MATH-H-405 : Decision aid for a academic development plan

Thomas Meessen

Abstract

The complex task of ranking proposals of professorship present a good opportunity to experience the usage of MCDA tools. The points of difference and their relative importance are presented and the weight are distributed using a Majority - Marginal - Compromise approach. The result is credible and stable. The stability is then analyzed to provide instruction to defend the result to a management team.

1 Motivation

Universities are the seat of a number of complex decision where balance are needed between different objectives;

- High quality teaching and life-quality while studying
- Making breakthrough in research
- Civil engagement in moral objectives like diversity and practical like language information
- Services to the industry
- International aid in development

To better manage the ever so scarce resources and given the ambitions of the different missions the universities are often made of a number of faculty that pooled they resources. It ideally create an healthy environment in which each project can compete for access to a "large" pool of resources. Resolving this competition often require good practices in negotiating coherent objectives at each level of management (University, Faculty, Service, ...).

A common tactical choice assumed by each faculty is the attribution of the resources into selected professorship. The importance of a professor to a service can not be underestimated and for good management practice sometimes the faculty ask proposals to complete a 5 years development plan. With the contract of a professor not limited to 5 years, everything is not reshuffled at each time. But decisions are still required for example to smooth changes in the faculty's resources pool and to reallocate eventual or planned departures.

The choice of this tactical plan is complex and will mobilize strategic reflexion

within each group to build a candidate profile that might give the best benefit to the faculty. But the benefit space is large and possible categories of gain include research workforce, teaching activities attractiveness, industry synergy and also organization-based behavior like equity.

This case seemed relevant to assess the possibility of a Decision-Making tool called D-Sight. On paper it would propose a grounded, complex and interesting choice offering a good experience of using this tool in a management case.

2 Criteria

The differentiation of each proposal is based on a the submitted strategic assessment made by each smaller entity inside the school. The articulation between different points of comparison is started by the required list of evaluation published by the management prior to the submission. These however are not all off the criteria that have been applied as it was the first time that process was implemented. Some others characteristics have been found to emerge from the following debates or from the submitted files.

2.1 Criteria communicated prior to submission

Associated teaching need

An faculty program have submitted a profile for it's well being and development. The critical aspect of the proposition is evaluated qualitatively based on the description submitted.

- 3: If not obtained some essentials parts of the programs will have to be dropped
- 2: Required to maintain current offer but minor adjustments are possible
- 1: Will contribute to the program's development.

For this criteria the difference between two alternatives are of exponential importance with regards to their score difference.

Develop a research group in the direction defined by the school

The sucess of an enterprise is often correlated with it's ability to concentrate it's resources on a select few chosen tasks or objectives. The proposed profile is given a score for the synergy of it's research contribution with the school strategy.

- 3: Complete support of the strategy
- 2: The contribution consolidate actual current orientation
- 1: The subject is innovative or support ancient subjects

A innovative orientation is not much worse than a partial contribution but is better than it so a threshold of 1 is applied to evaluate the ranking contribution of this criteria. Any correlation with the objective of joint programs is relevant in this criteria.

Synergy with the school resource

The candidate professorship is able to leverage the specificities of existing teams from both the teaching or the research point of view.

- 3: Strongly
- 2: Moderately
- 1: Marginally

No significant appreciation between the research or the teaching perspective is expressed. A gap of 2 in this score is more evaluated than a gap of one hence, a linear evaluation of the difference is chosen.

Start-up cost

Does the research activities require further funding to start ?

- 2: No
- 1: Yes

Contractual research opportunity

The research activity proposed is likely to attract industrial of institutional investment. A simple 3 - shade score is proposed because of the likely relative lack of definition of the candidature. An emphasis is put on research area that have already proven their attractiveness.

- 3: The field has been historically attractive
- 2: Given the economic development their is potential
- 1: Not of common industry interest

Teaching attractiveness

Having a rich program both in terms of quality or in terms of content is a fundamental to attract student and investment. Having courses fleshed out with specialized knowledge from various professor is a strong point of differentiation. A 3-shade description is simple enough to give a classification on a consensus might agree.

- 3: Contribute to multiple programs including prioritized programs
- 2: Contribute to enrichment of a specialized program
- 1: Inter courses synergies are not apparent

2.2 Discovered criteria

Those aspect of a professor profile have been submitted in addition to the required vision. And/or have been used by management do describe their solution.

Contractual obligation

In the case of previous contracts needing this profile to be fulfilled this criteria is set to be advantageous.

One way to use this criteria is to set the associated weight to 0. If the required profiles are not at the top then one can increase the importance of it until the result is satisfying. The importance of this criteria can be computed for each concerned alternative in order to represent how competitive the alternatives are. Moreover, it provides an estimate on the loss of opportunity caused by a contract.

Values:

- 2: Yes
- 1: No

Integration in a program strategy

The program(s) benefiting from the potential professorship have made the proposal motivated by a strong strategic reflexion on the program cost-attractiveness.

- 2: The professorship is well integrated within the program strategy and reforms.
- 1: The program did not propose strategic evaluation on the program cost-attractiveness.

Contribution to teaching cost

The context of the decision is one of scarcity and as such one objective is to reduce the cost by student of each program. If impacted courses are intended to develop a program they receive a minus while professorship resulting from a merging of previous functions will obtain a bonus.

- 3: New program deliver a reduction of cost for a degree.
- 2: Replacing existing courses, no change in the overall cost
- 1: The majority of impacted program will see an increase of costs.

Opinion of board of advisers

A boards of selected industrial representatives have ranked each proposition following their insights on the future positioning that engineers should have. Given the complexity of sampling the industry to create a board able to give a neutral opinion only three category will used.

- 3: Top performer
- 2: Average interest
- 1: Weak potential.

Strategic partnership

The profile is designed to reinforce, develop or fulfill strategic partnership with other faculty or organization. This refer to historical or opportunistic relation that are not directly related to the poles but should be maintained.

- 2: The profile play an essential role.
- 1: No

Investments exploitation

External investment previously received by the faculty are available for exploitation by the proposed professorship. It can be materials, team members that may result in additional results in terms of research.

- 2: Yes
- 1: No

3 Alternatives

Due to the favorable context the alternative set is inspired from a recent submission process. The following profile for a future professorship have been presented.

- **Mechanical and Aeronautical Engineering** with emphasis on Multiphysics problem. This profile would strengthen strategic relation with the Von Kerman Institute, will develop the faculty towards space science and will assure the well-being of the Aerodynamic master.
- **Data-Driven Modeling of Multi-Scale Biological Processes Modeling**. A profile aimed a developing a trans-disciplinary resource used in cooperation with a number of existing initiatives, it will further develop the faculty of Bioengineer and will some of the bachelor's mathematical course.
- **Computational Quantum Mechanics**. Research profile in a historical domain of excellence at the ULB.
- **Data-Science**. Ensure the continuation of a contractual EU-funded master and strengthen the position of another inter-faculty master. The research potential is highly supported by the industry and exploit planned investment in research equipment.
- **Structural Engineering**. Resource needed to fulfill a master. While research domain is pertinent no EU-funding in the research group and industry contract have been reported.
- **Mathematic for the engineer**. Pedagogic profile of critical importance in all the faculty formation and contract-enabler for the industry by association to existing reasearch resources.
- **Nanophotonics**. Fulfilling existing course that have lost resources in a master and possible teaching opportunity in bachelor. Aimed in response to European's intent to assume leadership in Quantum Technologies and exploiting existing precious research equipment.
- **Radiophysics**.

- **Cybersecurity of communicating systems**. A important field of expertise nowadays, the development of cybersecurity is strongly supported by the faculty and associated partners. The professorship will contribute to number of existing program, some of which are required by contracts.

4 Evaluations

Criteria	Aero	Bio	Quant	Data	Struct	Math	Nano	Radio	Cyber
Teaching needs	3	2	3	3	3	3	3	1	3
Research adequacy	2	2	2	3	1	2	1	1	3
Synergies	2	2	1	1	1	3	1	1	1
Startup cost	2	2	2	2	2	2	2	2	2
Contractual obligation	1	1	1	2	1	1	1	1	2
Contractual opportunity	2	1	1	1	1	1	1	1	1
Teaching attractiveness	2	2	1	1	1	3	1	1	1
Contribution to costs	2	1	2	2	2	3	1	1	1
Board of advisers	2	2	1	3	2	3	1	1	3
Strategic partnership	2	1	1	2	1	1	1	2	2
Investments exploitation	1	1	1	1	2	1	1	2	1
Program strategy	2	2	1	2	1	2	1	1	2

4.1 Discrimination power

Teaching needs have a little discriminating power because the context of recession have created a implicit restriction on the proposed profile to only what is required to maintain much of the previous offer in terms of courses. This criterion is marked for potential reduction.

The **Setup cost** has already been mentioned to have no power due to the recession context and is removed from the discussion.

Contractual opportunity is also not relevant given the sampling of proposals that is available.

5 Weights

A number of the studied points of differences concern naturally the alignment of the proposal with the faculty strategy in terms of research and reduction of cost. Creating the concept of strategic alignment score seems a good start to create the relative evaluation of each points.

5.1 Strategic alignment

> *Given two solutions is it preferred to have a slightly better research alignment or a advantages in terms of cost by student?*

Immediately anyone will tells that this question is not pertinent because it do not reflect the complexity of the reality. The two types of advantages are not comparable. Mainly because there is not enough resolution in the informations available to cast a meaningful vote. More precisely, the management is not yet at a level that enable a program cost analysis precise and trusted or to formulate the best research direction. Because the two indicators have no relative evaluation a possible alternative a to build an aggregate of them using the following rule extended for disadvantages:

Research alignment	+	+	0	+	-	-
Cost reduction	+	0	+	0	+	-
Strategic Alignment	++	+	+	+	-	- -

This table is not practical therefore a approximation should be used such as giving to each separate alignment an equal weight.

Strategic alignement (SA) = 1/2 (Research + Cost)

5.2 Breaking a tie

Strategic Alignment is understandably the most important criteria however it has a limited resolution. The role of a tie breaker is push the profile that present the best design but not giving it enough so that it may step over one advantage in alignment.

weight(Marginal advantage) < 1/5 weight(Strategic alignment)

The criteria that have the potential to give a marginal advantage are the following:

- Research synergies
- Contractual opportunities
- Board of advisers
- Investments exploitation
- Startup cost
- Teaching attractiveness

To assign the relative weight it is required to introduce some new assumption on what could be a desired solution. Note that those assumptions should be debated by a strategic committee before usage.

> *A good research synergy and enrichment of the program should place the alternative at the top*

Potential contracts and the opinion of advisers are more important than not having to acquire new equipment

Exploiting existing investment is not as much important as following the trend in the industry

With the result :

Research synergies	30
Teaching attractiveness	30
Board of advisers	12.5
Startup cost	10
Investments exploitation	5
Contractual opportunities	12.5
Marginal advantage	

5.3 Opposition to Strategic Alignment

Strategic partnership should be allowed to happen at the cost of some strategic alignment

Fulfilling the needs for teaching in a program can not always be done without compromising on the strategic goals.

In no situation should an alternative that is barely aligned with the faculty objectives be allowed at the top ranking.

To satisfy those conditions a first step is to give a minimum to the influence of SA:

2/5 * weight(Strategic Partnership) > weight(Marginal) + weight(Opposition)

A acceptable choice is to give more importance to teaching need and then fixing the weight of the Opposition criterion then :

weight(Opposition) = 1/4 weight(Strategic Partnership)

weight(Teaching Needs) = 1/5 weight(Strategic Alignment)

5.4 No-go criterion

What about the case of programs that submit a **professorship without an accompanying reform** of the program? It seems that this criterion is logically tied to the reduction of cost and the strategical position of the program. But it is more a no go criterion that should trigger the rework of the proposal than a pertinent discriminating aspect. However in the case studied the prior statements did not included it as a requirement leaving the impacted alternatives to be **dropped without practical option of resubmitting** a proposal.

5.5 Weight distribution

- Strategic alignment (74%)
  - Research adequacy (50%)
  - Cost reduction (50%)
- Marginal gain (7.5%)
  - Investments exploitation (5%)
  - Advisers (12.5%)
  - Contractual opportunities (12.5%)
  - Synergies (30%)
  - Startup cost (10%)
  - Teaching enrichment (30%)
- Opposition to strategy (18.5%)
  - Strategic partnership (50%)
  - Teaching needs (50%)

6 Discussion

The obtained ranking is:

- Mathematic
- Data-Science
- Aeronautic
- Cybersecurity
- Bio-modeling
- Computational Quantum
- Nanophotonics
- Radiophysics

Without surprise this ranking is highly sensible to a change of weight in the 50/50 split in strategic alignment. Reducing the importance of proposing a profile that result from the merging of previous professorship will place the Data-science profile at the top.

A semi-surprise is also that the opinion of the board of adviser is not having an influence even if the associated weight were to be increased up to be a major player.

Based on this analysis in someone would desire to defend the proposed ranking he would have to insist on the importance of assessing the cost of each program. Effectively pushing to the attendance the importance of proposing different scenario to reform a program to concentrate the cost on the focus of the faculty. But this would be quite impossible to say to people that have submitted their proposal without receiving specific instruction to accompany it with a reform of the costs.

7 Concluding remarks

The framework for decision making that a MCDA like D-Sight offer is useful in management because computing the model (criteria, weight and evaluation) is accessible. It is also a powerful communication tool that allow to offer an information succinct way but with the possibility for each one to dive right into the small details in order to carefully craft a decision matrix. However the success of the discussion around the evaluation and the weight is highly dependent of the strategy clarity. Indeed a strategy is required for evaluation and if no agreement in found on the strategy then MCDA are of no use.

But the framework definitely offer precision and efficiency in management is used with transparency. If not then it's worth nothing due to the sensibility to it's parameters.