46	1,54	1,63	1,65	1,71	1,79	1,79	1,76
Kosten der Sachschäden	16,25	16,22	17,09	16,96	17,23	18,07	18,05	18,57	19,08	18,80	20,13	20,35	21,04
Gesamte Unfallkosten	31,48	30,95	31,97	31,00	30,52	30,44	32,12	32,11	32,51	32,77	34,44	34,28	34,23

## Cost per Person and severity (Germany)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Fatalities</b>	1.018.064 €	1.013.326 €	1.025.067 €	1.035.165 €	996.412 €	1.022.401 €	1.177.980 €	1.161.892 €	1.182.126 €	1.191.397 €	1.191.937 €	1.164.328 €	1.150.234 €
<b>Severely injured</b>	105.476 €	106.758 €	107.837 €	110.506 €	110.571 €	114.020 €	112.834 €	116.151 €	121.776 €	120.921 €	123.510 €	123.964 €	116.335 €
<b>Slightly injured</b>	4.305 €	4.327 €	4.354 €	4.403 €	4.416 €	4.458 €	4.482 €	4.829 €	4.982 €	5.014 €	5.139 €	5.094 €	5.138 €

### Sachschadenskosten je Unfall

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Unfall mit Personenschaden								15.606 €	16.233 €	16.041 €	16.784 €	16.706 €	17.391 €
Unfall mit Getöteten	38.344 €	39.836 €	40.430 €	40.242 €	40.108 €	45.469 €	42.880 €	43.096 €	47.157 €	48.003 €	48.495 €	47.626 €	51.322 €
Unfall mit Schwerverletzten	18.386 €	18.890 €	18.892 €	19.436 €	19.215 €	20.637 €	20.400 €	20.782 €	21.646 €	21.883 €	22.756 €	22.889 €	23.994 €
Unfall mit Leichtverletzten	12.326 €	12.389 €	12.613 €	12.775 €	13.036 €	13.654 €	13.676 €	13.959 €	14.515 €	14.190 €	14.919 €	14.865 €	15.405 €
Schwerw. Unf. mit nur Sachsch.	17.884 €	18.281 €	18.500 €	19.035 €	19.365 €	19.843 €	20.442 €	20.808 €	21.484 €	21.484 €	22.369 €	22.114 €	22.839 €
Übriger SachschUnfall (einschl. Alkoholunfall)	5.277 €	5.337 €	5.435 €	5.550 €	5.643 €	5.729 €	5.839 €	5.951 €	6.095 €	6.040 €	6.208 €	6.086 €	6.177 €



# Benefit – Cost Values Per Casualty – Alternative values (as used in other countries)

**Tabelle 42: Spezifische Schadenskosten für Personenschäden [€/Person]**

<b>Kostensätze</b>	<b>Fatalities Getötete</b>	<b>Severely injured Schwerverletzte</b>	<b>Slightly injured Leichtverletzte</b>
Ressourcenverzehr	1.161.892	116.151	4.829
Risk-Value-Komponente	1.319.104	171.484	13.191
<b>Gesamtkosten</b>	<b>2.480.996</b>	<b>287.635</b>	<b>18.020</b>

# Cost Assumptions

- ⇒ What is the effect of new material on bus cost?
- What is a typical bus price? → 500 k€?
  - What is the ratio bus cost to bus price? → 20%?
  - What is the share of interior material on bus price? → 20%
  - What is the increase of material price for new material? → 150%
  - What is the number of busses in Germany? → 80.000 coaches?
  - What is the typical bus lifetime? → 20 years?



- ➔ Annual bus fire casualties
- ➔ x annual cost for bus fire casualties = **Benefit p.a.**
- ➔ Bus price
- ➔ x bus price-cost-ratio
- ➔ x Share of interior material on bus cost
- ➔ x Percentual increase of material cost
- ➔ x Number of busses in Germany
- ➔ x Efficiency in reduction of fatalities
- ➔ / lifetime of bus = **Cost p.a.**
- ➔ **BCR = Benefit p.a./Cost p.a.**
- ➔ BCR should be  $> 1$  for societal benefit.



# First Results for BCR

(without discounting, for 100% efficiency)

Cost	Price per Coach	500.000,00 €		Assumed
	Price/Cost Ratio	0,20		Assumed
	Share of Material on Coach cost	20%	20.000,00 €	See BMFE-07-09e
	Number of coaches in Germany	80000		From official statistics
	Material cost in Germany	1.600.000.000,00 €		calculated
	<b>How much more is the material cost?</b>	<b>150%</b>		Lowest number in BMFE-06-13-r1
	Total increased cost in Germany	800.000.000,00 €		calculated
	Lifetime of a bus	20	years	Assumed
	Annual increased cost in Germany	40.000.000,00 €		
Benefit	Number of fatalities p.a.	10		Assumed
	Cost per fatality	2.500.000,00 €		Official figures
	Annual Benefit	25.000.000,00 €		calculated
	<b>BCR</b>	<b>0,63</b>		calculated



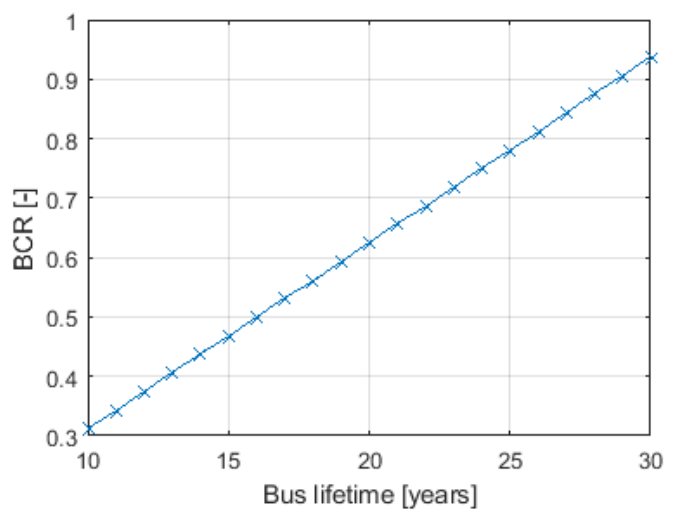
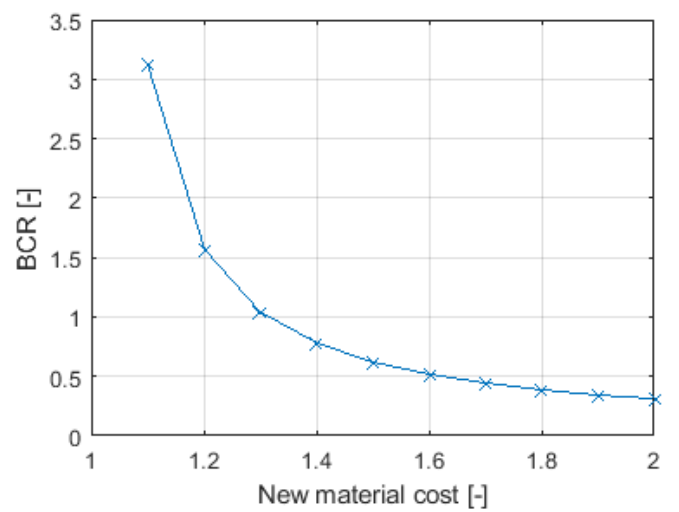
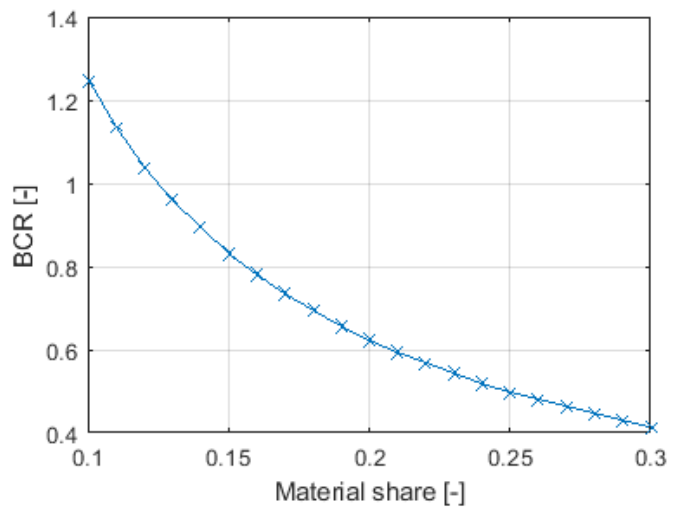
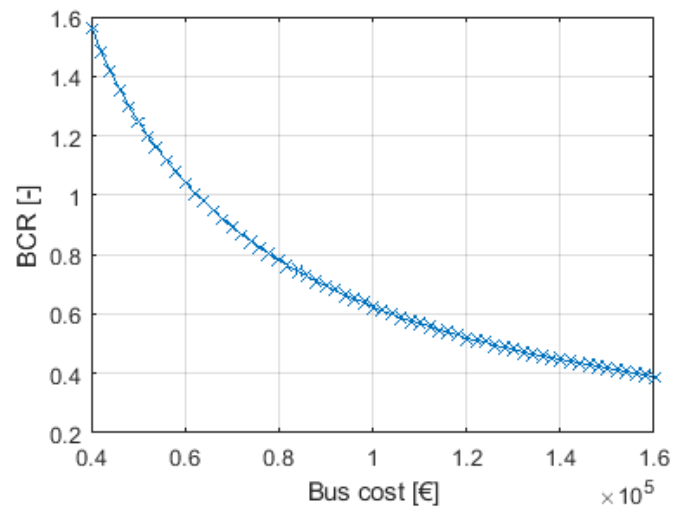


## Benefit Calculation - Efficiency

- ➔ Following calculations assume a 100% efficiency of the measure
- ➔ Measure: Smoke gas toxicity limitation
- ➔ Will this measure save 100 % of the casualties?
- ➔ If not, expected efficiency has an effect on BCR!

# Discussion and Incertainties

- ⇒ Unclear / hard to find numbers:
  - Material cost increase
  - Share of material cost on bus price
  - Bus price / costs
- ⇒ Efficiency of measure to reduce fatalities
- ⇒ Sensitivity analysis!

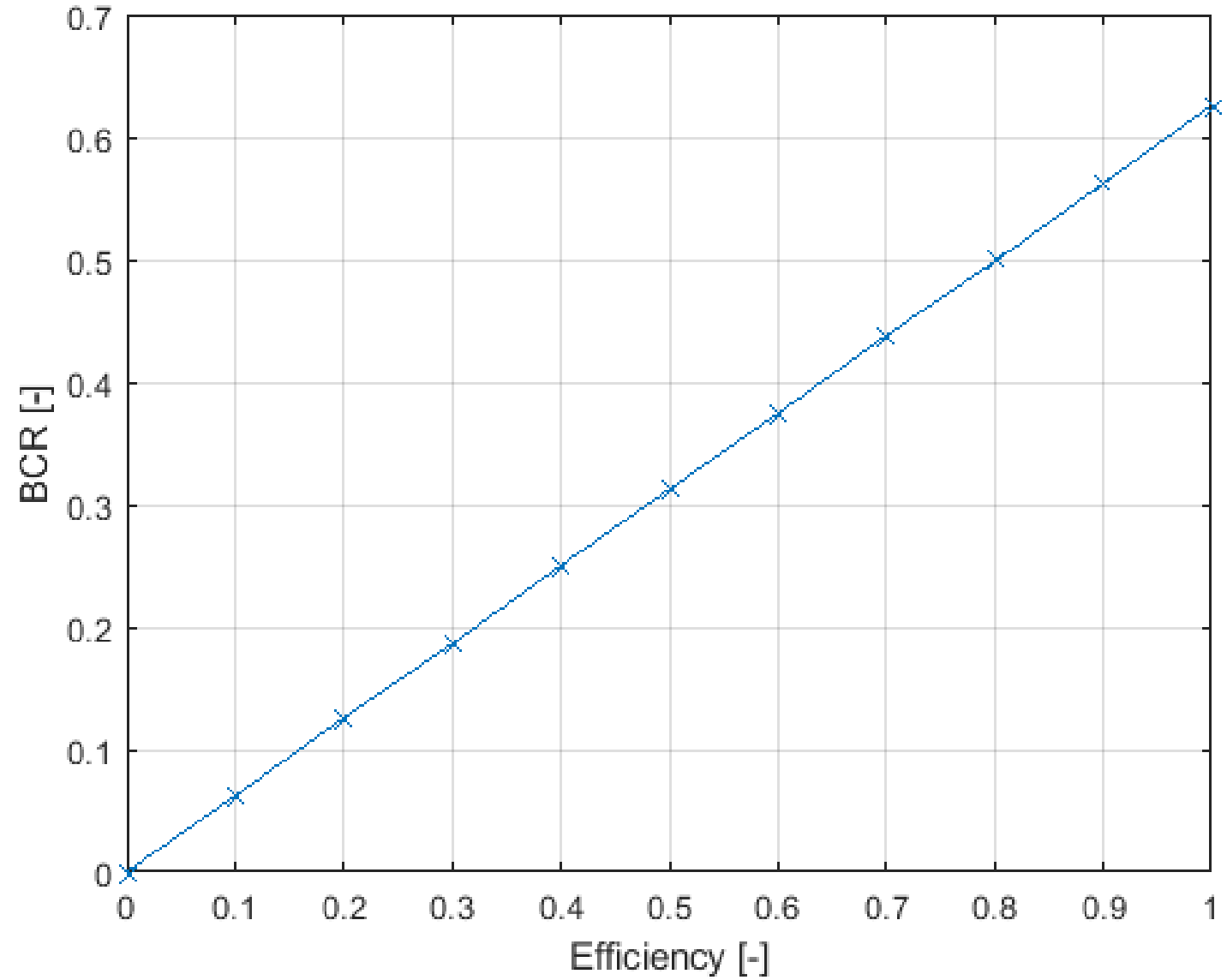


## Base numbers:

- 10 fatalities p.a.
- Severely, slightly injured neglected
- Bus price 500 k€
- Bus cost 100 k€ (20%)
- Int. material share 20%
- New int. material cost 150%
- Bus lifetime 20 years
- **100% efficiency!**



# Effect Of Efficiency





## Conclusion

- ➔ A BCR calculation (no discounting, 100% efficiency) has been carried out
- ➔ Based on the assumptions discussed in BMFE-07 and BMFE-06, BCR is  $\ll 1$
- ➔ BCR value sensitive to assumptions and efficiency
- ➔ For a robust BCR estimation, valid numbers should be agreed on



## Update for 9th meeting

- ➔ Is there a chance a different material might be able to fulfill the BCR calculations?
  - BCR says: X fatalities per year, and this results in Y € cost per year
  - A technical measure that saves X fatalities therefore could cost Y € per year to be efficient
  - Will a different material significantly decrease the number of fatalities per year?
- ➔ What values for the BCR can be agreed upon?
  - Please all provide feedback in four weeks time as to where you see the values taken into account in 08-09 (both documents) are inappropriate.