Institute for Sustainable Energy, UNIVERSITY OF MALTA

SUSTAINABLE ENERGY 2015:
THE ISE ANNUAL CONFERENCE

Tuesday 17th March 2015, Dolmen Resort Hotel, Qawra, Malta

ISBN No. 978-99957-853-0-7

THE 'ENERGY PERFORMANCE RATING OF DWELLINGS IN MALTA' (EPRDM) CALCULATION TOOL – THE EPB ASSESSORS' PERSPECTIVE

E. Camilleri, S.P. Borg[1] and V. Buhagiar[2]
Tel: (+356) 7991 9257, E-mail: elizabeth.camilleri.91@gmail.com
[1, 2] Department of Environmental Design, Faculty for the Built Environment,
University of Malta, Msida, MSD 2080, Malta
Tel: (+356) 2340 2870 [1]E-mail: simon.p.borg@um.edu.mt [2]E-mail: vincent.buhagiar@um.edu.mt

ABSTRACT: Research has amply shown that by improving the energy efficiency of buildings, the European Union (EU) could reduce its total energy consumption and associated carbon emissions by a considerable amount. To address this aspect, the EU in 2002 issued Directive 2002/91/EC (later repealed by Directive 2010/31/EC), primarily requiring Member States to set up a system where buildings would be certified for their energy efficiency. In this context, each Member State was required to develop and institute its own methodology for the certification of buildings. Most countries achieved this through the creation of a dedicated software tool conforming to this calculation methodology. In Malta, the national calculation tool developed is the '*Energy Performance Rating of Dwellings in Malta*' (EPRDM). Although available since 2009, very little feedback is available on how the software has so far performed in terms of providing a useful platform for the issue of energy performance certificates of buildings. To address this aspect, the research presented in this paper explores and assesses the strengths and weaknesses of EPRDM, by gauging the experience of EPB Assessors in using this particular tool. Finally a number of preliminary recommendations on possible changes and improvements are presented.

Keywords: Energy Performance of Buildings, EPRDM, EPB Assessors, Energy Performance Certificate.

1 INTRODUCTION

1.1 Energy performance of buildings within the EU

Reducing energy consumption and the associated carbon emissions have been amongst the main goals of the European Union (EU) for the past years [1]. Notwithstanding this, with 40% of the total energy demand, the building sector is still a predominant energy consumer within the Union [2]. This fact is as expected well-known to most technical persons working in the industry. Amongst the general public however, such a fact is perhaps less known and most probably not fully understood.

In order to create a market favouring energy performing buildings and as part of its commitments on climate change made under the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCC) [3], the EU in 2002 enacted the '*Energy Performance of Buildings Directive*' (EPBD), Directive 2002/91/EC [4]. This Directive required all EU Member States to establish minimum energy performance regulations for new and refurbished buildings, as well as to introduce energy certification schemes for buildings. As part of this energy certification process, each Member State within the EU had to institute its own methodology for the certification of buildings, provided that the general framework established in the Directive was taken into account. In order to comply with requirements of the Directive, and for the quick and accurate issuing of an '*Energy Performance Certificate*' (EPC), most Member States decided to develop their own software application, designed specifically in conformity with the general framework established by the Directive.

These new requirements led to an introduction of national laws, which were a fundamental development in mobilizing energy efficiency across the EU. This Directive was later repealed by a new Directive issued in 2010, Directive 2010/31/EC [5]; an amendment over the existing Directive, specifically aimed at strengthening the regulatory aspect of the energy performance requirements.

1.2 The local scenario

The responsibility for the implementation of the EPBD in Malta rests within the '*Building Regulation Office*' (BRO) and the '*Building Regulation Board*' (BRB) [6].

The transposition of the EPBD was done by means of three successive legal notices, issued between 2006 and 2012 (GN 1002 of 2006, LN 261 of 2008 and LN 376 of 2012). When the Government drew up the legislation, it was set up on a self-regulatory basis, hoping that buyers and

lessees would want to impose their right to have information on the quality of buildings they were buying or renting. However, most buyers and lessees so far appear to have preferred not to enforce their right to ask the property owners to provide an Energy Performance Certificate, because of the perceived added cost associated with the issuing of an EPC [7].

In terms of instituting the local calculation methodology, the BRO addressed this requirement by producing two distinct software packages, specifically designed to be used by approved '*Energy Performance of Buildings*' (EPB) Assessors; the '*Energy Performance Rating of Dwellings in Malta*' (EPRDM) for the energy certification of residential buildings, and the '*Interface for Simplified Building Energy Model for Malta*' (iSBEM-mt) for the energy certification of non-residential buildings.

1.3 The EPRDM calculation tool

The national calculation software tool, EPRDM Version 1.0, was developed in 2009 by CASAinginiera [8], and is applicable to all self-contained dwellings. It calculates the annual values of delivered and primary energy consumption, as well as the carbon dioxide (CO_2) emissions by taking into account the climate and net energy required for space heating and cooling, water heating, lighting, and ventilation, after subtracting any savings from renewable energy generation technologies, such as, photovoltaic electricity or hot water produced from solar water heaters.

Although existing research [9] has looked at how EPRDM compares to commercial software, the EPRDM has never been assessed in terms of how it performs as a tool in assisting EPB Assessors in assessing the energy performance of buildings. For any software tool to be successful, it is fundamental that it is both accurate and exhaustive, but nonetheless it needs to be considered user-friendly and practical to use by the people using it professionally, in this case the EPB Assessors.

The EPRDM is the only recognised methodology for the energy certification of residential property in Malta, hence, its accuracy and credibility are fundamental in providing an accurate energy assessment of a residential property in Malta and the eventual issuing of an EPC.

In order to address the aspect, the research presented in this paper explores and assesses the strengths and weaknesses of EPRDM, by gauging the experience of EPB Assessors in using this particular tool. In this regards, a survey study was conducted among locally registered EPB Assessors, in order to understand how EPRDM performs during the process of assessing the energy performance of a dwelling and the eventual issue of an EPC.

2 DATA COLLECTION

2.1 Questionnaire

A questionnaire was set up and sent to current local registered EPB Assessors. The aim of the survey was not only to assess the experience of the EPB Assessors with using the EPRDM tool, but also to obtain a more holistic overview of how the whole issue of energy certification of buildings is functioning in Malta. The questionnaire was therefore divided into two sections; one section aimed at highlighting the strengths and weaknesses of the EPRDM tool, and the other section aimed at obtaining a holistic view of how the EPC system is working.

A series of close-ended questions were devised, limiting the set of alternative answers being offered to the respondents. This was done by asking the respondent to quantify how much they agreed or disagreed with a given statement. Additional comments could be added at the end of the questionnaire. The questions drawn up were based on the experience obtained from analysing the software tool, through a dedicated exercise aimed at issuing an EPC for a mock building, and discussions with experts in the field.

2.1.1 Section 1 – The EPRDM tool

Section 1 specifically dealt with analysing the EPRDM software tool. The aim was to understand and assess how easy/difficult it is for an EPB Assessor to make use of such a tool for the issue of an EPC. The questions were further divided into four parts;

- A *General Part*, dealing with the user interface performance of the EPRDM tool, and the issue of whether it is easier to make use of this tool if you are an architect or an engineer;
- An *Inputting Data Part*, dealing with the qualifying of the ease with which data can be inserted in the tool;
- An *Issuing an EPC using EPRDM Part*, dealing with the relevance of the results issued by the EPRDM, and the ease with which an EPB Assessor can input data for complex building geometries which are either in shell or finished form; and
- Understanding the usefulness of *Introducing of an in-built library of building elements* in future revisions of EPRDM.

2.1.2 Section 2 – The EPC system

Section 2 takes a more holistic view and deals with the local EPC certification system. Specifically its aim was to understand the difficulties encountered by EPB Assessors throughout the whole process of issuing an EPC. This section consisted of four questions:

- A question related to the time taken to finish a report and issue a certificate;

- A question related to highlighting the main difficulties encountered when issuing an EPC;
- A question related to the difficulties encountered in issuing recommendations to be listed in an EPC; and
- A question related to the implementation of the recommendations suggested in the EPC for a particular building.

2.2 Target respondents

The survey study was sent to 113 registered EPB Assessors. Feedback was received from 50 respondents (equivalent to a response rate of 44%). Fifteen respondents (equivalent to 12% of the sample population) immediately stated that although listed as certified EPB Assessors, they were not in a position to answer the questionnaire, since they had never carried out an audit with the scope of issuing an EPC.

2.3 Evaluation of questionnaires and recommendations on improving EPRDM

The data from the questionnaires was then collected and the results were analysed. The results were then used to suggest a number of recommendations for improving the EPRDM tool. The recommendations were based on research done in a comparative study carried out on a selection of national calculation tools used in other EU Member States and the EPRDM tool [10].

3 DATA ANALYSIS

3.1 The EPRDM tool section results

3.1.1 The EPRDM interface

The aggregated results generally indicated that the EPB Assessors do not consider EPRDM and its interface to be a particularly user-friendly. In fact as shown in Fig. 1, approximately 30% of the respondents stated that they consider EPRDM as not being user-friendly. For a national calculation tool, and the only recognised tool in Malta, this is a significant amount.

Some of the respondents commented that the way the user interface is formulated needs to be improved especially in relation to specific aspects related to the input of data. With regards to presentation and design, when compared to other foreign products in the market, some respondents also commented that EPRDM could be improved and upgraded, to make it appear more professional in nature.

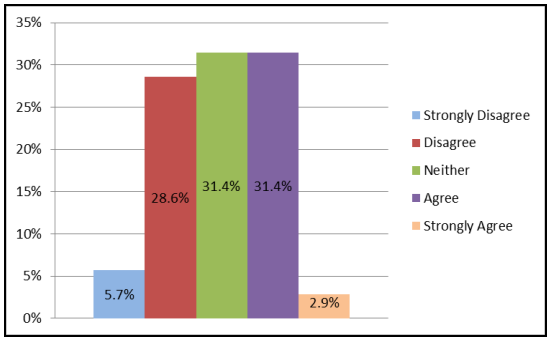

Figure 1: The software is generally user-friendly

3.1.2 Knowledge required by an EPRDM user

Locally, to become a registered EPB Assessor a person must be in prior possession of either a degree in Architecture and Civil Engineering, Building Services, Mechanical, or Electrical Engineering [11]. Training courses on using the EPRDM are then locally organised by the BRO as the designated authority.

Asked whether respondents thought that EPRDM required a certain degree of specialised knowledge, 91.4% of the respondents agreed that specialised knowledge is in fact required, as shown in Fig. 2. This is not at all surprising given that objectively EPRDM does require a certain degree of knowledge, both with respect to the inputting of data relating to the building envelope, as well as that relating to the systems used.

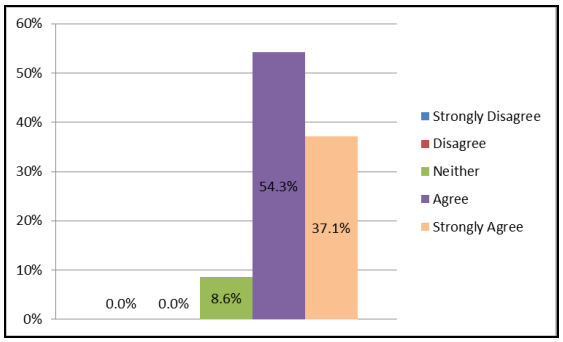

Figure 2: Using EPRDM requires a certain degree of specialised knowledge

3.1.3 Architect *vs.* Engineer

Given the vast range of specialisations one might present as an entry requirement to read for the EPRDM EPB Assessor course, and the type of data which needs to be inputted in EPRDM, respondents were asked whether EPRDM was easier to use if one was an engineer or an architect.

As shown in Fig. 3, although the aggregated results are rather balanced for the two professions, a small bias appears towards the engineering profession with 14% of the respondents strongly agreeing that EPRDM is easier to use if you are an engineer and only 3% agreeing that it is easier to use EPRDM if you are an architect. Such a result implies that the tool (especially the part related to

the systems usage) might be easier to use if the EPB Assessor was an engineer.

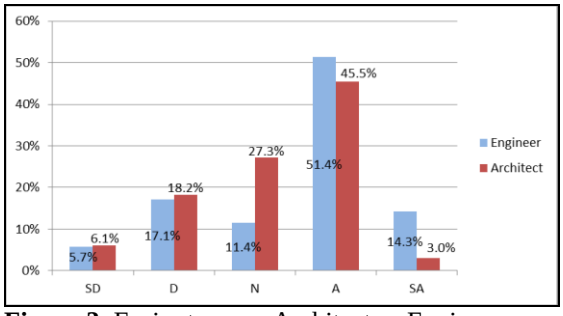

Figure 3: Easier to use - Architect or Engineer

Such result might stem from the fact that the level of detail required in inputting the data for the systems used in the dwelling is more complex, possibly verging on highly specialised, requiring more background knowledge.

Ideally, when performing an evaluation for the issuing of an EPC, both an architect and engineer should be involved. However, such a measure would certainly raise costs, and hence it is perhaps more fitting that potential EPB assessors are thoroughly instructed on both fields.

3.1.4 Ease of completion of different Tabs in EPRDM

The EPRDM interface is made up of a number of Tabs, each relating to specific data input requirements for the building being assessed. This part of the survey dealt with understanding which Tabs are more straightforward and hence easier to fill, and which are the hardest.

The easiest Tab to complete in the EPRDM is the '*Overall Dwelling Dimensions*' Tab, with 82% of the respondents agreeing it is easy to use. This is understandable since the data required is relatively straightforward relying only on inputting the building's dimension. Furthermore, the EPRDM tool does not divide the geometry into different zones, thus simplifying the process.

On the other hand as shown in Fig. 4, the most difficult Tab to complete is the '*Opaque Inputs*' Tab. Whilst 42.8% agree that it is straightforward to complete, 37.1% disagree.

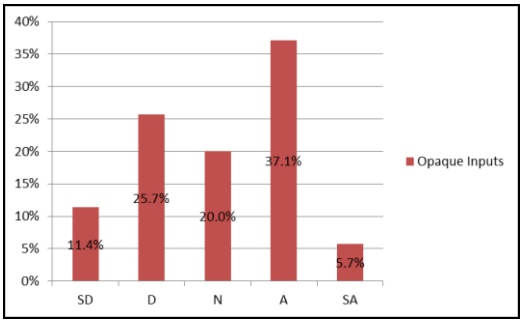

Figure 4: '*Opaque Inputs*' Tab is straightforward to complete.

One recurring comment received from the respondents was that one of the biggest challenges in using EPRDM is the calculation of the corrected U-values for building elements abutting an unconditioned space. The calculation for such U-values has to be done by the user himself, outside the software, and the level of detail required is considerable for just two values. Many of the respondents in fact commented that it is one of the main issues why completing the assessment is time-consuming.

In 2009, an excel document explaining how these U-values for an unconditioned space were to be calculated was provided, to harmonise the method being used by the different assessors. In this context, one immediate improvement to the EPRDM software tool could be for such calculations to be integrated within the tool itself.

In regards to the different Tabs required to be filled by EPRDM, some respondents further remarked that the level of detail required to be inputted is not uniform. Certain Tabs require a disproportionate amount of data, whereas others, possibly having a more profound effect, require less detail.

The remaining Tabs seem to be more straightforward to complete, due to the fact that they require simpler calculations and data can either be obtained from the EPRDM Manual or from the system manufacturer's information. This is shown in Fig. 5.

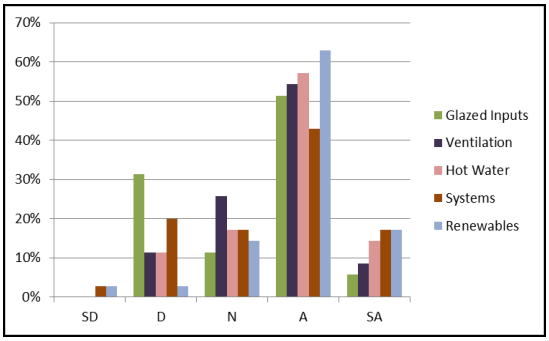

Figure 5: Tabs most straightforward to complete

3.1.5 Data input in different Tabs

Understanding the underlying calculation processes, algorithms and assumptions and comprehend how these relate to one another and to the date being inputted, is important in properly understanding a software package.

To this end, the EPB Assessors were asked whether it is easy to understand how the data contained in the different Tabs relate to one another.

As shown in Fig. 6, this issue does not seem to be as straightforward as expected, and 66% of the EPB Assessors disagree that it is easy to understand how the different Tabs are related. Only 9% agreed with such statement.

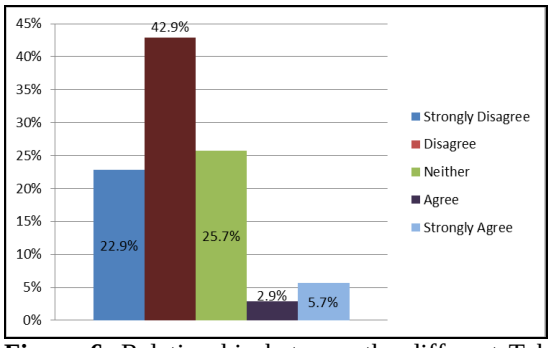

Figure 6: Relationship between the different Tabs is straightforward

Improving the way results obtained from the different Tabs are compiled in the EPRDM could also improve the general understanding of the tool, making it easier to use, possibly also leading to an upgrading of how the overall results are obtained.

3.1.6 Using EPRDM for *shell* or *finished* buildings

As already discussed, the EPRDM tool is the only recognised tool to issue an EPC locally. Hence it is vital for such tool to be as accurate and produce meaningful EPCs. This aspect seems to worry a number of EPB Assessors, especially when they are asked to assess a building which is still in shell form. Assessing such buildings relies on taking a number of underlying assumptions which might lead to possibly different results being obtained for the same dwelling. The EPRDM tool does not differentiate the data inputted between a building in shell or finished form. However an EPC is issued for these two types of buildings, irrespective of the state of the buildings [11].

As shown in Fig. 7, 68.5% of the respondents agree that it is difficult to issue a meaningful EPC for a building still in shell form, as a lot of assumptions need to be made regarding what the finishes and systems used are going to be. The data inputted for opaque and glazed inputs, such as the U-value, absorptivity and emissivity also cannot be defined with certainty for a building in shell form, hence a degree of inaccuracy might arise, unless further clarifications are sought from the owner of the building or the architect, if that is possible.

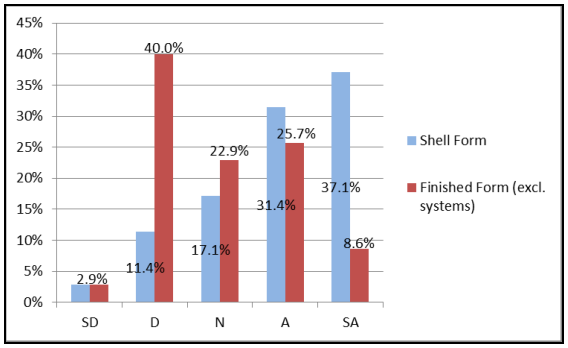

Figure 7: EPRDM use in *shell* / *finished* buildings

3.1.7 Complex building geometry

The '*Overall Dwelling Dimensions*' Tab is the easiest to use according to the respondents, as discussed in Sub-Section 3.1.4. However, when the assessors were asked whether relating multiple rooms or complex building geometry to the software is complicated or not, the majority said that it is complicated. As shown in Fig. 8, 82.9% agreed with such statement, with the majority strongly agreeing. Only 5.7% disagreed.

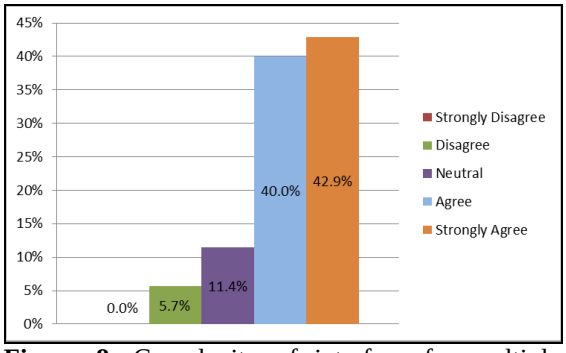

Figure 8: Complexity of interface for multiple zones

To date EPRDM tool does not require the user to divide the building into zones as this would require a higher level and amount of data. Dwellings which are not serviced by the same heating and cooling systems, however, need to be considered as multi-zone systems requiring such type building zoning. Currently EPRDM is not capable of supporting such type of building analysis.

3.1.8 Integration of an *in-built* library

The calculation of U-values for the opaque and glazed elements and for those abutting unconditioned spaces is time-consuming. In this context, respondents were asked whether an in-built library of building elements with pre-set U-values would aid the user and save time.

91.4% of the respondents agreed that an in-built library would drastically make the filling of data forms easier. Some of the respondents however argued, that it is difficult to find a standard U-value for the specific building elements used, and hence working out the relevant U-value would be more accurate. One suggestion was that the tool should allow the user to incorporate and build up a library of materials used (or encountered by the EPB Assessor during the normal course of work). This would facilitate the data inputting process.

Furthermore, to date, the EPRDM tool does not provide an adjusted U-value (UA value), *i.e.* the U-value multiplied by the corresponding area. Such a value could aid the EPB Assessor to understand whether there is heat loss or gain for a specific element.

3.1.9 Other observations on the EPRDM

A number of respondents commented on some aspects of EPRDM which need to be addressed with caution. One aspect is that EPRDM tool does not allow for a heating system to be absent. In fact, a coding error in the form of a 'NAN' i.e. 'Not a Number' is obtained if no heating system is assumed. The EPB Assessor is therefore required to assume a heating system with a specific Coefficient of Performance (COP).

Another aspect which some respondents commented about is the fact that if no air-conditioning system is used for more than 40% of the floor area, EPRDM assumes that the remaining floor area is heated using electric heaters. This means, that if a dwelling is passively built, as is required by the 2020 targets of the recast EPBD, possibly with no heating and cooling needs, the current version of the EPRDM still calculates heating loads based on electric heaters. With the concept of Nearly-Zero Energy Buildings (NZEBs), this aspect of EPRDM would need to be revised.

3.2 The EPC system section analysis

As explained earlier this second part of the survey was particularly aimed at obtaining a holistic view of the EPC certification system.

3.2.1 Time taken to finish a report

Fig. 9 shows the average time taken for the assessors to finish a report and issue a certificate for different types of buildings.

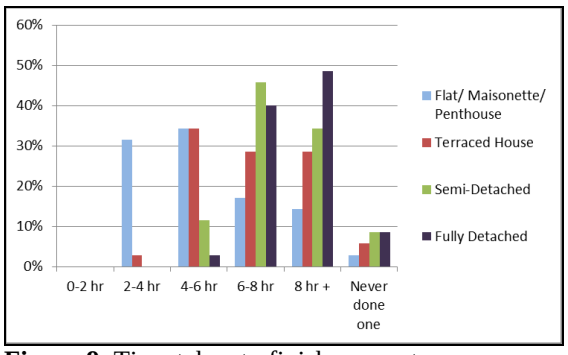

Figure 9: Time taken to finish a report

As can be seen the simpler the building geometry, the less time it takes for the EPB Assessor to evaluate the building and issue a certificate. On the low time-consuming part of the scale are apartments, maisonettes and terraced houses while detached and semi-detached properties are the ones taking longer to be assessed. Nonetheless, a number of respondents also commented that calculating unconditioned spaces also results in a longer process to issue the certificate.

3.2.2 Main difficulties when issuing an EPC

Asked about what type of difficulties they encountered when issuing an EPC, survey respondents reported that the two main difficulties encountered are: (1) the whole process is time-consuming, and (2) drawing up the actual measurements on site is a laborious process, as shown in Fig. 10.

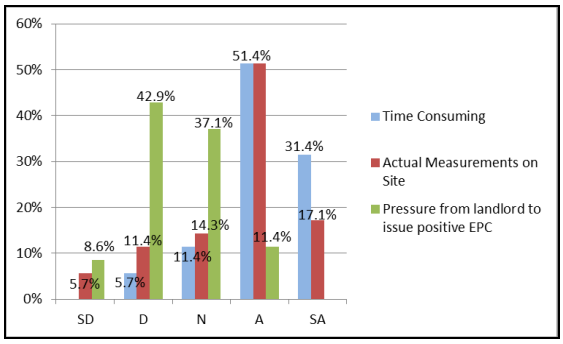

Figure 10: Difficulties in Issuing an EPC

Respondents also commented that usually, the only pressure from landlords is making sure that the EPC is issued in time before the sale/lease of the property, generally lacking any interest as to the results shown by the EPC. Also, according to a number of respondents, landlords are generally not interested in obtaining a positive EPC.

One further general comment was regarding the EPC portal system that to date, does not allow an EPB Assessor to view and edit the certificate before payment is done.

3.2.3 Difficulties in issuing recommendations

As required by LN 376 of 2012 on the '*Energy Performance of Buildings Regulations, 2012*', an EPC should provide recommendations on how the energy performance of the building, could be improved in a cost-optimal manner [11]. Recommendations can vary from one assessor to another, since currently EPRDM does not incorporate a common database from where to select possible recommendations. In this context, EPB Assessors were asked to comment on what the main difficulties were when issuing such recommendations. As can be seen in Fig. 11, the main difficulty is for the assessor to relate costs to the recommendations suggested in the EPC.

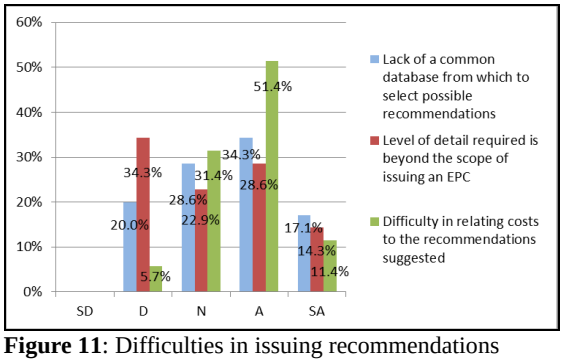

Figure 11: Difficulties in issuing recommendations

The introduction of a common database would be a step forward in improving the overall significance of an EPC, as it would be a concrete and concerted attempt to harmonise efforts geared towards improving the making an EPC easy to understand and implement, should any recommendations be listed.

3.2.4 Implementation of recommendations suggested in EPC

In terms of the energy certification process, aggregated questionnaire results indicate that most people commissioning EPC consider an EPC as another 'tax' and an unnecessary cost, whilst there seems to be little interest from the landlords to obtain a positive EPC or indeed to do a follow-up after an EPC has been issued. In fact, as can be seen in Fig.12, from all of the respondents, none of them had ever been asked to do a follow-up, *e.g.* by implementing the recommendations suggested.

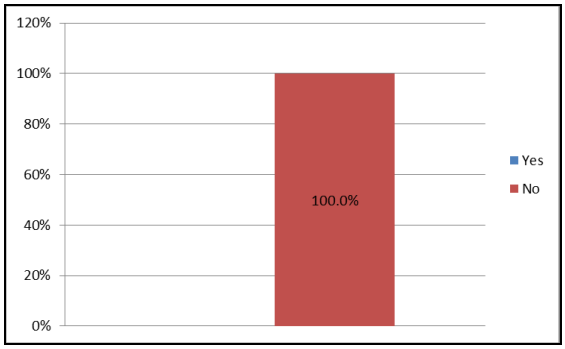

Figure 12: Follow-up after EPC

In this regard, more education is required with respect to the real benefits of obtaining an EPC, since to date, there seems to be a lack of knowledge by the general public of the real gain that an EPC offers in terms of potential energy savings.

4 RECOMMENDATIONS

4.1 Recommendations to improve EPRDM

Based on the results obtained by conducting such a survey it was possible to comprehend and understand the current problematics encountered by professional users of the EPRDM tool.

Using work done in a comparative study carried out on a selection of national calculation tools used in other EU Member States and the EPRDM tool [10], a number of recommendations on possible improvements, suggestions, and additional features which could be added in a future revision of the EPRDM tool, were produced. These recommendations are listed Table 1.

Such recommendations are however being made without neglecting the fact that for improving the overall efficacy of the tool and improve the professional's understanding and *'modus operandi'* of the tool (and more in general the public's general awareness and importance of an EPC), an effective educational campaign and proper enforcement are essentially a pre-requisite.

Table 1: Recommendations for the upgrade of the EPRDM tool

Improving the EPRDM Interface	
Input of Data	• Provision of direct references from where input data can be obtained • Definitions and descriptions of data requested embedded in EPRDM user interface • Integration of a data compliance checking mechanism to ensure that data inserted is within standard values (and current legislation) • Tabulation of calculations performed by software tool
EPRDM & Issue of an EPC	• Tool should be able to generate a draft EPC for checking before submission • Provision of worksheets and output reports of the ratings obtained in PDF format
Recommendations listed in EPC	• Automatic generation of recommendations, allowing for additional user-defined recommendations • Categorisation of recommendations (*e.g.* High/ Low cost improvement; Payback period; Calculated energy savings)
Possible Additional Features within EPRDM	
In-Built Libraries	• Construction systems and material for opaque and glazed elements • Systems used, including the possibility of inserting current energy tariffs • Customisation permissible • Integration of U-Value calculator
Building Geometry	• Integration of 3D building model. • Introduction of a zoning system • Increase number of possible building elements • Automatic calculation of net areas
Assumptions	• Possible revision of assumptions used in the tool, or more customisation being allowed

5 CONCLUSION

In conclusion, the outcome of this research paper has established that the EPRDM software needs to be improved on various counts, namely:

1. Data input validation needs to be carried out through the integration of a data compliance check, verifying compliance with current standards.
2. The issue of a preliminary draft of the EPC for prior validation with an accompanying output data report before the issue of the final EPC.
3. Recommendations need to be more user-defined, allowing for a more flexible and detailed list of potential improvements, including their cost-benefit analysis and respective energy savings.

Professionals using the software have also highlighted the importance that future revisions of the EPRDM software should possibly take on board the following:

1. When using EPRDM, more flexibility is needed to customise the assumptions made for the building under the lens for an EPC.
2. Introduction of a built-in calculation tool for a range of possible building elements, and their respective net areas. This could possibly be extended to incorporate a 3-D schematic view of the building.
3. Additional features could include an in-built library of construction systems (options). Additionally, a plug-in could also include options to adjust current energy tariffs, especially in the light of more diversified sources of energy (HFO/Diesel/Gas/Cable interconnection), possibly including a dual-tariff system, apparently to be introduced imminently in Malta.

The research herewith presented in this paper, has primarily assessed the performance of the EPRDM software tool itself, based on a questionnaire review and feedback by professional practitioners. To date this has been a milestone in the history of the building industry in Malta.

Nevertheless, in view of the fact that an EPC is released and lodged, its quality and the level of energy rating remains unquestioned. It is only after 10 years that one needs to come back to the building to re-evaluate its energy efficiency, in tandem with current practice and the state of the art of the technology of the day. Hopefully, within the same 10 years, EPRDM would equally be in tune.

6 REFERENCES

[1] *'Presidency Conclusions - Council of the European Union 8/9 March 2007'* - European Parliament and European Council - Doc No. 7224/1/07 REV 1.

[2] ENERDATA. '*Energy Efficiency Trends in Buildings in the EU'* Editor (D. Bosseboeuf). Paris, France, 2012.

[3] Concerted Action '*Energy Performance of Buildings Directive' Website*. Retrieved 03/02/2015 Available from: http://www.epbd-ca.eu

[4] *'Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings'* - European Parliament and European Council.

[5] *'Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast)'* - European Parliament and European Council.

[6] Concerted Action '*Energy Performance of Buildings Directive', 'Implementing the Energy Performance of Buildings Directive*', [e-book]. Retrieved 03/02/2015 Available from: https://www.dropbox.com/s/mcufajra03lz3hl/CA_EPBD_BOOK_2012_small_no_links.pdf

[7] Malta Resources Authority, (2011). "*Malta 2nd National Energy Efficiency Action Plan*"- Retrieved 03/02/2015. Available from: http://ec.europa.eu/energy/efficiency/doc/mt_-_energy_efficiency_action_plan_en.pdf

[8] Abela, A., Azzopardi, D., Cassar, P. and Spiteri, K., *Energy Performance of Residential Dwellings in Malta (EPRDM). 1st ed. Malta*: CASAinginiera, 2009.

[9] Yousif, C., Diez R. M. and Martinez, F., '*Asset and Operational Energy Performance Rating of a Modern Apartment in Malta*' International Conference on Sustainability in Energy and Buildings 2012 (SEB'12), Stockholm, Sweden, 3-5 September, 2012.

[10] Camilleri, E., '*The 'Energy Performance Rating of Dwellings in Malta': An Evaluation in Comparison with Equivalent European Tools*' B.E.&A.(Hons.) Dissertation, University of Malta, 2014.

[11] L.N. 376 of 2012 '*Energy Performance of Buildings Regulations, 2012*'. Retrieved 03/02/2015. Available from: http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=11947&l=1