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Simulation Based Experiments for Testing the Balanced Scorecard's Built-in Performance Improvement Theory

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Oxford, 26th July 2004

Research Question

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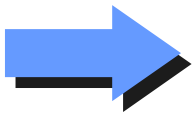
- “In our view, the balanced scorecard is among the most significant developments in management accounting and, thus, deserves intense research attention.”
  (Atkinson et al. 1997)
- "The primary research question arising from the use of nonfinancial measures and the balanced scorecard is the net economic benefits from these measurement practices.”
  (Ittner and Larcker 1998)



Does the balanced scorecard really improve organisational performance?

Current State of Research

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- “Surprisingly little research has been conducted on the implementation or performance consequences of the balanced scorecard concept, despite widespread practitioner interest in the subject.”
  (Ittner and Larcker 1998)
- "Given its high profile, surprisingly little academic research has focused on either the claims or the outcomes of the BSC.“
  (Malina 2001)
- Since Kaplan and Norton (1992) only 13 empirical research studies in German and English literature have been published:
  - 1 archival study
  - 10 survey studies
  - 2 experimental studies

Shortcomings of Existing Empirical Research Studies

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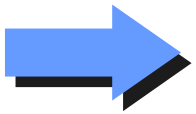
- Poor Representativeness
  - Dubious sampling of organisations/participants included in the study
  - Insufficient feedback/low response rate
- Survey Biases
  - Authored or sponsored by firms offering consulting services
  - Highly subjective measurement of balanced scorecard usage/implementation and organisational performance
- Insufficient control of independent variables and other factors makes causal inference difficult or impossible.



Research design chosen: Laboratory experiment

Transforming the Research Question into an Operational Scientific Hypothesis

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Question: Does the balanced scorecard really improve organisational performance?

H_1: If the management of an organisation uses a balanced scorecard as management and controlling system, the organisation's performance will increase.

H_{1O}: Participants in the laboratory experiment using a balanced scorecard as management and controlling system will perform better than participants using traditional reports as management and controlling system.

Setting of the Experiment

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- Participants in the experiment are given the role of a managing director of a recently founded restaurant business – Happy Family Restaurants (HFR).
- HFR's business concept, strategy and environment are described in detail in a 13-page case-study.
- The experiment is conducted as a computer aided simulation experiment .
- A specifically developed simulator, which is similar to the Beefeater Restaurants Microworld, is used.
- The task of the participants is to make HFR's strategy a success by deciding on
  - 9 variables $\Rightarrow$ high-complexity setting
  - 4 variables $\Rightarrow$ low-complexity setting
- Given time span: 90 Minutes. Unlimited number of simulation runs.

The Happy Family Restaurant Simulator Interface

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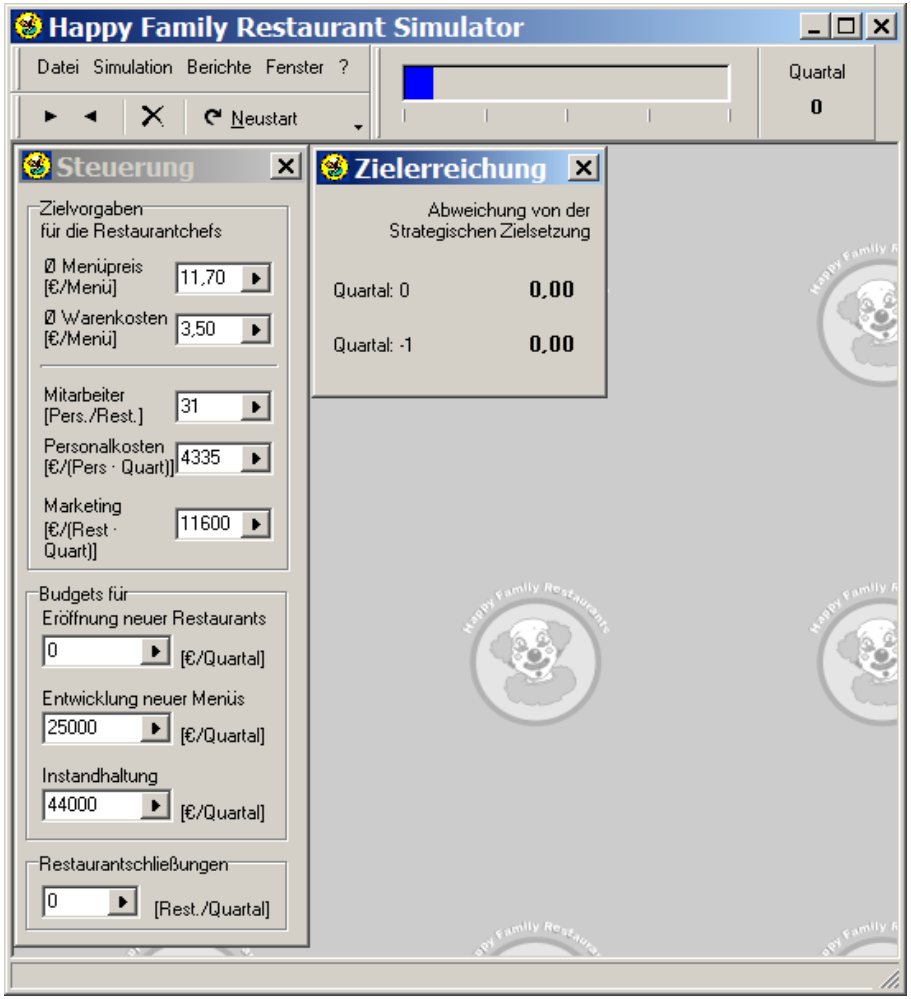
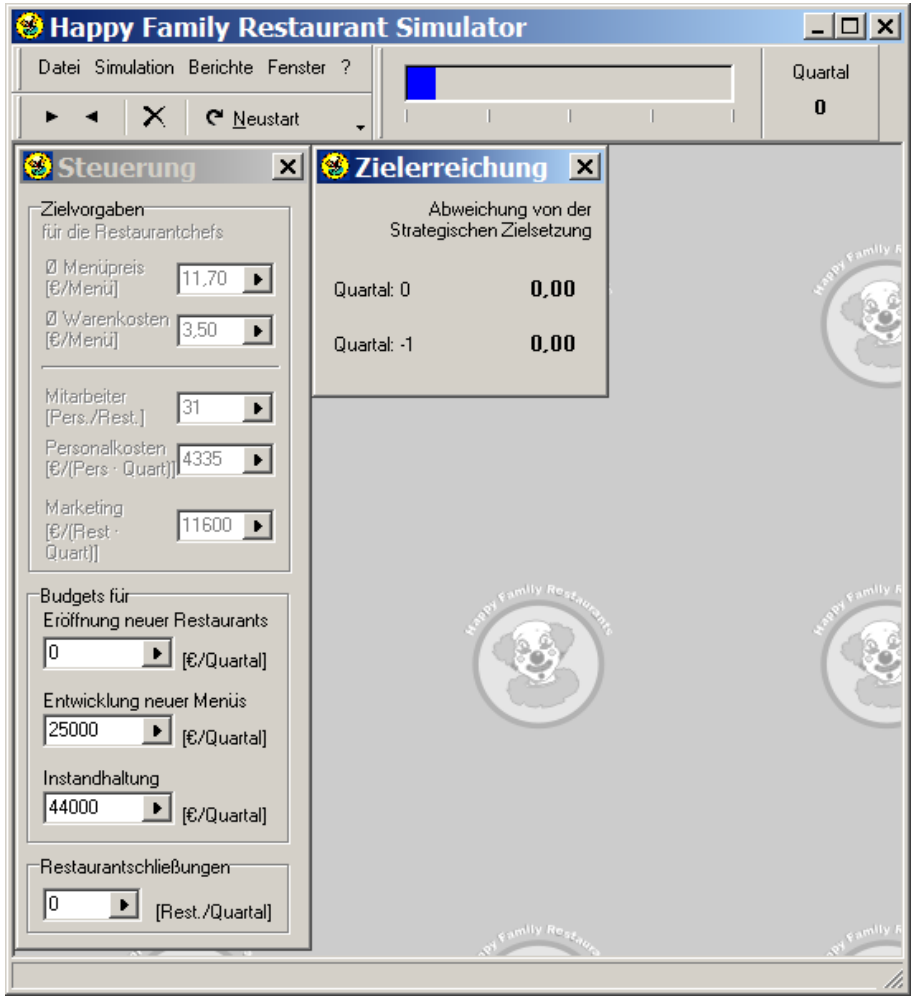


High-complexity setting



Low-complexity setting

Randomized, Pretest-Posttest, Control-Group Design

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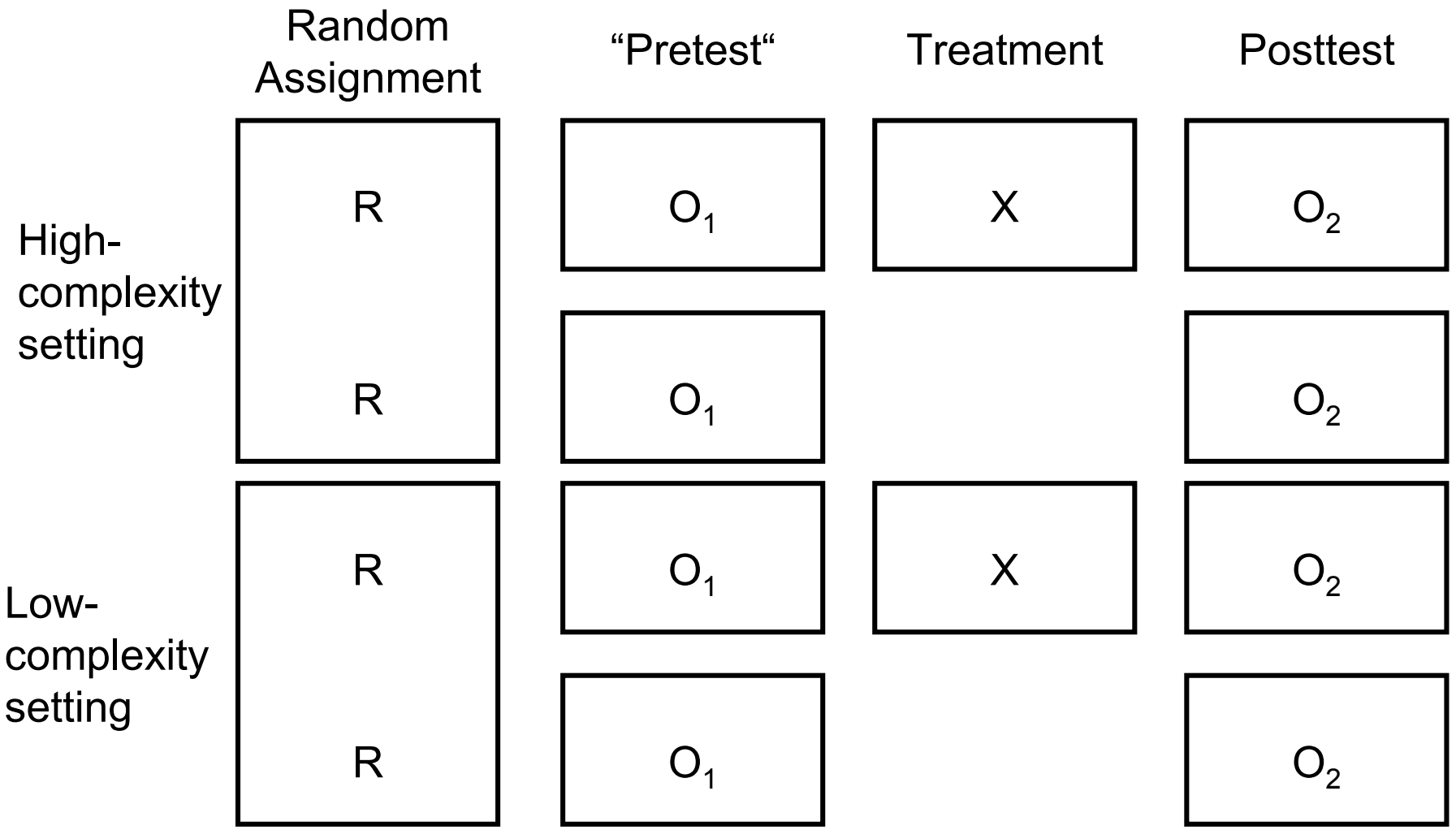
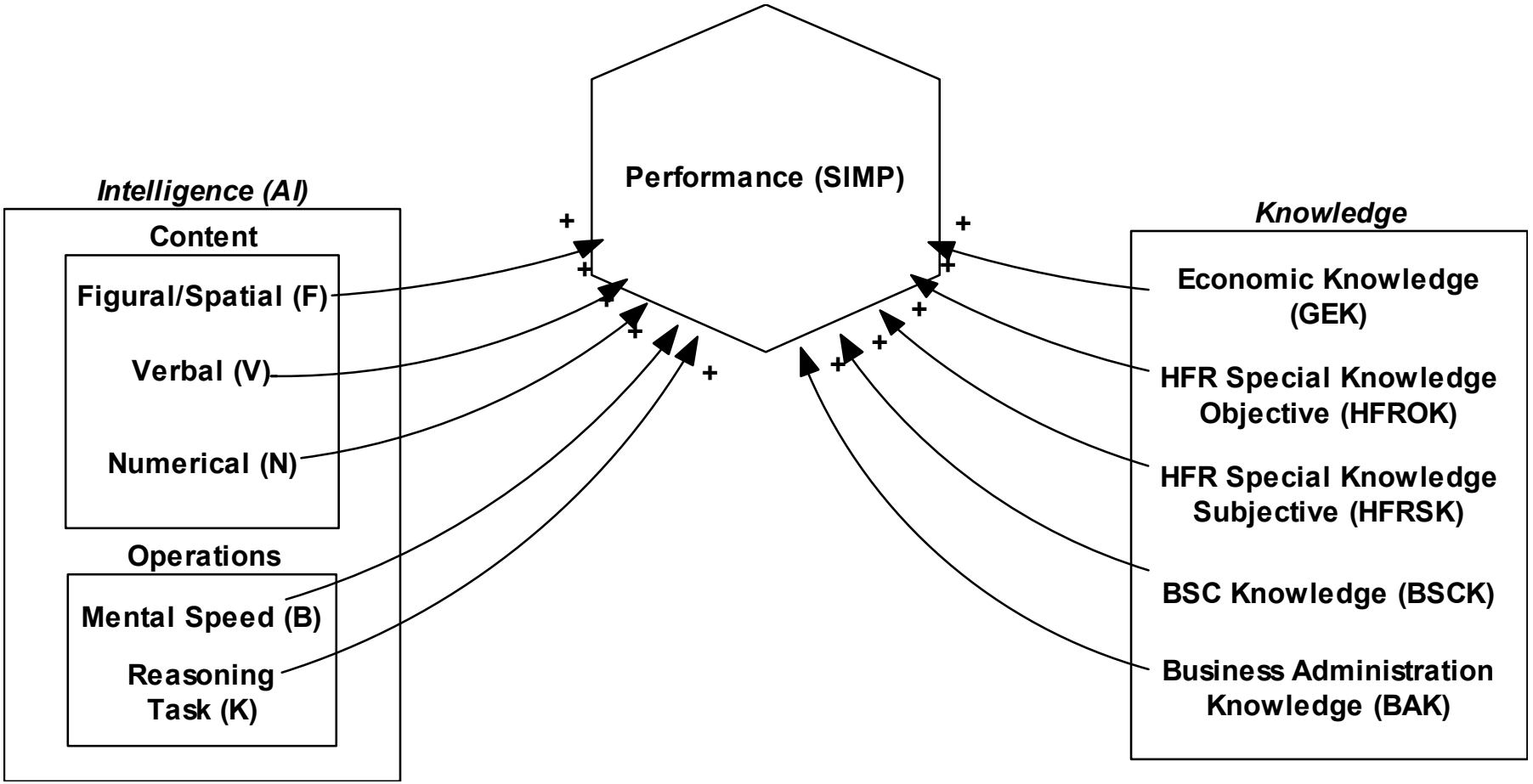


Parameters Controlled in the Pretest



Treatment for the Experiment Group: BSC as Information System

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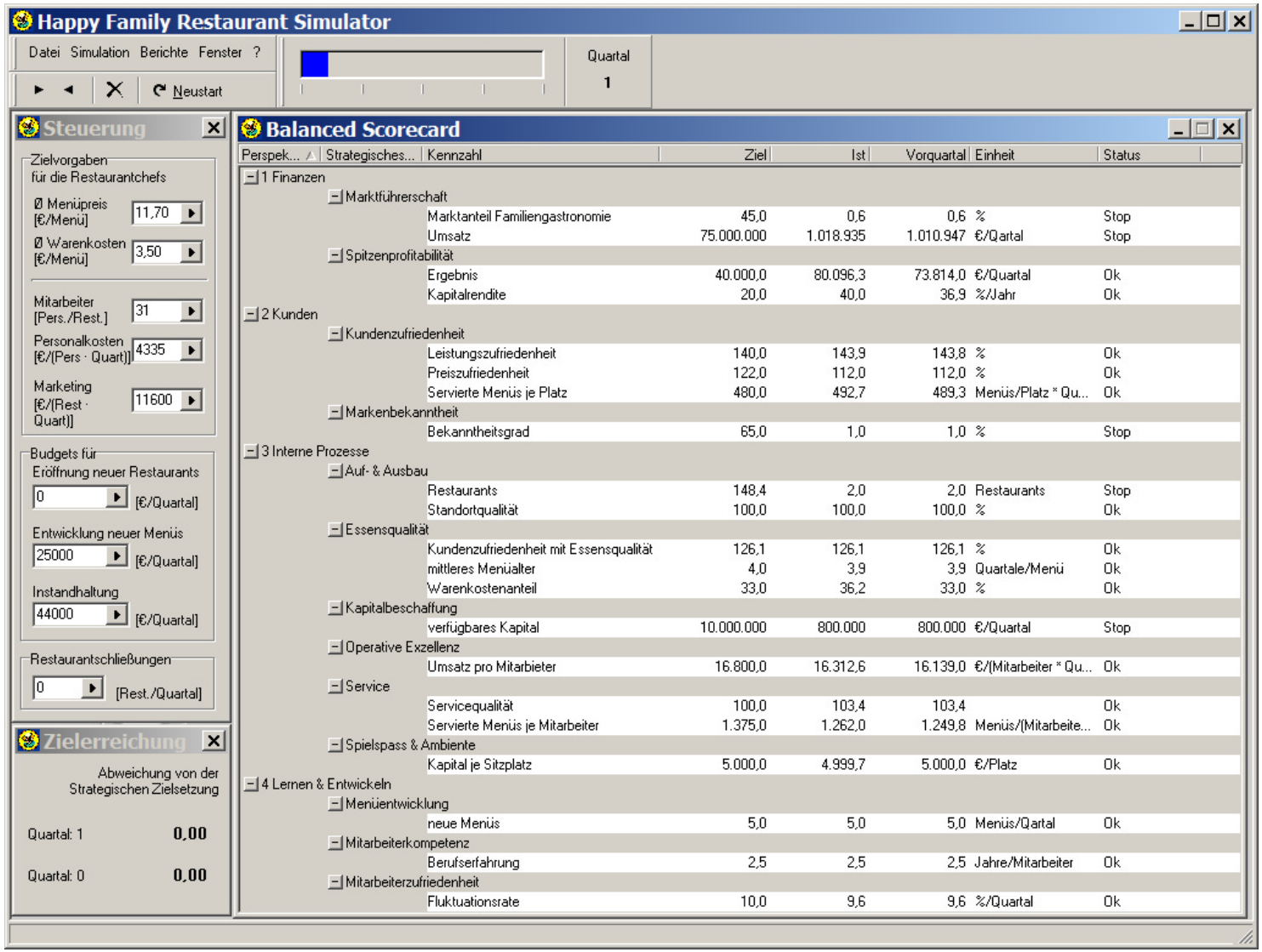

Treatment for the Control Group: Traditional Reports

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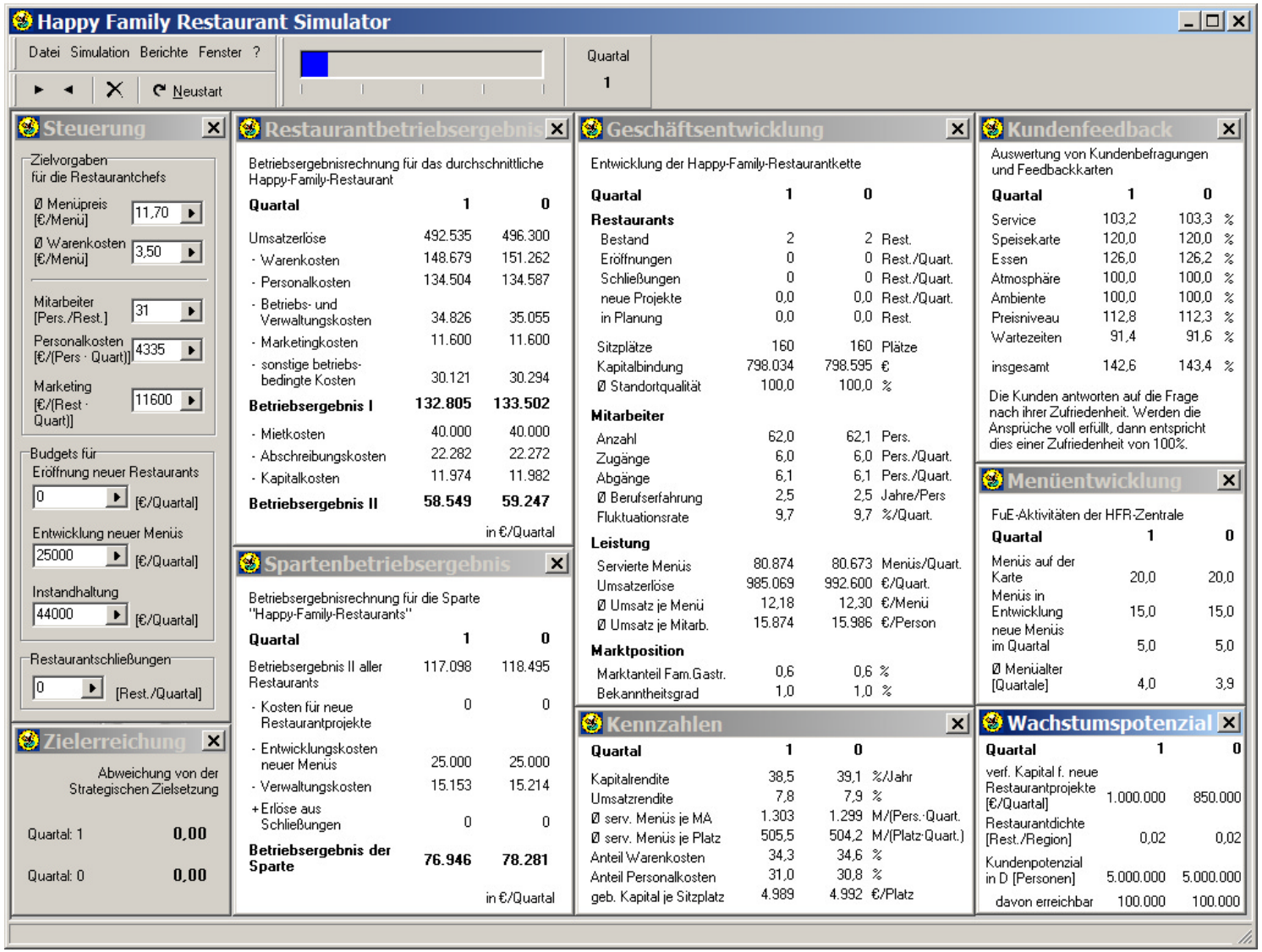

Posttest
Measuring Performance

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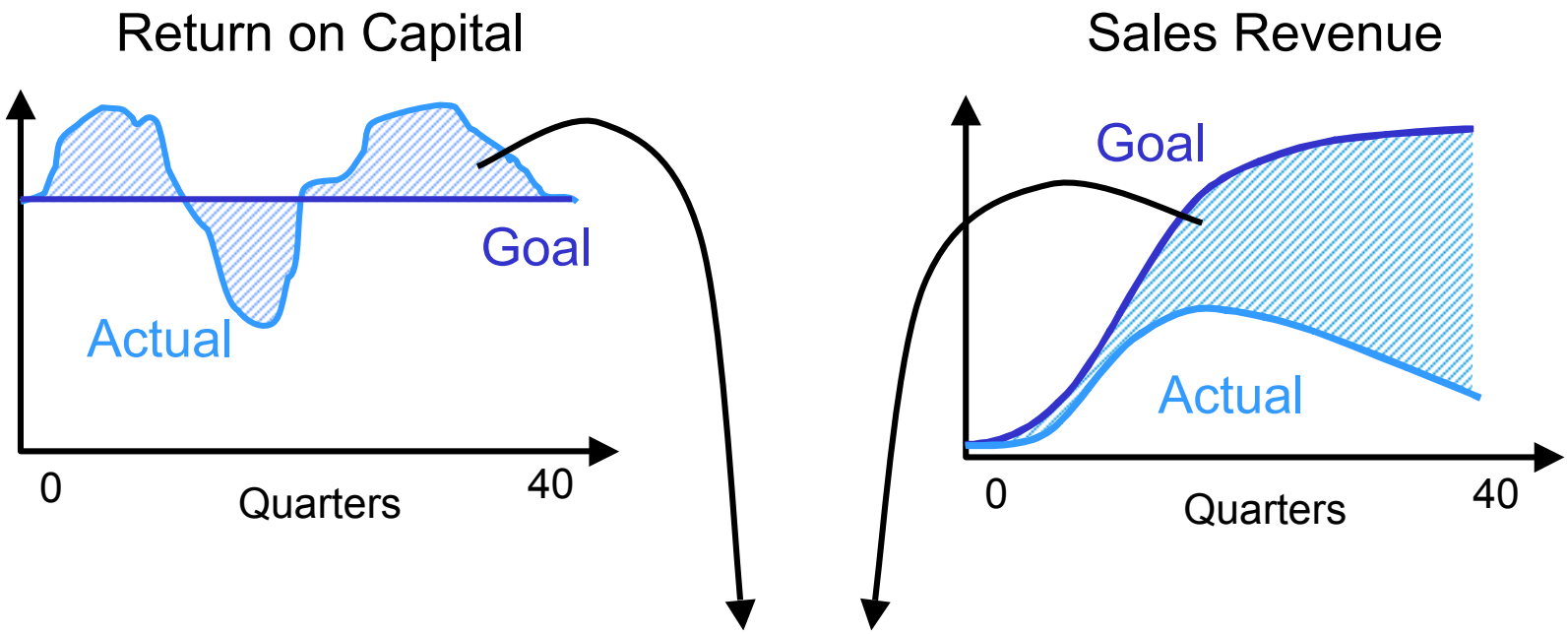

Weighted average of cumulated fractional deviation between goal and actual outcome

⇓

SimP

Implementing the Research Design

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Complexity	Experiment	Date	Treatment	No. Participants	Total
1 (High)	2	27/05/2003	BSC	14	
			Reports	11	25
	3	03/06/2003	BSC	12	
			Reports	13	25
	4	27/11/2003	BSC	18	
			Reports	15	33
	5	04/12/2003	BSC	21	
			Reports	11	32
	6	08/12/2003	BSC	20	
			Reports	8	28
	Total		BSC	85	
			Reports	58	143
2 (Low)	7	12/12/2003	BSC	11	
			Reports	7	18
	8	06/01/2004	BSC	12	
			Reports	14	26
	Total		BSC	23	
			Reports	21	44
Total			BSC	108	
			Reports	79	187

Performance Measure SimP - Descriptive Statistics

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Complexity	Experiment	Treatment	Mean	Std. Deviation	N
Total	2-8	BSC	-39.24	18.17	108
		Reports	-35.70	17.99	79
1 (High)	2-6	BSC	-39.62	18.35	85
		Reports	-38.61	16.27	58
2 (Low)	7-8	BSC	-37.84	17.79	23
		Reports	-27.66	20.39	21

ANOVA and ANCOVA Results

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ANOVA

Difference in the mean performance:

- Not significant for the whole sample and the high-complexity sample
- **Significant** (0.08) for the **low-complexity** sample

ANCOVA

Adjusting for differences in the pretest-parameters, the differences in the mean performance are

- Not significant for the whole sample and the high-complexity sample
- **Significant** (0.03) for the **low-complexity** sample

Linear Regression confirms the ANOVA/ANCOVA results.

Linear Regression

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Model: $$SimP = b_1 + b_2 GEK + b_3 BAK + b_4 K\_S + b_5 B\_S + b_6 N\_S + b_7 AI\_S + b_8 Treatment$$

Linear Regression confirms the ANOVA/ANCOVA results:

	Treatment	
	Beta	Sig.
Whole Dataset (N = 152)	0.030	0.691
High Complexity (N = 113)	-0.069	0.447
Low Complexity (N = 39)	0.302	0.032

Limitations

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- The data sample especially for the low-complexity setting is rather small (N = 39).
- Assumptions of ANOVA, ANCOVA and linear regression are violated for some data samples (e.g. normal distribution).
- Implementing HFR's strategy in the microworld was obviously challenging for many participants. Approximately half of the participants were not able to finish the simulation without being fired (SimP <= -50).
- Balanced scorecard's performance impact through
  - improved strategy translation and communication within the organisation,
  - improved alignment of the organisation to the strategy,
  - improved strategy control and evaluation

  was (deliberately) not investigated in the laboratory experiment.

Summary

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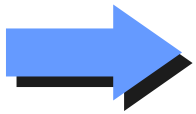
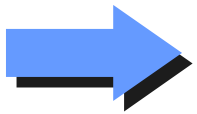
- Mean performance differences between treatment group (BSC) and control group (Reports) are statistically insignificant for the whole data sample and for the high-complexity sample.
- In the low-complexity setting participants equipped with the balanced scorecard perform significantly worse compared to the control group relying on traditional reports.



Hypothesis H_{1O} has to be rejected.



Using a BSC as single source of information could lead to wrong decisions.

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Empirical Research Studies and Research Methods Used

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Archival	Survey	Experimental
▪ Bryant, Jones and Widener 2004 (forthcoming)	▪ Hoque and James 2000 ▪ Buckmaster 2000 ▪ Sim and Koh 2001 ▪ Rigby 2001 ▪ PriceWaterhouseCoopers 2001 ▪ Gilles 2002 ▪ Bauer et al 2002 ▪ Speckbacher, Bischof and Pfeiffer 2003 ▪ Horvath & Partners Management Consultants 2003 ▪ Maiga and Jacobs 2003	▪ Lipe, Salterio 2000 ▪ Roberts, Albright and Hibbets 2004

ANOVA Results

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Complexity		Sum of Squares	df	Mean Square	F	Sig.
1 (High)	Between Groups	35.51	1	35.51	0.1154	0.7346
	Within Groups	43,385.38	141	307.70		
	Total	43,420.89	142			
2 (Low)	Between Groups	1,137.28	1	1,137.28	3.1274	0.0842
	Within Groups	15,273.35	42	363.65		
	Total	16,410.64	43			
Total	Between Groups	573.43	1	573.43	1.7516	0.1873
	Within Groups	60,564.64	185	327.38		
	Total	61,138.07	186			

ANCOVA Results –
Whole Sample, Selected Covariates

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Dependent Variable: SimP

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	10,749.92	7	1,535.70	5.1414	0.0000	0.2000
Intercept	4,140.43	1	4,140.43	13.8620	0.0003	0.0878
BAK	1,445.48	1	1,445.48	4.8394	0.0294	0.0325
GEK	1,906.93	1	1,906.93	6.3843	0.0126	0.0425
K_S	2,178.66	1	2,178.66	7.2940	0.0077	0.0482
B_S	1,682.23	1	1,682.23	5.6320	0.0190	0.0376
N_S	815.48	1	815.48	2.7302	0.1006	0.0186
Al_S	1,995.81	1	1,995.81	6.6819	0.0107	0.0443
Treatment	47.46	1	47.46	0.1589	0.6908	0.0011
Error	43,011.44	144	298.69			
Total	254,073.22	152				
Corrected Total	53,761.36	151				

[a] R Squared = ,200 (Adjusted R Squared = ,161)

ANCOVA Results
High-complexity, Selected Covariates

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Dependent Variable: SimP

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6,390.27	7	912.90	3.0253	0.0062	0.1678
Intercept	3,335.28	1	3,335.28	11.0531	0.0012	0.0952
BAK	54.25	1	54.25	0.1798	0.6724	0.0017
GEK	1,333.80	1	1,333.80	4.4202	0.0379	0.0404
K_S	2,180.62	1	2,180.62	7.2265	0.0084	0.0644
B_S	1,973.09	1	1,973.09	6.5388	0.0120	0.0586
N_S	228.42	1	228.42	0.7570	0.3863	0.0072
AI_S	2,068.63	1	2,068.63	6.8554	0.0101	0.0613
Treatment	175.60	1	175.60	0.5819	0.4473	0.0055
Error	31,683.99	105	301.75			
Total	197,812.91	113				
Corrected Total	38,074.27	112				

[a] R Squared = .168 (Adjusted R Squared = .112)

ANCOVA Results
Low-complexity, Selected Covariates

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Dependent Variable: SimP

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7,752.31	7	1,107.47	4.7716	0.0010	0.5186
Intercept	1,218.08	1	1,218.08	5.2481	0.0289	0.1448
BAK	1,819.84	1	1,819.84	7.8408	0.0087	0.2019
GEK	554.62	1	554.62	2.3896	0.1323	0.0716
K_S	736.40	1	736.40	3.1728	0.0847	0.0928
B_S	386.86	1	386.86	1.6668	0.2062	0.0510
N_S	0.04	1	0.04	0.0002	0.9901	0.0000
AI_S	591.08	1	591.08	2.5467	0.1207	0.0759
Treatment	1,177.76	1	1,177.76	5.0744	0.0315	0.1407
Error	7,195.05	31	232.10			
Total	56,260.31	39				
Corrected Total	14,947.36	38				

[a] R Squared = .519 (Adjusted R Squared = .410)

Linear Regression

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	Whole Dataset (N = 152)			High Complexity (N = 113)			Low Complexity (N = 39)		
Model	B	Beta	Sig.	B	Beta	Sig.	B	Beta	Sig.
(Constant)	-352.78		0.0002	-285.47		0.0014	-326.56		0.0166
BAK	34.61	0.1781	0.0294	16.55	0.0420	0.6724	74.58	0.4368	0.0087
GEK	42.18	0.2064	0.0126	-10.32	0.2115	0.0379	48.14	0.2300	0.1323
K_S	5.74	2.8681	0.0077	0.98	4.5646	0.0084	4.87	2.3836	0.0847
B_S	3.89	2.0488	0.0190	-8.58	3.5779	0.0120	2.84	1.3734	0.2062
N_S	0.32	0.1883	0.1006	11.81	0.1206	0.3863	0.01	0.0027	0.9901
Al_S	-7.34	-4.1060	0.0107	3.62	-6.6013	0.0101	-5.93	-3.2040	0.1207
Treatment	1.13	0.0300	0.6908	2.58	-0.0689	0.4473	11.81	0.3016	0.0315
R Square	0.200			0.168			0.519		

Dependent Variable: SimP