Towards improving tenders for Higher Education timetabling software

“Uncovering the selection criteria of HEIs when choosing timetabling applications, using ERP as a reference”

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Abstract Higher Education Institutions (HEIs) are under constant competitive pressure, resulting in the increased importance of achieving both efficiency and effectiveness in such organizations. This intensifies the importance of selecting a suitable timetabling software application, which can be considered to be at the heart of the organization, as it supports organizing the primary process. The timetable software regulates the scheduling of teachers, students and staff, and thus significantly impacts on their effectiveness and efficiency. The selection of such an important application is an essential first step for managing and controlling the schedules.
The contribution of this paper is threefold. First, we decide on a method for comparing the criteria found in tenders to software selection theory. We select and analyze an existing model for selecting ERP software from the literature. Second, we evaluate public tenders submitted in several northwest European countries from 2003 to 2016 and demonstrate that HEIs use a varied and incomplete set of tender criteria. Third, we apply the ERP software selection model to the selection criteria of timetabling applications in HEIs. We present and discuss the model as the approach for HEIs to select timetabling applications in a more structured and consistent way, intended to lead ultimately to use resources more effectively and efficiently.

Keywords Higher education, timetabling, public tenders, selection criteria, ERP

1 Introduction

Timetabling applications are essential for HEIs to control the effective and efficient deployment of teachers, staff and other resources (SURF, 2014), as HEIs are in a constant race to lower costs while attracting more students at both the national and international levels (Jacob, 2015). This results in an increasing demand for flexibility, meaning more student- or individual-centered timetabling practices (Cook-Sather, Bovill, & Felten, 2014) (Oude Vrielink, Schepers, & Jansen, 2016). Selecting a suitable timetabling application that maximizes the efficiency and effectiveness of a HEI is therefore critical.

Timetabling applications are concerned with “the allocation of resources to specific objects being placed in space and time, in such a way as to satisfy as nearly as possible a set of desirable objectives, subjected to constraints” (Wren, 1996). A timetable is not acceptable when any hard constraint is violated, whereas it is considered feasible when no hard constraint, but only some of the soft constraints are violated, which is usually the case. Timetabling tries to approximate optimal solutions as it is an NP hard problem (Moura & Scaraficci, 2010) (Bettenelli, Cacchiani, Roberti, & et al., 2015), meaning that for large instances only feasible rather than optimal solutions can be found in limited time. Three categories of university timetabling can be distinguished: Examination Timetabling, Post-Enrolment-Based Course Timetabling and Curriculum-Based Course Timetabling (Second International Timetabling Competition, 2007) (Di Gaspero, McCollum, & Schaerf, 2007). We consider software applications dealing with one or more of these categories to be timetabling software applications.

HEIs regularly re-evaluate their current timetabling software and make a decision on whether they should keep it as-is, modify it or replace it. A public tender must be issued when the decision is made to acquire a new application and the value of the contract exceeds the threshold that is laid down in EU regulations. This threshold was €209,000 in 2016 for the total costs of purchase, implementation, maintenance and other additional costs, combined over a time period of 5 years (Europa.eu, 2016). This means that HEIs will generally have to issue a tender when acquiring new timetabling software. At the end of such a tender process, the contract is awarded to the vendor who best meets the requirements set out in the tender.

This paper first surveys the literature on selecting timetabling software applications for HEIs. Second, a suitable model is proposed incorporating criteria for selecting timetabling software applications. For this purpose, we analysed ERP theory, as timetabling is considered to be a form of an ERP process (Rabaa'i, Bandara, & Gable, 2009), and, where in contrast with timetabling theory and practices, there is an extensive knowledge base. Third, this paper examines the currently used selection criteria by HEIs in selecting timetabling software applications and compares these criteria to the theoretical model. Finally, we demonstrate that the model is applicable when combining the findings from literature and looking at practical relevance. We propose that applying this specific ERP model in the selection process of timetabling applications is a good step towards improving timetabling application selection and consequently towards improving the competitiveness of the HEI as a whole. This results in the following research question:
What can be learnt about current practices in timetabling application selection issued by HEIs, when comparing tenders to ERP system selection theory?

To find answers to this question, we search for answers to the following sub-questions:

- What model for tendering ERP software can also apply to tendering timetabling software?
- To what extent are selection criteria used by HEIs in tenders similar, when selecting a timetabling application?
- To what extent does ERP theory capture timetabling tender criteria in HEIs?

Figure 1 shows the roadmap of the research process to help improve the tenders for timetabling software.

![Roadmap of research process to improve tenders for timetabling software in HEIs](image)

Section 2 discusses the literature about timetabling in higher education. Section 3 addresses the selection of a suitable ERP model for evaluating public tenders. Section 4 gives an outline of all the selection criteria used by HEIs in their tendering processes when selecting a timetabling application and compares them to each other. Section 5 analyzes these selection criteria by comparing them to ERP theory. All selection criteria set out in the tenders are compared to determine to what extent the ERP theory matches these criteria. In the final section, we present our conclusions and recommend further research.

2 Literature

Searching in Google Scholar, Web of Science and in Scopus reveals that little research has yet been performed on the subject of the selection process for timetabling software applications for HEIs. We used the following search query to search for papers and other theory on software selection in higher education in the areas of computer science, business, decision support or economics:

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TITLE-ABS-KEY("Software Selection" AND "Higher Education") AND ( LIMIT-TO ( SUBJAREA,"COMP" ) OR LIMIT-TO ( SUBJAREA,"BUSI" ) OR LIMIT-TO ( SUBJAREA,"DECI" ) OR LIMIT-TO ( SUBJAREA,"ECON" ) )
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Figure 2 shows that there are only a very small, but increasing, number of papers concerning the selection process of timetabling software in HEIs. We also found that these papers are only occasionally cited and, perhaps for that reason, they are limited in their relevance. For instance, one paper is concerned with the comparison of two implementations of SAP R/3 scheduling modules, which does not provide any scientific grounding for improving the tendering process. Furthermore, we searched for articles that cover the selection of software within the higher education sector, which limits the number of results but increases the relevance of the search results.

Figure 2 Count of papers found on the selection process of timetabling software in HE

Enterprise resources planning (ERP) has its roots in the field of manufacturing resources planning, but has come to have a more central position and influence on the enterprise-wide operations of an organization (Chen, 2001). Timetabling is considered to be a subset of ERP (Rabaa'i, Bandara, & Gable, 2009). Even though timetabling is only a part of the much wider field of ERP, both ERP and timetabling systems are central systems that greatly influence almost all aspects of an organization. However, the field of ERP research is a much more mature field of research than the field of timetabling in HEIs, and can therefore be used as a reference to evaluate the tenders collected from HEIs. Better insight into the selection criteria used by HEIs in selecting timetabling applications and evaluating the process, can be achieved in a systematic way by comparing ERP system selection with the actual tenders for selecting timetabling software applications.

3 Selection of an ERP model for timetabling software tenders

We used the literature from the field of ERP to establish the model as there are, to the best of our knowledge, no theoretical models of this kind in the specific field of selecting timetabling software. However, in the ERP literature there is a high number of models for selecting software systems, based on scientific research. We compared ERP software selection models with each other in order to find an established model consisting of a set of useful selection criteria and also influencing system selection when considering the weight of the key criteria. Figure 3 shows the outline of the search for potentially relevant ERP theories. The search with only the first three criteria led to 40 relevant papers, and we found that most models are based on earlier models. Of these, one paper is by far the most cited, is considered well-established and uses weighted selection criteria for system selection applicable in higher education.
This most-relevant model we found is the ERP system selection model proposed by Wei, Chien and Wang (2005). It covers the selection criteria for ERP system selection used in other literature such as Van Everdingen, Van Hillegersberg, & Waarts (2000), Verville and Halingten (2002), Kumar et al. (2003) and Hecht (1997). In the academic search engines Google Scholar, Scopus and Web of Science, this article is frequently cited on this subject. It is referenced as a key source for many other papers on ERP and therefore is a useful source from which to further explore and derive theory for timetabling system selection in HEIs. The paper may seem outdated because it was published many years ago, but that only strengthens the idea that it is the original paper with the original theory on ERP system selection, and the basis of many other papers on this subject.

When selecting software, one could use multi-criteria decision making or multi-criteria heuristics. Korkonen et al. (1992) wrote an, in our opinion, excellent article that provides a review of multi-criteria decision support. Wallenius et al. (2008) wrote a follow-up to this article. We have personally been involved in several tenders and, to the best of our knowledge, HEIs do not use multi-criteria decision support systems when selecting timetabling software. This provides further support to our proposal to use the model by Wei et al. (2005) as the best suited model to evaluate the selection process.

That model consists of two main parts, in which both the system itself and the supplier are assessed. The first part includes categories of selection criteria for selecting the most suitable ERP software system for a particular organization, while the second part encompasses categories of selection criteria for selecting the most suitable ERP vendor for a particular organization. The model has nine categories of selection criteria, which are taken into account when selecting an appropriate ERP system, divided into the two main parts system and vendor. The categories of selection criteria according to Wei et al. (2005) are set out in the table below.

<table>
<thead>
<tr>
<th>A. Selecting the most appropriate system</th>
<th>B. Selecting the best vendor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Minimising Total Costs</td>
<td>7. Having Good Reputation</td>
</tr>
<tr>
<td>3. Having Complete Functionality</td>
<td>9. Supplying Ongoing Service</td>
</tr>
<tr>
<td>4. Having User-Friendly Interface and Operations</td>
<td></td>
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<tr>
<td>5. Having Excellent System Flexibility</td>
<td></td>
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<tr>
<td>6. Having High System Reliability</td>
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</table>

These categories have each been given a specific weighting, indicating their relative importance.
3.1 Most suitable system selection criteria

We first discuss the six categories for selecting the most suitable system.

3.1.1. Minimizing Total Costs
This category of selection criteria encompasses factors contributing to the costs of the system. The model makes a distinction between (1) price, (2) maintenance costs, (3) infrastructure costs, and (4) consulting expenses. We consider price to be the direct cost of gaining the right to use the software. Maintenance costs are considered the costs brought about by repairs and fixes to keep the system performing as expected, not to be confused with infrastructure costs which are the costs of the support systems that enable the software to run. Consulting expenses are the costs of consultancy, mainly during the implementation phase.

3.1.2. Minimizing Implementation Time
This category includes selection criteria concerned with the implementation time of the system. It contains criteria related to the (1) planning and (2) implementation timeframe for the system in the organization.

3.1.3. Having Complete Functionality
This category contains criteria contributing to ensuring complete functionality of the system. The model makes a distinction between (1) module completeness, (2) function fitness, and (3) security. Module completeness criteria ensure that the system contains all the modules the HEI expects it to have. Function fitness ensures that the implementation fits within the current timetabling process. For instance, the criterion that a system can import student data is therefore a module completeness criterion, while the criterion that the system should be able to handle at least 40,000 students is considered to be part of function fitness. The final subcategory of these selection criteria, namely security, contains criteria which ensure the security of the data held and produced in the system in terms of both unlawful external access and unlawful internal access.

3.1.4. Having a User-Friendly Interface and Operations
This category of selection criteria encompasses factors contributing to the user-friendliness of both the interface and the operations of the system. The model makes a distinction between (1) ease of operation, and (2) ease of learning. Ease of operation means that operations within the system can be done in a sufficiently easy and quick manner. Ease of learning means the effort that users of the system—especially new users—have to put in to learn to use the system.

3.1.5. Having Excellent System Flexibility
This category encompasses all the selection criteria contributing to the flexibility of the system. The model makes a distinction between (1) ease of integration, (2) upgrade ability and (3) ease of in-house development. Ease of Integration concerns the connectivity of the system to other systems already in place. Upgrade Ability deals with the ease of upgrading, such as the ability to develop and implement upgrades. Ease of In-House development concerns the extent to which the system can also be upgraded and adapted by the HEI itself.

3.1.6. Having High System Reliability
This category encompasses all the factors contributing to the reliability of the system. The model makes a distinction between (1) stability, and (2) recovery ability. Stability concerns the selection criteria ensuring that the system will not stop functioning when faced with unexpected internal and external influences. This in contrast to recovery ability which concerns the criteria that will ensure the system is able to recover back to a functioning state after it stopped functioning.
3.2 Best vendor selection criteria

Next, we discuss the three categories of selection criteria that involve choosing the most suitable vendor.

3.2.1. Having Good Reputation
This category of selection criteria encompasses all the factors contributing to the reputation of the vendor. The model makes a distinction between (1) the scale of the vendor, (2) financial condition, and (3) market share. Scale of vendor criteria are concerned with the size of the vendor. Financial condition criteria are concerned with the financial standing of the vendor. Market share criteria concern the number of other organizations using the system.

3.2.2. Technical Capability
This category encompasses all the factors contributing to the perceived technical capabilities of the vendor. The model makes a distinction between (1) research and development ability, (2) technical support capability, and (3) implementation ability. The ability of the vendor to research and develop new technologies is classified as a Research and Development criterion. Technical support capability criteria are concerned with the ability of the vendor to deal with technical difficulties while implementation ability criteria are concerned with the ability of the vendor to implement agreed and specified functionality.

3.2.3. Service
This category encompasses all the factors contributing to the vendor providing ongoing services. The model makes a distinction between (1) warranties, (2) consultancy services, (3) training services and (4) service speed. Warranty criteria are concerned with the warranties the vendor provides in case the system or the implementation process do not meet the promised levels. Consultancy services cover the criteria ensuring the number of consultants and experience of the consultants working at the vendor. Criteria concerned with the amount of training time and the quality of the trainings are bundled into training service criteria. Service speed is concerned with the required response time of the various services.

4 Selection of tenders used in higher education

This section is concerned with the evaluation of the tenders and grouping the information in these tenders to find out the selection criteria used in tenders for timetabling software in HE. First, we searched for suitable tenders. Then, we listed all demands and requirements in these tenders and grouped them. We searched for similarities and differences used in these actual tenders from HEIs and compared them to the ERP model to find out to what extent tenders can be improved by learning from each other and from theory. We considered tenders that comply with the following three rules:

1. The tender is for a timetabling application (may also be termed a timetabling system)
2. To achieve comparability, the tender is issued by an HEI located in the North-West region of Europe (i.e. Benelux, Scandinavia, Germany, UK and Ireland)
3. Not only the RFP, but also more explanation in accompanying tender documents are available.

The tenders were gathered by searching the “online version of the 'Supplement to the Official Journal' of the EU, dedicated to European public procurement” (TED, n.d.). The selection criteria were then extracted from the tenders in order to be able to compare them to each other and analyze them using the ERP selection model.
4.1 Analysis of the categorized selection criteria

The categorized selection criteria were analyzed to determine to what extent the requirements of the actual tenders can be labelled employing the criteria of the ERP software selection model, and, vice versa, to what extent the categories of the ERP software selection model can be found in the tenders. To achieve this in both directions, means that we maximized the opportunities to learn from both theory and practice. Possible categories presented in the tenders that are not present in the ERP software selection model, were found by evaluating the newly created category ‘Miscellaneous’, which contained selection criteria from tenders that could not immediately be allocated to an existing category. In addition, the weight of the categories relative to each other was analyzed and compared to those used in our ERP evaluation model.

5 Analysis of timetabling tenders

Eighteen tenders were collected for this research, from The Netherlands, Belgium, the United Kingdom, Ireland and Norway, and which were published between 2003 and 2016. The process of extracting the selection criteria from the tenders was difficult because of the very different formats and structures of the tenders. It became apparent that they lack consistency and do not use any kind of general framework.

Figure 4 Map of the origin and the number of tenders found on timetabling in HEIs

5.1 Cleaning the data

A first indicator for the quality of a tender is the number of categories of selection criteria it addresses. Figure 5 shows how many tenders addressed how many categories. Of the tenders evaluated, one outlier only addressed two categories. The remaining 17 tenders addressed on average 7.4 of the 9 categories from the model, ranging from 5 up to the full 9 out of 9 categories. The outlier is therefore eliminated from the dataset as we suspect there is incomplete documentation. The remaining dataset consisting of 2,190 selection criteria was divided into the 9 different selection categories from the ERP model, and 46 selection criteria did not fit in any of these categories and were thus classified as ‘Miscellaneous’. This accounts for an average of 132 selection criteria per tender for a total of 17 usable tenders.
After the criteria from the tenders were classified, a closer look was taken at the criteria that were left in the category ‘Miscellaneous’. Although roughly 76% of the tenders have one or more selection criteria that were labelled Miscellaneous, this category only contains 46 of the 2,190 selection criteria in total, which makes this category marginal (2.1%). As almost all criteria could be related to existing tender categories in the model, there is no need for new categories of system selection. This suggests that current practices of tendering for timetabling software in HEIs do not use other selection criteria or categories not yet known to the ERP system selection theory proposed by Wei et al. (2005).

5.2 Count of categories addressed per tender

Figure 6 shows the tender and the ERP categories. All tenders have selection criteria in the Flexibility, Functionality and User-Friendliness categories. The Reliability category is similar to these categories with 94% of the tenders having selection criteria in this category. After these four categories, a large drop is seen in the number of categories that the tenders include. These first four categories combined are therefore considered to be a consistent part of timetabling software selection tenders in practice.

Criteria in the Service and Reputation categories are mentioned in 82% of the tenders, and criteria in the Technical Capability and Costs categories are mentioned in 76% of the tenders. Most tenders thus have selection criteria in these categories, although a notable number of tenders do not. This suggests that these tenders could have been improved by adding selection criteria in these not-yet-covered categories. It is remarkable to find 24% of the tenders not addressing total costs.

The least number of tenders, at 59%, contained selection criteria from the Implementation Time category. Thus, of all the 9 categories, adding criteria concerning the implementation time seems to offer the most potential for the improvement of future tenders.
5.3 Determination of the relative importance of the selection criteria

Weights to determine the relative importance of criteria were not defined in the tenders we found. This, to us, is a mayor improvement point for tenders. For the analysis, we had to find a way to differentiate in terms of importance between the various selection criteria in tenders from HEIs. We assume that the difference in the number of selection criteria between categories can be seen as an indicator for their relative weight. This assumption is based on the idea that elements with a higher importance are mentioned more often, either because the same criteria are mentioned several times in different parts of the tender, or because the criteria in a category are of a higher detail resulting in more criteria in the same category. Either way, more importance for a criterion leads to it being mentioned more often in the tender, meaning more weight is given to it. With this in mind, a comparison can be made between the weight of categories given in public tenders and the weight of categories as given in the ERP model. This results in Figures 7 and 8, where Figure 7 shows the comparison between the weight of the system selection criteria between the ERP model and the tenders found, and Figure 8 shows the same for the vendor selection criteria.

As most notable differences, we can identify those where the relative count of criteria is less than half or more than double the weight given by the ERP model. For the system selection, these are System Flexibility (5 vs 19%), Implementation Time (15 vs 2%), System Reliability (24 vs 7%) and User-Friendly Interface and Operations (called: User Friendliness) (4 vs 8%). System Flexibility and User-Friendliness are considered to be less important by the ERP model than they are valued in tenders for timetabling software issued by HEIs. On the other hand, Implementation Time and System Reliability are valued as more important by the ERP model than by tenders for timetabling software issued by HEIs.
This means that, according to the model proposed by Wei et al., the practice of these tenders could be improved by giving more attention to implementation time and system reliability, and perhaps less to system flexibility and a user-friendly interface and operations. Figure 8 shows the comparison between the weight of the vendor selection criteria between the ERP model and the selected tenders.

Good Reputation and Good Technical Capability are the most notable criteria categories in the vendor selection factors. Good Reputation is valued as less important by the ERP model than it is valued by tenders for timetabling software issued by HEIs. However, Good Technical Capability is valued as more important by the ERP model than by tenders for timetabling software issued by HEIs. This means that in tenders, HEIs focus more on reputation than on the technical capability of the supplier, as compared to the ERP theory.

5.4 Weight of the subcategories

Figure 9 shows the sub-criteria for all the nine categories. The category Costs consists of the sub-criteria Consultancy, Infrastructure, Maintenance, Price, and Miscellaneous. Infrastructure criteria are a negligible part of costs criteria in tenders. Price criteria are most frequently mentioned and make 36% of the Total Costs criteria. The Consultancy, Maintenance and
Miscellaneous subcategories each form about 20%. The fact that the sub-criterion ‘Miscellaneous’ is still as large as it is, suggests that there are missing subcategories within the Costs category. The Implementation Time category was excluded from further analysis, as the ERP model does not provide sub-categories for it.

The System Flexibility category consists of Ease of In-house Development, Ease of Integration, Upgrade ability and Miscellaneous. Sub-criterion Ease of integration is by far the largest subcategory, accounting for 76% of the Flexibility criteria. This indicates that this subcategory might be usefully split up, giving room for more detail in this category when HEIs are tendering for timetabling software.

The remainder of the System flexibility sub-criteria are equally spread accounting for about 8% each. This is a low number which could be the result of the Integration subcategory being too large, but could also indicate that these sub-criteria should be widened and be made more general.

The System Reliability category consists of the Recovery Ability, Stability, and Miscellaneous labels. These subcategories are all fairly evenly distributed. The Miscellaneous subcategory could indicate a need for new subcategories that are currently missing. The Reputation category consists of the Financial condition, Market share, Scale of vendor and Miscellaneous labels. Financial condition and Market share make up 23% and 22% respectively of the criteria in the Reputation category. Scale of vendor is a smaller subcategory accounting for 14%. However, the Miscellaneous category contributes 41% of the Reputation criteria, indicating that there may be sub-categories missing.

The Good Technical Capability vendor selection category consists of the Implementation Capability, Research and Development, Technical Support and Miscellaneous labels. Implementation Capability and Research and Development account for 40% and 29% respectively of the selection criteria. Technical Support accounts for only 9%, making it the
The smallest subcategory, The Miscellaneous category accounts for 22% of the criteria, indicating a possible missing subcategory.

The User Friendliness, or “Having User Friendly Interface and Operations” category, consists of the Ease of Learning, Ease of Operation and Miscellaneous labels. Ease of operation accounts for 92%, by far the biggest subcategory of User Friendliness, which indicates that this subcategory can be more nuanced by splitting it up into more detailed subcategories concerning ease of operations. Ease of Learning and Miscellaneous both account for 4% of the User Friendliness criteria.

6 Conclusions and discussions

Analyzing the data produced several findings that can be summarized in the following five points:

1. The ERP system selection model proposed by Wei et al. (2005) provides a suitable reference for current tenders for timetabling software in higher education, as no new categories of selection criteria were needed to label the selection criteria found in the tenders evaluated. Tenders evaluated address on average 7.4 of the 9 categories provided by the ERP software selection model.

2. The Flexibility, Functionality, User Friendliness and Reliability selection criteria can be found in all selected tenders, while Reputation, Service, Technical Capability and Costs selection criteria are found in considerably fewer tenders, at about 80%. The Implementation Time selection criteria are found in the least number of tenders, at about 60%.

3. The tenders put more weight on the Flexibility and User Friendliness system categories, and on the Reputation vendor category than Wei’s model for ERP system selection does.

4. The tenders put less weight on the Implementation Time and Reliability system categories and on the Technical Capability vendor category than Wei’s model does.

5. Wei’s ERP model provides a set of subcategories for each category to be used in evaluating systems. Several of these subcategories are probably too general, namely: Flexibility-integration, Service-consultant service and User Friendliness-Ease of Operation. Some subcategories were found to be too narrow in definition, namely: Costs-Infrastructure and User Friendliness-Ease of Learning. Also, indications were found for several categories where subcategories are missing, namely: Costs, Flexibility, Reliability, Reputation, Service and Technical Capability.

Overall, the tenders seemed to be of a reasonable level of completeness, with several categories of selection criteria identifiable in all the analyzed tenders. However, there are several categories of selection criteria which are not yet optimally integrated in current timetabling application tenders. The Implementation Time category provides the biggest opportunity for improvement. The system categories were identified in descending order of the number of tenders in which they have appeared: Flexibility and Functionality and User Friendliness, Reliability, Costs and Implementation Time. Subsequently, the vendor categories were identified in descending order of the number of tenders in which they appeared: Service and Reputaion and Technical Capability.

Timetabling application tenders issued by HEIs seem to have a higher interest in the flexibility of the system and reputation of the vendor than would be expected from the ERP literature. The high need for flexibility can possibly be explained by the fact that the timetabling application often is one of the core systems in an HEI and that the system is often linked to multiple databases and portals. However, reputation is a category for which its higher weight is more difficult to explain. Timetabling tenders by HEIs seem to have less interest in the implementation time, and the reliability of the system and the technical capability of the vendor than would be expected from the ERP literature. The low importance placed on implementation time could be caused by the nature of the category, as often only a few criteria are needed to cover its domain. However, this raises the question of whether implementation time deserves to
be a category on its own. The apparent low interest in reliability and technical capability of the vendor is surprising, and cannot easily be explained. This probably indicates an opportunity for the improvement of HEI timetabling application tenders.

This paper aimed to provide insight in the selection criteria used by HEIs to select timetabling applications. This can be the first step in improving this selection process, leading to a better understanding of ways to control effectiveness and efficiency in education. The paper identified the various categories of selection criteria appearing in public tenders for timetabling applications in HEIs located in North-Western Europe. This was done by comparing these tenders with a well-established and well-regarded ERP software selection model. This paper also provided some further insight into the relative weights given to the categories. Finally, a first critical view of possible subcategories was made.

7 Further research

Possible additional subcategories were discussed in the conclusion and discussion. Further labelling of the dataset could provide a more thorough insight in the subcategories specific to tenders for timetabling application by HEIs. When comparing the tenders that were researched, we found large differences between them. A generally accepted framework seems to be missing, which would provide a great opportunity to increase the efficiency and effectiveness of the timetabling application tender processes within HEIs. A framework encompassing all the various aspects of the tendering processes, including the selection criteria, should be established. The findings of this paper can be a good starting point for such a framework.

Further steps for future research would be first to collect more tenders from other countries to facilitate a more accurate analysis. Second, tenders from other parts of the world, such as North-America, Australia and New Zealand, would have to be looked at to see differences in tendering between countries in different parts of the world. Third, a close look at which supplier actually won which tender would be helpful for further analysis. Conclusions can be drawn from the outcomes of the tendering process, and the contents and quality of winning tenders.

References


