

CART-SEM Approach to TAM

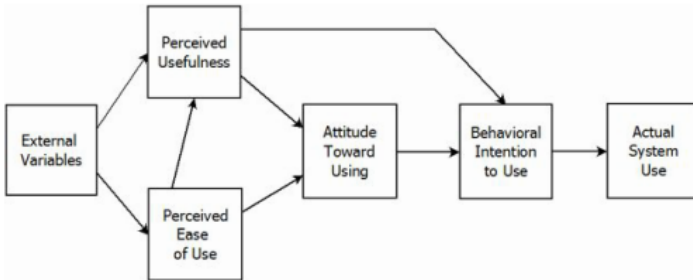
Adam Sagan, Mariusz Grabowski

Cracow University of Economics

20th International conference on IT4P - Information
Technology for Practice 2017
Ostrava 9th – 10th October 2017

- ① Technology Acceptance Model
- ② CART-SEM approach to model building
- ③ Application of CART-SEM in TAM for Moodle platform
- ④ Conclusions

Technology Acceptance Model



Technology Acceptance Model (TAM) (Davis, 1989; Davis, Bagozzi and Warshaw, 1989) and its derivatives e.g. UTAUT (Unified Theory of Acceptance and Use of Technology) (Venkatesh, Morris, Davis, and Davis, 2003) are frequently used theoretical frameworks aimed at explaining the behavior of users with regard to IT/IS artifacts and their acceptance.

CART-SEM approach to model building

- ① CART-SEM approach combines the advantages of exploratory classification tree methods and the structural equation modeling
- ② The purpose of the CART-SEM approach is to divide the population into segments that most differentiate the groups, based on the size of the SEM model parameters estimated in each of the classification tree leaves
- ③ The process of model building consists of two stages. In the first stage, the SEM base model is developed for the whole sample, which is the model in the „root,, of the classification tree (this is so called template model)
- ④ In the second step, given the set of covariates and its interactions, the „temporary,, subdivision of the sample is made for the subgroups, within which the SEM models are constructed and compared to the baseline model.
- ⑤ The comparison is based on differences in the log-likelihood ratio of both models ($-2LL$)

CART-SEM algorithm

- 1 Selection of SEM model indicators and set of covariates
- 2 Development of SEM model on total sample (pre-split model)
- 3 Parameter estimation and evaluation of goodness of fit (log-likelihood ratio)
- 4 Recursive binary splits of the data based on covariates (all possible splits based on covariates)
- 5 For each split, development of SEM sub-models and evaluation based on likelihood ratio
- 6 Models evaluation using
$$\Lambda = -2LL(pre - splitmodel) - \sum LL(post - splitmodel)$$
- 7 On each step, the best dichotomized covariate is selected for which log-likelihood ratio is maximum
- 8 The tree is finished when no additional covariate contributes to better test statistics

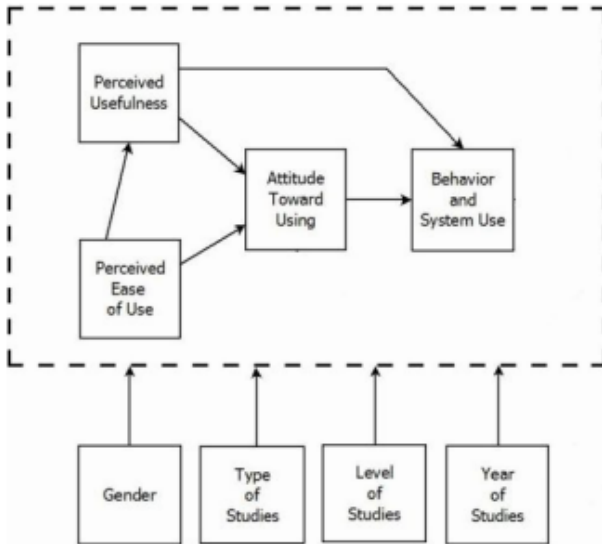
Application of CART-SEM in TAM for Moodle platform

- 1 The study was conducted among the students majoring in IT/IS (business information systems) at Cracow University of Economics (CUE), Krakow
- 2 All students from all types, levels and years of studies were asked to fill noncompulsory questionnaire. As a result, 204 nonrandom responses were obtained

Full Time				Part Time			
Graduate		Postgraduate		Graduate		Postgraduate	
Total	Survey	Total	Survey	Total	Survey	Total	Survey
474	124	68	35	160	31	107	14
RR:	26.2%	RR:	51.5%	RR:	19.4%	RR:	13.1%

- 3 There are significant differences in response rates (RR) across full time and part time students. This is especially evident at postgraduate level

Model used during the study



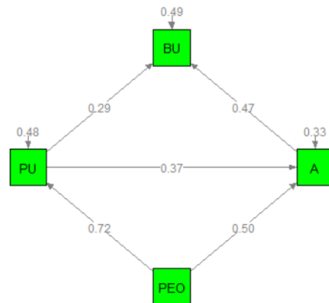
Model used during the study

Regressions:

	Estimate	Std.Err	z-value	P(> z)
BU ~				
A	0.479	0.075	6.423	0.000
PU	0.291	0.072	4.017	0.000
A ~				
PEOU	0.600	0.070	8.608	0.000
PU	0.364	0.057	6.404	0.000
PU ~				
PEOU	0.884	0.059	14.865	0.000

Variances:

	Estimate	Std.Err	z-value	P(> z)
.BU	0.503	0.050	10.100	0.000
.A	0.325	0.032	10.100	0.000
.PU	0.494	0.049	10.100	0.000



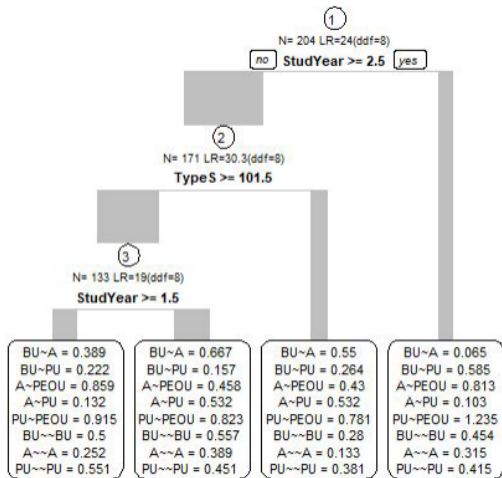
The Chi-square statistic = 0.644(1df), p-level = 0.42.
Root Mean Square Error of Approximation (RMSEA = 0.00).
The comparative fit indices: CFI = 1.00, TLI = 1.04

Total and indirect effects

Paths	Estimate	S.E.	Est./S.E.	P-Value
Total	0.699	0.066	11.59	0.000
PEOU - PU - BU	0.257	0.066	3.878	0.000
PEOU - A - BU	0.287	0.056	5.148	0.000
PEOU - PU - A - BU	0.154	0.036	4.338	0.000

CART-SEM model

The most important covariates for post-split models were type of study (101 = regular students, 102 = part-time students) and year of study (1st, 2nd, 3rd). The stopping rule ($N_{min} = 10$)



Segment description

- 1 The first segment (N=55): **1st year, regular students** (“freshmen”). In comparison to total sample, the relationship between **perceived easiness of use and attitudes** are relatively stronger but impact of attitudes on behavior and system use is weaker. So, this group of students are learning the system and forming the positive attitudes toward the Moodle platform.
- 2 The second segment (N=78) is formed by **2nd year, regular students**. They reveal strong relation between **perceived usefulness and attitude toward the system** and substantially weaker relationship between perceived usefulness and behavior and system use. Thus, the representatives of the segments learn to perceive the usefulness of the Moodle system, skipping the importance of easiness of use
- 3 The third segment (N=38) is defined by 1st and 2nd year of **part-time students**. For extramural students, the relationships between constructs seem to be moderate and mostly weaker in comparison to the base model. However, the relation between **attitude and perceived usefulness on behavior and system use** indicates the importance of practical aspects of Moodle system. platform
- 4 The fourth segment (N=33) consists with **3rd year students**. The specific relationships for this segment is based on the strong influence of **perceived ease of use on usefulness and perceived usefulness on behavior and system use**

Conclusions

- ① SEM/PLS models of TAM rarely involve the heterogeneity of the populations (are based on single – group SEM)
- ② The hybrid approach uses exploratory classification tree method on background variables and structural equation confirmatory model on construct level. It allows for incorporating the hidden heterogeneity of population in the process of model building.
- ③ The model results show the diverse relationships between TAM constructs depending on combinations on important institutional background variable. The study type and study year appear to be most important variables for students' heterogeneity.
- ④ The regular and freshmen students seem to be more sensitive to learning effects with respect to Moodle platform, whereas the part-time and older students stress the practicability and usefulness of the system.

- 1 Brandmaier, A., M., Oertzen, T., McArdle J., J., Lindenberger, U.(2015) Exploratory Data Mining with Structural Equation Models Tree, in: J., J., McArdle, ed., Contemporary Issues in Exploratory Data Mining in Behavioral Sciences
- 2 Brandmaier, A., M., Oertzen, T., McArdle J., J., Lindenberger, U. (2013) Structural Equation Models Trees, Psychological Methods, 1, s. 71-86
- 3 Davis,, F. D. (1989) 'Perceived usefulness, perceived ease of use, and user acceptance of information technology', MIS Quarterly, vol. 13, no. 3, pp. 319-340.
- 4 Davis F. D., Bagozzi, R. P. and Warshaw, P.R. (1989) 'User acceptance of computer technology: A comparison of two theoretical models', Management Science, vol. 35, no. 8, pp. 982-1003.
- 5 Łapczyński, M. (2016) Modele hybrydowe w marketingu relacji, Wydawnictwo UEK, Kraków
- 6 Sagan, A. and Grabowski, M. (2015) 'TAM Model as an assessment method for Moodle e- learning platform', Proceedings of the IT for Practice 2015 18 th International Conference on Information Technology for Practice, Ostrava, pp. 167-175.