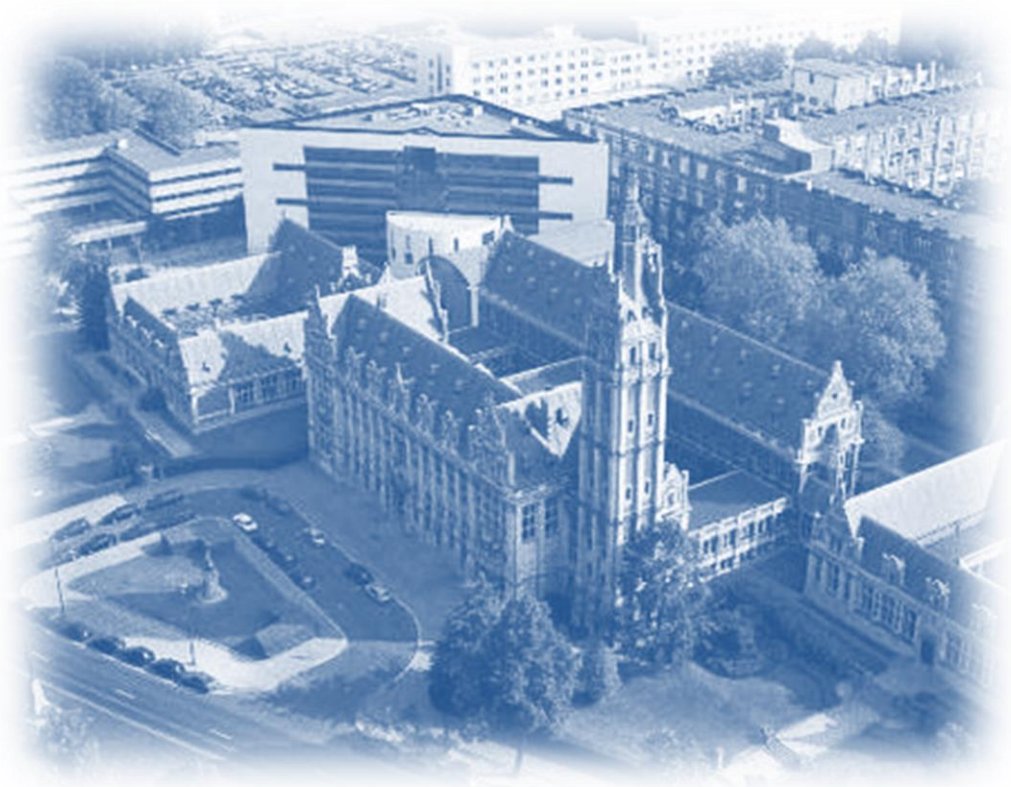


Université libre de Bruxelles
Campus de la Plaine
Brussels, Belgium
January 23, 2015

2nd International MCDA Workshop on PROMETHEE: Research and Case Studies

Booklet of Abstracts



<http://cs.ulb.ac.be/conferences/imw2015/>

Université libre de Bruxelles
Campus de la Plaine
January 23, 2015

2nd International Workshop on PROMETHEE: Research and Case Studies

The ULB in collaboration with the VUB is pleased and proud to welcome you in Brussels for the second international workshop on Multi Criteria Decision Aid (MCDA) with focus on PROMETHEE: Research and Case Studies.

This one-day workshop will be held on: January 23, 2015 at Université libre de Bruxelles, Campus de la Plaine (Forum, F & G), Brussels, Belgium.

The aim of the workshop is to bring together researchers and practitioners from all the disciplines that engage with the PROMETHEE methods.

The PROMETHEE methods have effectively been functional in many areas of research and several case studies. Globally, in thirty years, several hundreds of scientific papers related to PROMETHEE have been published in scientific journals.

The number of practitioners who are applying the PROMETHEE method to operational multiple criteria decision problems, and researchers who are interested in studying the PROMETHEE method in-depth, increases constantly.

Call for Papers

The workshop will cover, but not be limited to the following themes for discussion:

- Theoretical advances in the PROMETHEE methods
- PROMETHEE applications in:
 - Environment Management
 - Hydrology and Water
 - Business and Financial Management
 - Chemistry
 - Transport, Logistics and Urban Mobility
 - Energy Management
 - Social Public Welfares
 - Manufacturing and Assembly
 - International Cooperation
- PROMETHEE software packages with demonstration stands during the workshop
- Round table with Industrial & Governmental PROMETHEE practices

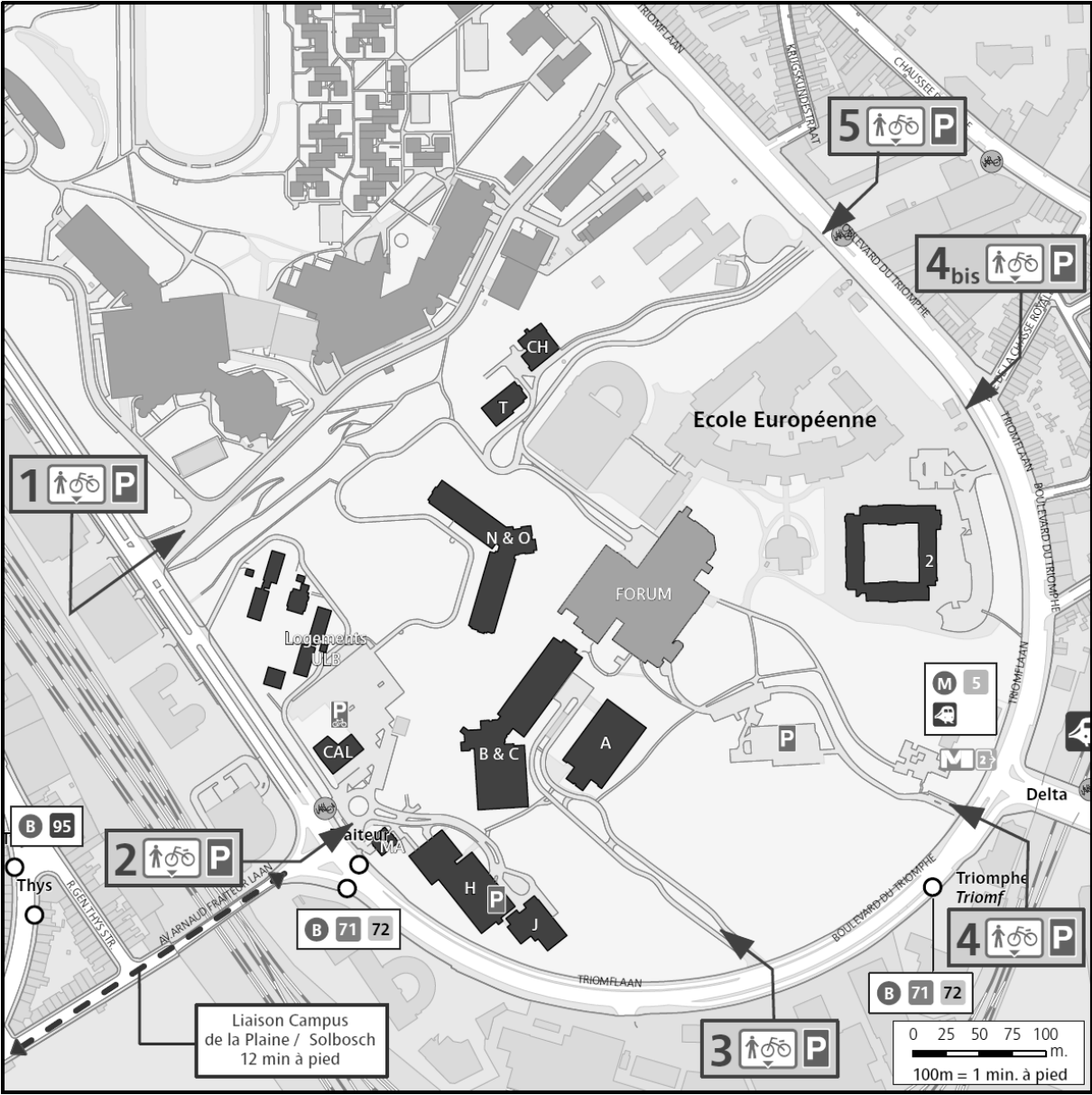
We invite original contributions that reflect on these concerns and expect interesting viewpoints from different planning contexts. Contributions that consider both content and process issues are highly appreciated.

PhD students that will attend the workshop will be awarded with two ECTS credits.

The best paper will be granted with the "Jean-Pierre Brans - PROMETHEE Award"

Venue

The conference will take place on the Plaine Campus of the Université libre de Bruxelles. The reception will be held in the Forum in front of rooms F and G.



General Information

Note to Speakers



Speakers are asked to present themselves to their session chair at least 10 minutes before the start of their session. Please ensure your presentation in Powerpoint or PDF format is loaded either by sending it in advance or by bringing it on a USB drive.



Since the schedule will be tight, we also ask all speakers to respect the 20 minutes timeframe they are given for their presentation in order to avoid any delays.

Coffee Breaks and Lunch



Morning and afternoon coffees and teas as well as the lunch will be served in the corridor outside the two main workshop rooms. The reception will also be open during those breaks should you have any enquiries.

Evening Cocktail



In the evening, after the winner of the "Jean-Pierre Brans PROMETHEE Award" has been announced, a cocktail will be organised. This will take place in the same area as the coffee breaks.

Internet Access



The ULB Plaine Campus is part of the eduroam (educational roaming) network. Should your institution be part of it, you should have access to it using your regular login credentials. Additionally, you will get a login and password for the local WiFi network.

Name tags



Participants are asked to wear their name tags at all times during the workshop. These will give you access to the lunch at noon. Additionally, your WiFi connection credentials will be indicated on them.

Mobile Phones, Pagers, and Laptop Sounds



As a courtesy to presenters and colleagues, please ensure that all mobile phones, pagers, and sound from your laptop are switched off during the workshop sessions.

No Smoking Policy



We warn you that smoking is prohibited in Belgium in all public buildings, restaurants, bars, casinos, and public areas in hotels. Of course, the university buildings follow this rule as well.

Climate



The climate in Belgium can change on a daily basis. While winters are usually cold and clear, please be prepared for the occasional rain or hail showers. An umbrella or raincoat would therefore be advised.

Money



Belgium's unit of currency is the Euro. Foreign currency can be exchanged at banks and exchange counters (e.g. at the airport or main train stations). Visa, Master Card, Maestro and Cirrus are accepted in most big shops and restaurants in Belgium. However, most bars and small shops only take cash. To withdraw money, you can make use of the many ATM machines as most banks in Belgium are entirely automated.

Electricity



Electricity is supplied throughout the country at 230 volts and 50 hertz (with type C or E electric sockets), which most adapters from across the world are compatible with. However it is recommended to check the voltage of your devices before plugging anything in.

Tipping & Etiquette



All displayed prices in Belgium include all taxes (VAT of 6% or 21% depending on the product), and service is always included in restaurants and bars, so tipping is not mandatory. Service staff do not rely on tips to make up their income. However, if you are very happy with the service you got, leaving a few euros (e.g. to round up your bill) is the way to go.

Sending Postcards



Stamps are sold in post offices and most bookshops and libraries. You can post your letters in one of the red street letter boxes or in a post office.

Program

8:30	Reception	Hall
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9:30	Opening Session	Forum F
9:30 - 9:50	Welcome Speech Yves De Smet	
9:50 - 10:10	On the Conjoint Use of MCDA Tools and Spatial Analysis: Some Applications of the PROMETHEE Methodology Karim Lidouh	
10:10 - 10:30	Including stakeholders in the decision process: The Multi Actor Multi Criteria Analysis Cathy Macharis	

10:30	Coffee Break	Hall
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11:00	Combining Methods and Domains	Forum F	11:00	Extensions and Theoretical Developments	Forum G
11:00 - 11:20	The application of PROMETHEE with Prospect Theory - Opportunities and Challenges Nils Lerche		11:00 - 11:20	PCLUST: an extension of PROMETHEE to partially ordered clustering Renaud Sarrazin	
11:20 - 11:40	A New Weight-Restricted DEA Model based on PROMETHEE II Maryam Bagherikahvarin		11:20 - 11:40	FlowSort parameters elicitation based on assignment examples Dimitri Van Assche	
11:50 - 12:10	Extension of PROMETHEE methods to temporal evaluations Issam Banamar		11:50 - 12:10	An empirical distribution-based approximation of Promethee II's net flow scores Stefan Eppe	
12:10 - 12:30	The use of AHP and PROMETHEE to evaluate sustainable urban mobility scenarios by active stakeholder participation: the case study of Leuven Imre Keseru		12:10 - 12:30	Approximating the Results of the PROMETHEE II Method through Comparisons with Global Profiles Karim Lidouh	

12:30	Lunch Break	Hall
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14:00	Software for Decision Support	Forum G
14:00 - 14:20	Integrated modelling platform for territorial and environmental planning Jean-Philippe Waub	

14:20 -	PROMETHEE applications in various industrial cases Myriam Noureddine
14:40 -	Developing hydropower decision aid on project prioritizing applying Visual PROMETHEE - Case study from Nepal Rana Pratap Singh
15:00	

15:00 ☕ **Coffee Break** **Hall**

15:30	Extensions and Practical Cases	Forum F	15:30	Methods and Tools	Forum G
15:30 -	The contribution of the multicriteria method: PROMETHEE to the corporate valuation process Latifa Barbara		15:30 -	The Multi-Actor Multi-Criteria Analysis (MAMCA) Method and Tool Sheida Hadavi	
15:50 -	Comparing patient preferences for medical treatments with PROMETHEE II: a pilot study Henk Broekhuizen		15:50 -	PROMETHEE within the MAMCA methodology to evaluate the Mobile Depot Demonstration in Brussels Bram Kin	
16:20 -	Innovative project selection for technology transfer activities in a public University Stelios Rozakis		16:20 -	PROMETHEE-compatible representations of multicriteria evaluation tables Nguyen Anh Vu Doan	
16:40 -	A multiple criteria methodology to classify zones in protected areas: A Mediterranean Case Study Marina Segura		16:40 -	SMAA-GAIA: A Complementary Tool of the SMAA PROMETHEE Method Jean-Philippe Hubinont	
17:00			17:00		

17:00 ☕ **Coffee Break** **Hall**

17:30	Research and Academic Concerns	Forum F
17:30 -	PROMETHEE-related literature: some statistics Annalia Bernardini	
17:50 -	How to obtain a ranking of individuals measuring their excellence by means of a multicriteria decision model Gabriela Fernández Barberis	
18:10 -	Multi-Criteria Decision Aiding in the process of applying for AACSB accreditation Dorota Górecka	
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18:30 🍷 **Closing Session and Cocktail** **Hall**

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The application of PROMETHEE with Prospect Theory –Opportunities and Challenges

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Abstract

The incorporation of elements from Prospect Theory into PROMETHEE enables the decision maker to integrate reference dependency as well as to express loss aversion. To illustrate occurring opportunities and challenges of the developed approach, the results of an application concerning the identification of a sustainable bioenergy concept as well as the feedback from decision makers are presented. Additionally, potential approaches concerning a corresponding sensitivity analysis and the consideration of risk or uncertainty are discussed.

Keywords: PROMETHEE, Prospect Theory, Sensitivity Analysis, Uncertainty, Sustainability Assessment

The consideration of behavioral effects within methods of MCDA (Multi-Criteria Decision Analysis) is of major interest for further research (e.g. Morton, Fasolo 2009). The findings of Prospect Theory (Kahneman, Tversky 1979) seems to be particularly suitable for an incorporation, since its elements reference dependency and loss aversion do not represent cognitive biases, but rather an actual perceived assessment of potential outcomes by decision makers. Therefore, an approach to consider these two elements within PROMETHEE (Brans et al. 1986), further denoted as PT-PROMETHEE, has been developed.

To gather feedback from decision makers with respect to the procedure of PT-PROMETHEE, the extended approach has been applied within a case study concerning sustainable bioenergy concepts. Based on observations and the feedback provided by the decision makers, several findings with regard to corresponding opportunities or challenges are presented.

However, due to the extension of the original procedure of PROMETHEE, additional subjective information in terms of reference values and loss-aversion coefficients is required. Therefore, a corresponding sensitivity analysis and the development of an approach for visualization of the results from such an analysis seem to be necessary. Additionally, since Prospect Theory was originally developed as a decision theory under risk, potential concepts for the consideration of scenario planning are discussed.

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A New Weight-Restricted DEA Model based on PROMETHEE II

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Abstract

The weight restrictions [4,6,7,8,9,10] in Data Envelopment Analysis (DEA) [2] models were initiated with the goal of making DEA outputs more reasonable to managers. The aim of this paper is to propose a new weight restricted DEA approach based on a MCDA [3] methodology. To achieve this goal we use the stability intervals [5] computed with PROMETHEE II [1] method as weight constraints in DEA. These restrictions improve the discrimination power of the model [4,6,7,8,9,10]. Furthermore we show the compatibility of the results between PROMETHEE II and the new model. Additional comparisons with the output of other decision making tools such as BCC, CCR and ELECTRE III [3] are illustrated.

Keywords: Data Envelopment analysis, Multiple Criteria Decision Aid, PROMETHEE, Stability Intervals, weight restrictions

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Extension of PROMETHEE methods to temporal evaluations

Issam Banamar, Yves De Smet

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Abstract

PROMETHEE methods [1] are multicriteria decision aid techniques which aim to provide to decision-makers a tool to solve problems where several conflicting criteria are taken into account. Lots of applications have been treated by using these approaches in many areas such as water or human resources, industrial location, investments, finance, health care, etc [2].

This success is partly due to the simplicity of the methods, the existence of user-friendly software (like D-SIGHT [3]) and the availability of visual interactive tools that help to better structure and understand the decision problem.

However, current PROMETHEE methodology treats problems without considering the time variable. Thus, the purpose of this work is to study the extension of PROMETHEE in situations where the evaluation of the alternatives may evolve over time. As a consequence, this research topic is at the intersection between multicriteria decision aid and time series.

To illustrate this point, let us consider the case of a hospital where physicians want to monitor the health of many patients (alternatives) against several criteria (cholesterol, pulse, temperature,...) every 2 hours. After one week, the hospital would adapt the care given to these patients, also, to follow (rank) the health evolution of each patient over several days. In this case, we could imagine that both evaluations and preferences (criteria weights, indifference and preference thresholds) are likely to evolve over time. This contribution investigates how the GAIA plane can be extended in order to display temporal evaluations.

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The Use of AHP and PROMETHEE to Evaluate Sustainable Urban Mobility Scenarios by Active Stakeholder Participation: The Case Study of Leuven

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Abstract

In urban transport and mobility planning, the participation of relevant stakeholders has become more and more important. This participation is desired since the analysis and evaluation should take into account the preferences of the social and business partners which are affected by the planned project. This paper discusses whether a multi-actor, multi-criteria analysis (MAMCA) can provide a structured way to interact with the stakeholders in the urban mobility planning context. Secondly, we investigate how the application of group decision support systems (GDSS) software can enhance MAMCA to provide a structured way to involve a wide range and a high number of stakeholders.

We organized an interactive MAMCA-workshop where four scenarios to improve mobility in the city centre of Leuven, Belgium (business as usual, car free city centre, smart road user charging and park & walk) were evaluated based on stakeholder preferences. The 40 participants were divided into 7 stakeholder groups and 14 subgroups. Each subgroup of 3-4 people used the D-Sight Web online GDSS software simultaneously to carry out the weighting of their own criteria and the evaluation of the scenarios. The AHP and PROMETHEE methods were combined to benefit from the advantages of both methodologies. The AHP method was used for the weight elicitation since it is easy to use and it can decompose a complex problem into its constituents. PROMETHEE was used for the evaluation of the scenarios in order to avoid trade-offs between scores on criteria and to simplify the evaluation procedure in comparison to AHP.

Based on the evaluation, the local and regional governments, citizens, public transport users and the public transport operator has similar preferences with the car-free city centre as the best alternative. Both car users and local businesses, however, prefer the park & walk scenario. Within the stakeholder subgroups, we detected considerable heterogeneity in the evaluation, which confirms that the evaluation should be carried out by a limited number of experts rather than the stakeholders themselves. The workshop demonstrated that MAMCA assisted by GDSS software combining AHP and PROMETHEE can be used to evaluate urban mobility strategies with multiple stakeholder groups and value trees and allows the participation of a large number of stakeholders in a cost-efficient and time-saving manner. The GDSS software made it possible to consult stakeholder groups simultaneously. It has also been revealed, however, that the currently available GDSS software are not suitable for MAMCA without major modifications. Therefore our further research will focus on

developing software that would allow the user-friendly set-up of multiple decision trees, user management for stakeholder groups and the direct production of a multi-stakeholder view at the end of the evaluation.

Keywords: sustainable urban mobility, stakeholder participation, interactive workshop, multi-actor multi-criteria analysis

PCLUST: an extension of PROMETHEE to partially ordered clustering

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Abstract

In the field of multicriteria decision aiding, solving a sorting problem refers to the assignment of alternatives into ordered categories. In classification problems, the alternatives are associated to categories that are pre-defined, which requires a priori information and knowledge about the structure of the data. While in clustering problems, the categories are detected during the solving process from the analysis of the structure of the data. Then, several clustering approaches had been developed among them we could distinguish between the classical approach and the criteria-dependant approach. The latter uses the additional information that is given by the criteria to define the clusters, and it could be divided into two categories: relational and ordered clustering.

In this paper, we are focusing on ordered clustering approaches, and more particularly we address the question of partially ordered clustering. We have developed a method that constructs a set of partially ordered clusters on the basis of the multicriteria preference information among alternatives. This method is based on an extension of PROMETHEE I. We test the model and we measure the quality of the clustering on ordered data sets from the literature. In particular, we analyse the performance of three functions that are used to update the reference profiles of the clusters.

FlowSort parameters elicitation based on assignment examples

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Abstract

In multi-criteria sorting methods, it is often difficult for decision makers to precisely define their preferences. It is even harder to express them into parameters values. The idea of this work is to automatically find the parameters of a sorting model using classification examples. The sorting method we are working with is FlowSort [1], which is based on the PROMETHEE methodology [2]. Starting with an evaluation table and known allocations, we propose a heuristic based on a genetic algorithm (GA) to identify the weights, indifference and preference thresholds but also profiles characterizing the categories. We address both the case of partial and complete sorting. In the case of complete sorting, FlowSort uses PROMETHEE II. On the other hand for the partial sorting, FlowSort uses PROMETHEE I. The fine tuning of the parameters uses iRace for the complete sorting, and we use varying parameters in the case of partial sorting. We illustrate both the performances of the algorithm and the quality of the solutions on three standard datasets for the complete sorting. In the case of partial sorting, the validation is based on the same three datasets but with a categorization generated with a random instantiation of the parameters.

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An empirical distribution-based approximation of PROMETHEE II's net flow scores

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Abstract

PROMETHEE II is a well known MCDA method that allows ranking a set of alternatives; the rank of each alternative being determined by the relative value of its associated net flow score. As an outranking method, however, PROMETHEE II requires the pairwise comparison of all alternatives. Consequently, the number of these comparisons, and therewith the overall computational load to determine a ranking increases quadratically with the instance size.

To alleviate this drawback, we have recently proposed a first model that uses a piecewise linear approximation (PLA) of the unicriterion net flow scores [1]. This model only depends on the preference parameters on each criterion: the relative weight, as well as indifference and preference thresholds. Although we could show that this approximation provides a good correlation with PROMETHEE II's original net flow scores and ranks, a more demanding metric, such as the hit rate, i.e., the ratio of absolutely well ranked actions, shows the model's actual limitations: only a small fraction of actions are actually ranked as they should be. The main reason for this significant trade-off between accuracy and speed is related to PLA's assumption that the evaluations of alternatives on each criterion are uniformly distributed.

In this presentation, we propose the empirical distribution-based approximation model (EDA). It takes the evaluation distribution on each criterion into consideration and reaches an approximation quality that even outperforms a polynomial regression model of the third order. For sets of 1000 actions evaluated on 7 criteria, for instance, EDA ranks about 85% of the actions as PROMETHEE II would have, but 250 times faster.

Thus, at the relatively small initial cost of computing the evaluation's empirical distribution function on each criterion, EDA reaches a very good approximation. We consider it as intermediate, in terms of speed and accuracy, between PROMETHEE II and the previously proposed PLA model.

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Approximating the Results of the PROMETHEE II Method through Comparisons with Global Profiles

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Abstract

PROMETHEE II is a ranking method based on a valued outranking relation (Brans et al. 1984). It computes net flow scores for each alternative by comparing it to all the other alternatives. This gives an interesting view on the problem as the set of alternatives itself is used as a benchmark. However, in problems of substantial size, this can lead to long computation times. In this contribution we explore whether or not a limited set of global profiles can be used to substitute for the entire set of alternatives.

This idea is derived from several other works like the ordered classification FlowSort method proposed by Nemery et al. (2008) where each alternative is compared to a set of reference profiles defined by the decision maker to represent the classes; or the work by Eppe et al. (2014) that showed that in large datasets, the use of preference functions could be approximated by piecewise linear value functions.

By doing simulations with several problem sizes (number of alternatives, number of criteria), as well as types of preference functions, we highlight the cases where the approach works best and the way these global profiles can be obtained from a given dataset. Several interesting properties are deduced from this exploration:

(1) If there are any clusters of alternatives in the dataset, then the number of global profiles should be a multiple of the number of clusters when these are of equal size. Otherwise, the number of global profiles should reflect the density of alternatives in each cluster.

(2) As all pairwise comparisons are done for each criterion individually, the global profiles can be defined per criterion as well. This means that the numbers of global profiles can be different for each criterion to be analyzed.

(3) To help determine the number of profiles necessary when replacing the set of alternatives by a set of global profiles, one can make use of the preference functions. Indeed, the indifference threshold can indicate which intervals of evaluations can be replaced by a single value.

(4) When the datasets are far too large to allow for a preliminary study, a sampling of the possible alternatives yields satisfactory results.

Keywords: PROMETHEE II, Outranking, Approximation, Global Profiles, Large Datasets.

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Integrated Modelling Platform for Territorial and Environmental Planning

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Abstract

The intrinsic nature rising from this systemic quality of geographical space imposes, in an effort of rational abstraction, the use of formalization and modeling tools which must allow taking into account four basic elements: (1) the interactions between natural and man-made components of regional space ; (2) the feedbacks between these components; (3) the multiple organization levels of the territory and the environment; (4) the subjective characteristic of the decisional rules which contributes to set the dynamics of the socio-ecological systems. In this geographical context, we are presenting an integrated modelling platform for decision aiding in territorial and environmental planning.

First, we present an application of the soft system methodology (SSM) for the conceptual modeling of geographical processes of an agricultural socioecosystem of the city of Sainte-Claire in southern Québec. The soft system methodology is an approach used for the heuristic analysis of complex, fuzzy or ill-defined situations involving individuals or groups. This tool was abundantly used for organisational purposes in a decision-making context but very few applications are documented in the field of geographical sciences and regional planning. We expose the main stages of the approach, described as follow: addressing the situation; expressing the problem; formulating the root definition of the relevant social activity systems; building of the conceptual model of the socioecological system and validating the model. This model is a core piece of our platform for the problem setting phase.

Then, the platform combines advanced spatial modeling and multicriteria decision aid (MCDA) in a multi stakeholder context to simulate a territorial and environmental planning process. Benefiting from the SSM outputs, we formalize a problem of territorial and environmental planning scenario's selection in the Sainte-Claire municipality, southern Quebec. Four land use scenarios are designed. Twelve planning criteria and related measurement indicators are derived from content analysis of the regional public hearings held in the context of a strategic commission on the future of agriculture and food sectors in Quebec. These scenarios, with strong territorial references, are modelled in the ArcGIS geographical information system. Besides benefiting from a cartographic representation of the scenarios, it also enables us to carry out spatial analyses to measure the strategic environmental assessment criteria that correspond, for example, to impacts in terms of

losses or gains of territorial areas linked to differential affectations valued by the stakeholders. Each scenario is evaluated according the PROMETHEE and GAIA methods and related software package. This MCDA procedure enables us to formalize the decision-aiding process corresponding to the multi-preference and multi-stakeholder context, mainly by the aggregation of the stakeholder preferences, by the different ranking of the scenarios, and the identification of the opportunities for negotiations.

In the final phase, we illustrate the capabilities of the proposed integrated modelling platform. The four planning scenarios are discussed as constrained by a fictional but realistic multi-stakeholder context which is similar to that typically encountered in real-life situations. This contribution allow us to lay the very first foundations of what we could agree to call territorial analytic as a new field of research specifically applied to the generation of dynamic geographic knowledge in conjunction with territorial sciences, information sciences and decision modeling.

Keywords: planning, territory, environment, modeling, socioecologic system, soft systems, GIS, decision aiding, multicriteria analysis

PROMETHEE Applications in Various Industrial Cases

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Abstract

We present the application of the PROMETHEE method in three different industrial cases, identification of deadlocks in manufacturing systems, choosing a method for the enterprise modelling and classification of the critical equipments in an industrial system.

The first application is in the context of flexible and efficient production. So, it is imperative to control deadlocks between physical resources involved in the manufacturing process, because this dysfunction may interrupt the production and hence less productivity.

This application deals with a comparative evaluation (Nouredine, 2008) between two detection methods of deadlocks in flexible manufacturing systems. These methods are supported by specific methodologies and we develop a special software based on outranking approaches to compare them. The PROMETHEE result provides a ranking graph between the two methodologies, giving the choice among these methodologies for the deadlocks identification.

The second application is in the framework of enterprise modelling. The aim is to provide to leaders of Algerian enterprises an overview of modelling techniques, because we found in the reality, the difficulties of these enterprises to adopt a new and effective organization.

In this context, this application deals with a ranking (Hadj Tayeb and Nouredine, 2012) between the most popular techniques in enterprise modelling. The PROMETHEE Method is also implemented through specific software supporting our approach. Many experiments are done for local enterprises and the obtained ranking between the different techniques allows selecting the most appropriate methodology for a real given enterprise.

The last application deals with the maintenance context of the gas industrial complex located in Algeria. The objective is to classify twelve production equipments according to their degree of criticality.

In the proposed approach (Nouredine and Nouredine, 2012), each criterion is scaled by the occurrence and severity of the failure, from the least to the more critical. We applied the PROMETHEE method through the online software Visual PROMETHEE (Mareschal, 2012). The ranking obtained by the PROMETHEE software gives a full contribution for the hierarchy of critical equipments. Thus, this ranking will identify the priority actions for maintenance.

We have presented three PROMETHEE applications and during their respective implementations, we noticed both the simplicity and the power of the method, giving adequate results.

Keywords: PROMETHEE, manufacturing system, enterprise modelling, maintenance.

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Developing hydropower decision aid on project prioritizing applying Visual PROMETHEE – Case study from Nepal

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Abstract

In response to the economy to grow in Nepal, there has been a tremendous demand for hydropower development in the country. Though Nepal has huge hydro potential of 83,000 MW, only 727 MW is explored so far. Multi criteria decision approach with due weightage to various criteria is still not popular particularly in hydropower sector of Nepal. There is no stander or agreed decision framework which is extremely important in country where resources are limited but sector is full of conflicting interests. Present study is to propose and verify such frame work in Nepalese context through secondary information based analytic analysis and primary information based field study. Hydro potential, developing trend and other important aspects are analyzed under perspectives like technical, social, economic, environmental, political, financial, developer and associated risk to identify possible decisive elements. Through questionnaire field data collected from six sites and also consulted experts wherever necessary. An appropriate MCDM tool is required to process the data to develop the final list of decisive elements with due weightage to form a decision framework looked for. Among many MCDM tools, one with latest feature to provide in-depth views and helps to analyses the influences or impacts through various scenarios is Visual PROMETHEE (VP) which is applied in the present study.

Study identified 5 criteria, 22 sub criteria and 44 elements important for hydropower decision in Nepal. Following VP application and removing several of null elements through sensitivity analysis, the study finally develops a hydropower decision framework with total of 29 elements under various criteria and sub criteria. It was also concluded that the frame work developed is very much stable and applicable for present context for 5 years from now and immediate future for additional 15 years then after. However priority at present could change with time, experience, capability enhanced, increased international interest and hence the decision framework needs to be updated.

This paper is organized in seven sections. The first introduces hydropower and MCDM in Nepali context, second define problem, third discusses objectives and tasks, fourth explains Visual PROMETHEE (VP), fifth on application of Visual PROMETHEE, sixth on policy implication and recommendation and seventh on discussion and conclusions.

This paper is prepared to assist the reader and stake holders, mainly decision makers, experts and researchers for sound understanding in hydropower decision making, planning and strategy formulating. VP applied and methodology followed in the study is easy to

apply and gives reliable results. This could be applicable to similar country context like Nepal and/or subject of interest like hydropower.

Keywords: Decision framework, MCDM, Visual PROMETHEE, hydropower, criteria

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The contribution of the multicriteria method: PROMETHEE to the corporate valuation process

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Abstract

This research deals with the problem of choosing a target during a merger or acquisition especially in the area of the net economy where the decision has little time to be taken and the multicriteria decision aid has all its interest.

The PROMETHEE method therefore improves the result of the choice of target by a raider anxious to avoid all the problems of post-merger integration. Taking into account several criteria both quantitative and qualitative forms of unequal importance can be the best way, according to us to improve this decision.

The PROMETHEE method that achieves a ranking of several actions can appreciate the different targets and if any litigation with the first one of the list, choosing a new target will be done more easily.

In a merger, a raider is also facing the problem of choice synergies. Indeed, once the target chosen, the raider would need a ranking in order of priority of the various potential synergies and he can focus on the one that best meets these criteria.

We also used the MACBETH method to weight the criteria whatsoever for target selection or classification of potential synergies. This method has led to better decision maker's preferences (the raider).

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Comparing patient preferences for medical treatments with PROMETHEE II: a pilot study

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Background and objective

Although MCDA is increasingly used in healthcare, applications of outranking approaches like ELECTRE and PROMETHEE have been limited (1,2). The goal of this study is to assess the feasibility of using the PROMETHEE approach to compare patient preferences for medical treatments. A secondary goal is to assess the feasibility of addressing uncertainty in both criteria weights and treatment performances.

Methods

A case of choosing antidepressants was modeled as a PROMETHEE II decision problem using Visual PROMETHEE (academic edition) software. Criterion weights were derived from an earlier AHP study in which twelve patients suffering from major depression weighted the importance of the criteria response, remission, adverse events and severe adverse events (3). Treatments under consideration are Duloxetine, Venlafaxine and Bupropion. The performance of these treatments on the criteria were measured in earlier clinical trials with an odds ratio compared to placebo (4). Preference functions were assumed to be linear. Uncertainty in both criteria weights and treatment performances was explored in a probabilistic sensitivity analysis using Monte Carlo simulations programmed in R. Criteria weights were bootstrapped (with replacement) and odds ratios were assigned lognormal distributions.

Results

The net flow for Venlafaxine was 0.60, followed by Duloxetine (-0.37) and Bupropion (-0.97). These rankings were stable for eleven of twelve patients. The deterministic rank stability intervals for the criteria weights were [22%;100%], [0%;100%], [0%;23%] and [0%;46%] for response, remission, adverse events and severe adverse events, respectively. The probabilistic analysis shows Venlafaxine is most likely to be ranked first (ranked first in 61% of simulations), followed by Duloxetine (ranked second in 58% of simulations) and Bupropion (ranked third in 96% of simulations) when uncertainty in preferences and performances are considered.

Conclusion

This pilot study showed the feasibility of integrating patient preferences and clinical data in a PROMETHEE II model. Deterministic and probabilistic analyses were demonstrated. Future

research in the healthcare area should focus on the most appropriate preference functions for different kinds of medical criteria, how preferences from (a large group of) patients can be best elicited for a PROMETHEE-guided decision context, on the impact of health-regulatory requirements on the preference elicitation and decision process, and on using the GAIA plane.

Innovative project selection for technology transfer activities in a public University.

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Abstract

Beside education and research, higher education institutions are inclined these days to promote research output for commercial activities. In an era of decreasing funds, especially in countries under public funds scarcity, public Universities venture in technology transfer without much experience and lacking entrepreneurial culture. An ad hoc tech transfer office supported by an ongoing project has received 40 innovative business ideas elaborated by faculty and research staff in the Agricultural University of Athens. These proposals may be classified in several types, such as new products in agriculture or in industry, innovative processes, novel test and/or certification methods, applications/software, services etc. Funding is provided for a small number of selected proposals to implement fully fledged business plans for appropriate action (spin-off, licensing, etc.) and contacts with potential investors. The selection will be based on various criteria grouped into three categories: Technical maturity and degree of innovation, business opportunity and project team to be involved. These aspects consist of several sub-criteria respecting the principles of coherence in multi-criteria analysis.

The selection of a subset of alternatives using multiple criteria belongs to the ranking or sorting problematique. The decision situation becomes more complex if in addition to the multiple evaluation criteria the decision-maker has to comply with specific limitations e.g. segmentation or policy constraints that characterize the final selection. This is the case as the Tech transfer managers wish to select proposals in such a way that all University Departments and all different types of ideas are represented. Moreover, the University administration strategy may wish some kind of diversification, to target to a minimum number of spin-offs, a number of licences, providing services etc. These constraints distort the independence of the alternatives, a usual, underlying concept in most MADM methods. In the presence of segmentation constraints the decision problem becomes combinatorial and the actual options for the decision maker are the combinations of the alternatives that comply with the segmentation constraints.

Several applications are reported in the literature concerning resource allocations problems in IT, the academia and the industry. One way to deal with is to use a two phase approach: first obtain a multi-criteria evaluation of the alternatives using an MADM method that

evaluates the individual alternatives and then use this information in the objective function of an IP model that incorporates the constraints.

In the current work we apply an extension of the PROMETHEE V method, named PROMETHEE V2 that fully exploits the advantages of the PROMETHEE family methods and offers more flexibility to the decision maker. We use information provided by PROMETHEE I in the form of leaving (ϕ^+) and entering (ϕ^-) flows to formulate a bi-objective IP problem. In order to help the decision maker choose his/her most preferred solution a decision aid process is also developed. PROMETHEE V2 is particularly appropriate for group decision making as it can effectively and transparently incorporate the preferences of all the stakeholders in the final decision.

A multiple criteria methodology to classify zones in protected areas: A Mediterranean Case Study

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Abstract

Collaborative management represents a new paradigm for successfully implementing actions and monitoring and controlling protected areas. The objective of this work is to develop a methodology to implement collaborative ecosystem services management which would be capable of integrating available data in order to classify zones in protected areas, according to their functions (provisioning services, maintenance services and services direct to citizens). This methodology is based on hybrid multicriteria and group decision making techniques and has been applied in a case study in Serra d'Espadà Natural Park, which is a protected Mediterranean area in the region of Valencia, eastern Spain.

Collaborative management must involve decision makers, technical staff and other stakeholders in the process from the beginning, in our study by identifying ecosystem services and eliciting preferences and merging them with technical data. The involvement of stakeholders is important for implementing good governance and management, which is characterized by legitimacy as an attribute of quality in protected areas governance.

The proposed methodology combines two well-known multicriteria techniques, AHP and PROMETHEE. AHP is first used to elicit stakeholder preferences on the importance of ecosystem services in the management of protected areas. In addition, collaborative management needs objective data to be incorporated in a transparent process, not only judgments from one set of stakeholders. Thus, a PROMETHEE based method is used in a novel way in order to develop new composite indicators for three main functions of the ecosystem services. Their values show the ecosystem services utility, in the sense of overall benefits to society and can be used to make decisions which balance all functions.

The new proposal overcomes the difficulties in prioritizing the management objectives in a multicriteria context always necessary in scarce resource context and facilitates the consensus between all people involved. The availability of reliable data is the main challenge in applying robust decision making techniques in practice. Therefore, it is necessary to design tools that take advantage of the best current information and also provide a way to highlight the lack of relevant data, as well as a mechanism to enlarge and improve their quality and quantity in future actions. The new composite indicators obtained by applying PROMETHEE are useful for ecosystem services assessment as mechanisms to balance all of their functions. Finally, it is interesting to point out that reliable data together with suitable

multicriteria tools are also necessary to classify and prioritize the alternatives according to a new paradigm of management of protected areas, to solve conflicts among stakeholders as well as to establish a basis for new forms of financing, such as payments for environmental services interesting in European Natura Network management.

Keywords: Ecosystem Services; Collaborative Management; Composite Indicators; Multiple Criteria Decision Analysis; AHP; PROMETHEE.

The Multi-Actor Multi-Criteria Analysis (MAMCA) Method and Tool

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Abstract

The Multi-Actor Multi-Criteria Analysis (MAMCA) is a method to aid groups in decision-making. Several stakeholders' opinions are explicitly taken into account during the entire analytical decision process in a structured way. This paper reviews the methodology's implementation. The MAMCA method has already proven its effectiveness in evaluating complex sustainable mobility and transport policy decisions (Macharis et al., 2012). The MAMCA software is an interactive web tool related to complex Multi-Actor decision problems. It helps to establish a supportive policy framework and provide long-term signals to all actors involved in the decision-making process.

So far an integrated approach of the Multi-Criteria Decision Aid software Expert Choice (AHP) and D-Sigh was employed, but it appeared necessary to focus research on the development of a web platform software adapted to the MAMCA, leading to a better visualization of the multi-actor view.

In order to create a global multi-actor multi-criteria analysis application, the MAMCA method has been implemented in a Java-based web application. MAMCA methodology differs from the classical approach of MCDA in the explicit introduction of stakeholders in a very early stage. Users of the MAMCA web application are divided based on their roles. The project leader defines new projects, suggests alternatives and criteria and invites all actors involved in the decision-making. Actors follow the steps of classical MCDA methods: defining the problem, defining alternatives, developing a set of criteria and evaluating the alternatives.

Actors can belong to different actor groups, each having their rights defined, e.g. whether or not they can create new alternatives and criteria. Survey people can also be asked to provide their opinions while not using the software.

In order to assess the different strategic alternatives, any multi-criteria decision analysis can be used. For instance, the PROMETHEE method has been extended in Macharis et al. (1998) and the analytical hierarchy process (AHP) method in Saaty (1989). In MAMCA, pair-wise comparison is used for weighting the criteria. The software is enabled with both AHP and PROMETHEE for evaluating the alternatives. Actors in MAMCA can overview the activities of each of their group members, besides having an analysis of their group as a whole. Finally, in multi-actor view, they can see the results and the multi-criteria analysis.

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PROMETHEE within the MAMCA methodology to evaluate the Mobile Depot Demonstration in Brussels

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Abstract

PROMETHEE-GDSS is used within the Multi-Actor Multi-Criteria Analysis (MAMCA). It allows stakeholders to evaluate different alternatives with regard to their criteria. This method was applied to evaluate an innovative urban freight solution; the use of a Mobile Depot in Brussels. The outcome of the analysis enables to see who is in favour and who has doubts. The GAIA plane is used to visualize the results.

Keywords: PROMETHEE-GDSS, GAIA, city logistics

Extended abstract

In an urban context different stakeholders are directly and indirectly involved in and harmed by distribution activities. Solutions to problems regarding city distribution are complicated as these different stakeholders have different objectives. Within the European FP7 project STRAIGHTSOL ('Strategies and Measures for Smarter Urban Freight Solutions') an evaluation framework has been developed aiming to incorporate the views of the different stakeholders. Within this evaluation framework the Multi-Actor Multi-Criteria Analysis (MAMCA) is used. The MAMCA, developed by Macharis (2000) is an extension of the existing Multi Criteria Analysis (MCA) and allows stakeholders to evaluate the current way of working and different alternatives with regard to different criteria which are weighted in an earlier step of the MAMCA. For each assessed alternative the positive and negative impacts on the identified criteria are pointed out. The outcome of the analysis enables to see who is in favour and who has doubts.

Within STRAIGHTSOL the evaluation framework was applied to the different demonstrations. One of these demonstrations was a mobile depot (MD) operated by TNT Express in the city centre of Brussels. It was evaluated using the PROMETHEE-GDSS method directly integrating TNT Express, shippers, receivers, citizens and the local authorities in the decision process. In total six alternatives were formulated to be compared with Business as usual (BAU). The first alternative was the demonstration. The other alternatives were possible future extensions. The analysis clearly showed the importance of the relations between different stakeholders. First of all the relations between the stakeholders based on their preferences with regard to different alternatives were visualized in the GAIA plane view (Figure 1). It showed that there were two clusters of stakeholder groups whose preferences had similarities with regard to the alternatives. There was a relatively large difference in the preferences of the economic

stakeholders on the one hand and the local authorities and the citizens on the other hand. The large angle between TNT Express and the citizens indicated that there was least similarity in their preferences. The place on the decision stick revealed that the alternative with a scaled MD and a high congestion charge contributed most to the criteria of all stakeholders combined and the current situation and the demonstration the least. Secondly, the extent to which the alternatives contributed to the criteria of each stakeholder group separately became clear.

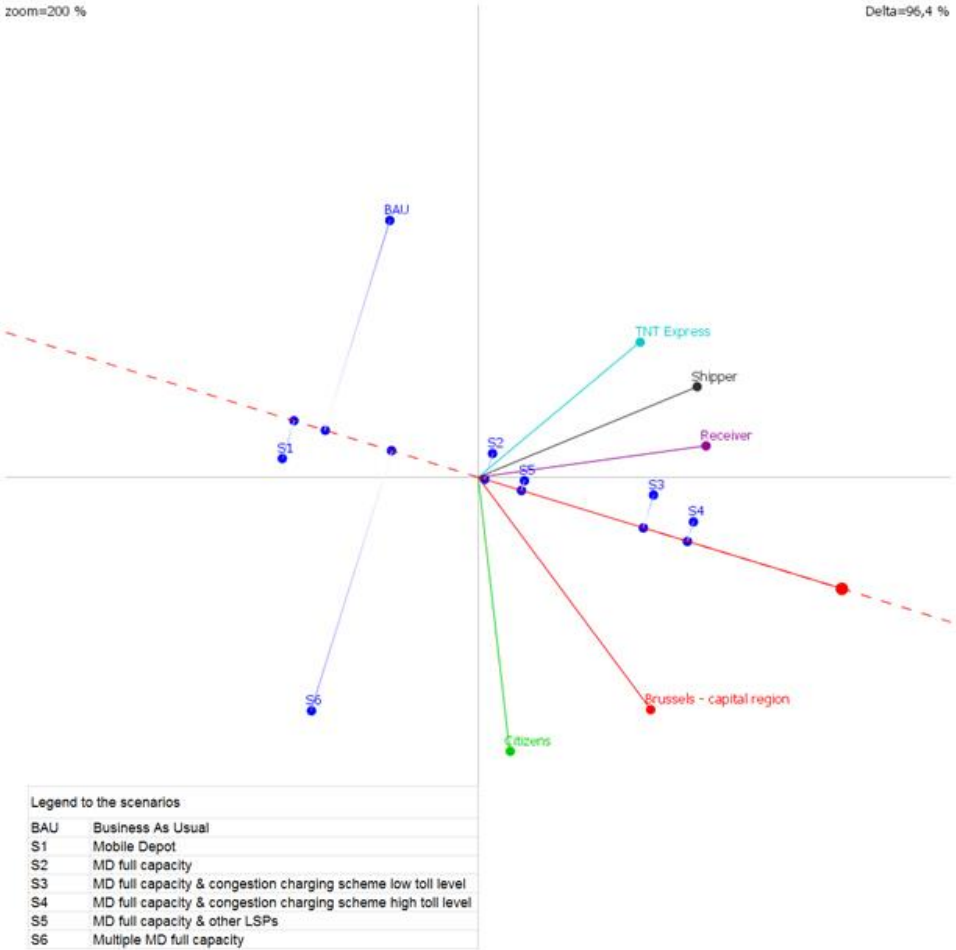


Figure 1: Multi-actor GAIA plane view Mobile Depot (STRAIGHTSOL, 2014)

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PROMETHEE-compatible representations of multicriteria evaluation tables

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Abstract

Most decision problems involve the simultaneous optimization of several conflicting criteria. Generally, the first step to solve such problems is to identify the set of alternatives and the criteria they will be evaluated on, leading to the construction of an evaluation table.

Of course, there are numerous ways to build such a table and to represent it. For a problem of n alternatives and m criteria, there are $n! \cdot m!$ possibilities of representation. However, from a multicriteria point of view some of them can be more interesting than the others. In this article, we will make use of the PROMETHEE and GAIA methods from which the extracted information will serve to restructure such tables.

In order to evaluate the properties of these PROMETHEE-based representations, an indicator will be defined that uses only ordinal information of the values contained in a given table. This measure will also serve as a fitness function for a genetic algorithm that will find good – if not the best – tables. These will allow to draw comparisons with PROMETHEE-based representations.

Keywords: Multicriteria decision aid, PROMETHEE, GAIA, Evaluation table, Visualization, Genetic algorithm

SMAA-GAIA: A Complementary Tool of the SMAA PROMETHEE Method

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Abstract

PROMETHEE [1] and GAIA [2] are well-known Multiple Criteria Decision Aid methods. Given an evaluation table and preference parameters they allow to rank the alternatives, to visualize the problem, to perform sensitivity and robustness analysis, etc [3]. Unfortunately, it is often hard for the Decision Maker (DM) to estimate the precise values of these parameters. Therefore an alternative option is to give ranges of potential values in order to apply Stochastic Multicriteria Acceptability Analysis [4]. This has been recently studied in the context of the SMAA-PROMETHEE method [5]. The aim of this contribution is to propose a SMAA extension of GAIA. We show how this tool can be useful and provide complementary information to SMAA-PROMETHEE. This is illustrated on a pedagogical example.

Keywords: MCDA, PROMETHEE, GAIA, SMAA

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PROMETHEE-related literature: some statistics

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Abstract

For this assessment the PROMETHEE Bibliographical Database created by B. Mareschal was used to sort out a review of publications that were related to the PROMETHEE methods. Behzadian et al. (2010) made a similar research based on 217 scholarly papers from 100 journals.

For this current review we retrieved 592 references (November 2014) related to this methodology, their theoretical foundations, their development and their application to real decision problems. The aim of this review is to provide an overview of the trends of use of PROMETHEE as evaluation methodology. The PROMETHEE Bibliographical Database allowed assembling publications covering the time frame going from 1982 until 2014 and their frequency per year (1982-2013). Furthermore this review allowed to give an overview of the use of the PROMETHEE methods in conjunction with the subject (category) and the time interval (years). Based on the following criteria: title, abstract, keywords and type of media, a pre-selection of the publications was made. Starting from this pre-selection, we first divided the retrieved papers based on the type of categories and sub-categories. Accordingly an ad hoc developed categorisation has been set up to standardize the identified categories. A distinction was made between the theoretical papers showing a potential application for the PROMETHEE methodologies and the more applied papers, actually using PROMETHEE for their 'practical' assessments. This categorization allowed also investigating on the variance. 88% of the retrieved publications are applied, the remaining 22% are 'theory of PROMETHEE methods' publications. Within the applied papers, only to mention some of the categories of appliance differentiated significantly, i.e.: Agriculture, Business and Financial Management, Chemistry, Energy Management, Engineering, Environment Management, Forestry, GIS, Hydrology and Water Industry, Information system, Risk Management, Social Public Welfares, Transport, Logistics, Waste Management, etc.

The PROMETHEE methods have gained importance as an evaluation method at international level. We see an increased importance of qualitative elements within the decision making process and as a result, an increased use of the PROMETHEE methods for real case application appraisals, especially over the time frame 2001-2011 (figure 1).

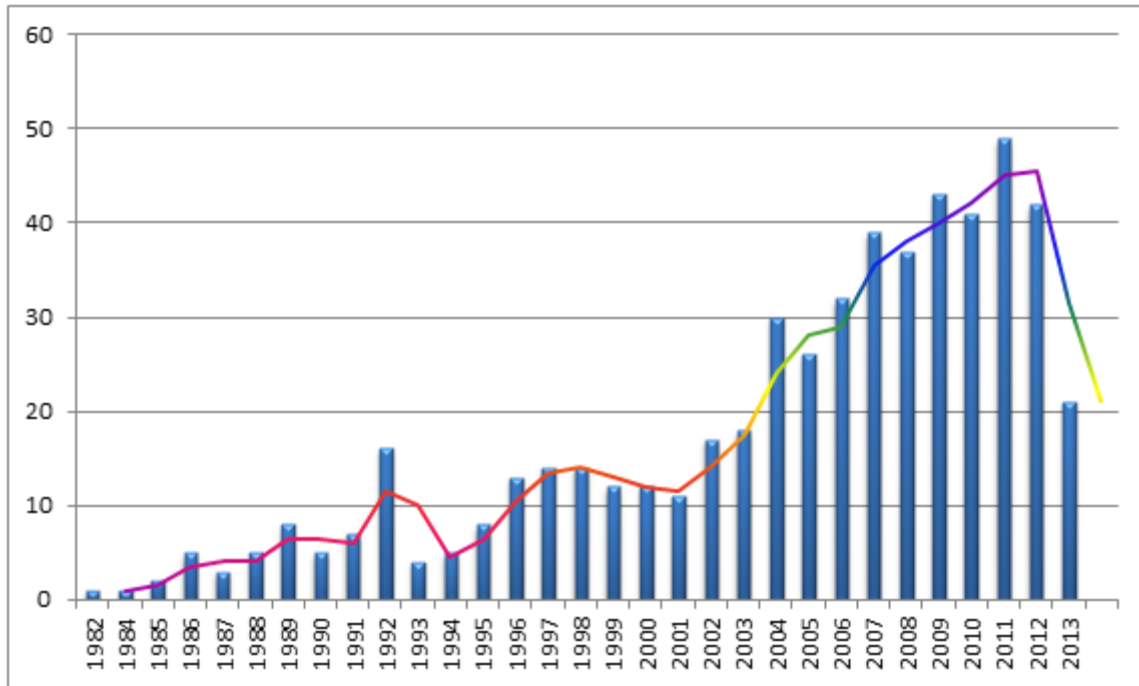


Figure 1: Number of PROMETHEE-related publications (1982-2013)

Source: own set up (2014)

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How to Obtain a Ranking of Individuals Measuring Their Excellence by Means of a Multicriteria Decision Model

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Abstract

A common problem in many areas, both public and private is ranking a group of individuals evaluated under different criteria which aim to measure their excellence.

In this paper we present a model belonging to the educational field, which establishes a ranking among students in the final year of Degree studies for the purpose of the election of their Final Degree Project (FDP).

The ranking obtained can be a partial or a total pre-order. These orders reflect the excellence of each student through a series of criteria, both qualitative and quantitative, taking into account the relevance that every criterion has for the academic authorities (Dean of the Faculty, Academic Secretary, etc.). We consider that PROMETHEE Methods are appropriate to manage this sort of decision problem. The study is enriched with the software Visual PROMETHEE, a new tool that has been designed to help the decision-maker in the decision process.

In this way a logic solution is obtained, devoid of inconsistencies and that can be firmly justified and therefore accepted by the academic authorities and by students who do not wish to be affected by arbitrary or changes in the rules.

Keywords: PROMETHEE Methods; Visual PROMETHEE; measure of excellence; Final Degree Project; robustness; sensibility analysis; weights.

Introduction

The decision problem that we face is the following: when students of Degree at the School of Business and Economics from the Universidad CEU San Pablo come to the last course must carry out a thesis or final degree project (FDP). This work has as many credits as a main-compulsory subject and the process of development of it should begin when the academic year starts. The election by the students of the FDP is usually carried out in the month of September or October, among those offered by the Faculty.

Until the academic year, 2012-2013, the criterion for establishing the order of election of the students was to give priority to those students who had better academic record. Given that the number of jobs that are offered by each Area of knowledge has a quota, those students have a privileged position with respect to their schoolmates. Many quantitative analyses

were taking into account and the conclusion was that the allocation system resulted in inconsistencies and sometimes became unfair. It is clear that we are facing a problem of Multicriteria Decision and we have to proceed to the solution of it, bearing in mind that it is not determined only by the basic information contained in the decision matrix, but that also depends on the decision-maker.

The best tools to deal with the problem: PROMETHEE and VISUAL PROMETHEE

PROMETHEE Methods have a large tradition in the field of Multicriteria Decision Aid and Visual PROMETHEE is the software that has been designed to help the decision-maker in the decision process. It is the most recent, complete and update tool to implement PROMETHEE Methods and GAIA Technique.

Since the objective of our work is not to make a detailed description of the methodology but use it as a reference tool for decision support models, next, we will describe the decision model at hand.

Decision Model: How to Obtain a Ranking of Individuals

The decision problem that we need to solve is to obtain a ranking of excellence among students of last degree course for the purposes of the choice of the FDP. This pilot study will be applied to only one of the degrees that are offered at the School of Business and Economics from the Universidad CEU San Pablo and consists of two groups of students.

Our alternatives are, logically, students who make up the two groups of the degree. For reasons of data protection and privacy, we will not indicate the names of the students but will call them as: op_1 , op_2 , etc. (referring to the number of options or alternatives). We have concrete data from each student, i.e., which will be reflected on quantitative criteria and qualitative data that were provided by the Dean (captured using various techniques).

The problem consists of six criteria. The elaborated model is flexible enough to incorporate other assessment judgments, to discriminate more, and therefore get more reliable decisions. The criteria considered in the problem are: academic record, specific activities, Business Program, copy in exams, written warning, delegate/sub-delegate (representative function). The vector of weights was given by the Dean: academic record receives a 90% of importance and the remaining 10% is divided proportionally among the other criteria.

Final results

The global ranking obtained among students in the pilot study analyzed, reflects the positioning of each student with respect to his schoolmates and the priority that has when choosing his FDP. The breakdown of scores in the remaining criteria is a further guideline that allows the student to recognize the absence of arbitrariness and uncertainty when he comes to the final decision. The detailed study of the rankings of each of the criteria, individually considered, offers students a clearer view of those "weak points" that should do

more to increase his total assessment. The solution obtained is logical and has a clear justification both for students and the Dean. The global attractive of every option has been studied with respect to each criterion; criteria have been weighted and we have explored the results of the model through an exhaustive analysis of robustness. In the coming academic years we will try to improve the model and apply it to all the degrees of the Faculty.

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Multi-criteria decision aiding in the process of applying for AACSB accreditation

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Keywords: AACSB accreditation, Comparison Groups, Comparable Peer Group, Aspirant Group, MCDA methods, PROMETHEE II with veto threshold, EXPROM II with veto threshold, MARS

Introduction

AACSB International is a global, non-profit membership organization of educational institutions, businesses, and other entities devoted to the advancement of management education. One of the major activities of this organization, established in 1916, is providing internationally recognized accreditation for undergraduate, master's, and doctoral programs in business and accounting.

The scope of the AACSB accreditation covers the following: curricula, broadly understood organization of studies, scientific achievements, qualifications and structure of the employed faculty, realization of various forms of international cooperation, teaching and scientific facilities, administrative services. Earning this prestigious accreditation means that an accredited educational institution is capable of meeting rigorous quality standards developed and revised by AACSB International. Nowadays only about 5% of the world's 13 thousand business programs hold AACSB accreditation.

Earning AACSB accreditation requires passing through a multi-step process in which it is necessary to take many different decisions. One of them concerns the identification of three Comparison Groups including: a group of competing schools (Competitive Group), a group of comparable schools (Comparable Peer Group) and a group of schools providing a developmental goal for the applicant (Aspirant Group). The Comparison Groups are used to determine a relevant context for judging how a school sees itself as well as to provide a pool of potential Peer Review Team members that may better understand the applicant and its aspirations, avoiding simultaneously potential conflict of interests from competitive schools.

The aim of this paper is to apply multi-criteria decision aiding methods based on the outranking approach from the PROMETHEE family in the process of selecting:

- Comparable Peers – schools considered similar in mission and assumed appropriate for performance comparison to school applying for AACSB accreditation,

- Aspirant Group – schools that represent management education programs or features that the school applying for AACSB accreditation hopes to emulate, and place the vision and strategy of the applicant in context.

The analysis will be carried out from the perspective of one of a few Polish schools applying for AACSB accreditation.

Methodology

In order to identify Comparable Peers and Aspirant Group for the school analyzed the PROMETHEE II method (see Brans, Vincke, 1985; Brans, Vincke, Mareschal 1986) with veto threshold (see Górecka, Muszyńska 2011; Górecka, Pietrzak, 2012; Górecka 2013) and the EXPROM II method (see Diakoulaki, Koumoutsos, 1991) with veto threshold (see Górecka, Szałucka, 2013) will be applied. Thanks to the introduction of the veto threshold both techniques are partially compensatory, which is desired in the problem considered.

Furthermore, since in the case of some criteria it is more convenient to use the descriptive evaluation scale and to express preferences linguistically, a two-step procedure based on the outranking methods and on Verbal Decision Analysis (Larichev, Moshkovich, 1997), has been proposed for solving the problem concerned: in the first step the PROMETHEE II method with veto threshold and the EXPROM II method with veto threshold will be applied, and next, in the second step, MARS technique (Górecka, Roszkowska, Wachowicz, 2014) will be used.

Evaluation criteria for the problem considered have been identified mainly through the AACSB requirements review. Data has been collected mostly from the AACSB accredited schools' web pages and from the AACSB DataDirect, which is the most comprehensive database on business schools worldwide.

Results

The procedures exploited according to the approach proposed are not too demanding for their users at the informational level and they can definitely assist with identification of comparison schools. Since their assumptions are in accordance with the reality, they can improve and simplify the process of selecting.

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