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Environmental design: incorporating a rating tool into the design of commercial buildings

Chris Lamborn, Mark B. Luther and Robert J. Fuller
School of Architecture & Building, Deakin University, Geelong, Australia

ABSTRACT: Environmental performance assessment or green building rating tools for commercial buildings are one of the more recent responses to encourage green solutions for commercial buildings. This paper discusses the initial stages of a research project that looks at the impact of a rating tool, such as Green Star, on design. There are numerous ways in which an architect can design commercial buildings, but environmental design solutions have consistently failed to become accepted practice. Therefore, how will this tool be incorporated into the building design process? Developed to assist the designer can the inclusion of a rating tool such as Green Star provide an effective framework to encourage the inclusion of environmental design strategies in commercial buildings? A field study, recording the design process of a commercial building, anticipates that a whole building assessment approach towards design, as proposed through the Green Star Rating Tool, will provide an effective framework to set and monitor design targets in order to optimise the environmental design goals in commercial buildings.

Conference theme: Architecture and the environment
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INTRODUCTION

The concept of environmentally sustainable design (ESD) has become increasingly important for architects and designers of commercial buildings. The issue has been enhanced with various government and industry organisations funding the development of green building rating tools for commercial buildings. Typically, developments of rating tools have focused on domestic buildings to assess their thermal performance or energy efficiency. However, the recent development of commercial rating tools has created much industry discussion. Rating tools provide a method of predicting and assessing a building’s environmental performance, and have been developed to address the design and environmental problems associated with current building design practices. These tools have the potential to inform design decisions and provide an effective framework to encourage the inclusion of environmental design strategies.

A research project has been initiated to investigate the implementation of a rating tool in the design of a commercial building to discover what impact these tools have on the designer? Are they a burden and hindrance or alternatively are they a driver towards high quality design? The research specifically aims to determine if the implementation of a rating tool is a design asset or a liability to architects, and whether rating tools can provide an effective framework to encourage the inclusion of environmental design strategies in commercial buildings. This paper discusses the initial stages of that research. It highlights the impact of commercial buildings on the environment and current problems associated with the inclusion of environmental design strategies in the design of these buildings. It also identifies various architectural design processes which raises questions about the inclusion of rating tools in the design process. The Green Star Rating Tool, which is the focus of the research, is also described, highlighting its potential impact on the design of commercial buildings. A field study is also outlined.

1. COMMERCIAL BUILDINGS AND THE ENVIRONMENT

At a time when finding green building solutions has become increasingly important, the growth of green building rating tools has been rapid. The prolific growth and implementation of these tools has been so significant in recent times that it has been said that ‘it will not be possible to get a building approved and built without compliance to some sort of Green Building Rating System’ (Archizine, 2003). There are several reasons for the development and growth of rating tools in Australia. One of the main reasons is the degree of political acknowledgement and commitment towards the environment that now exists. In Victoria, for example, the Government’s commitment is significant and rating tools have become a part of the Government’s long term plan, as outlined in their recent report on the built environment. Sustainability assessment tools undoubtedly have a role to play in facilitating the achievement of higher-level sustainability objectives through simplified and consistent assessment of design performance in relation to various resources or aspects of environmental sustainability (Department of Sustainability and Environment Report, 2003).

This commitment has now filtered through to the building approval process in the form of a Five Star Rating for residential buildings. It is now a requirement that new designs achieve a five star rating. (Between July 2004 and July 2005, a design will be approved if it achieves a four star rating but also includes a rainwater tank or solar hot water system). There is a possibility that a similar rating scheme will be introduced for the commercial building sector.
1.1. Environmental Impact

The environmental issues associated with the Australian commercial sector have been well documented. The concerns associated with energy use can be used to highlight this issue. The sector spends around $4 billion annually on energy and produces approximately 35 million tonnes of emissions (SEAV, 2004). Further to this, it is now also estimated that Australia’s energy demand continues to grow by approximately two percent per annum (SEAV, 2004).

Although the initial environmental concerns were associated with the dwindling energy resources, today, it has been extended to a much broader concern. Buildings consume about one third of the world’s resources; 12% of water demand is consumed by buildings and up to 40% of waste going into landfill is from construction and demolition (Green Building Council of Australia, 2003). The areas of water, material use and waste management now all require a great deal of attention and demonstrate the continuing need to push for change in our current design and building practices.

1.2. Environmental Design

Architect Lindsay Johnston, the former Dean of Architecture, Building and Design at the University of Newcastle, suggests that the lack of knowledge is not an obstacle to producing environmental responsive buildings, it’s the lack of commitment by society......driven by the short-term dollar gain rather than long-term quality’ (Johnston, 2002).

A great deal of information is emerging about sustainability and building performance, but environmental design strategies are still far from being accepted practice in the design of commercial buildings. Financial constraints and a lack of societal commitment, including the designer’s approach, remain the problems to be overcome in order to consistently achieve the inclusion of sustainable design strategies in commercial buildings. Commercial business attitudes are continually driven by the short-term dollar gain, focusing on the financial bottom line rather than long-term quality. Profits tend to go into tangible areas such as upgrading equipment or improving a company’s profile instead of into building features that address environmental performance. Factors such as achieving an energy efficient building are not seen as important because they amount to a fraction of the cost of other associated commercial requirements. For example, energy costs are approximately only one percent of staff costs, which means that there is no strong financial driving force supporting sustainability (Pears, 1998).

There is also a common misconception about environmentally responsive buildings. They are often perceived as being aesthetically undesirable by, for example, incorporating massive water tanks or solar hot water systems that detract from a building’s appearance. The push to incorporate environmental features into a design to improve a building’s performance should be encouraged, but it does not mean it should be at the expense of a building’s aesthetic. As suggested by Albert Schweitzer ‘people will not want to live in, work in and ultimately keep aesthetically inferior buildings’ (Wines, 2000). Therefore, regardless of best environmental intent or how well a building performs environmentally, the aesthetic component is a factor that is often used in business promotion and cannot be compromised. Also, from a designer’s perspective, putting the art in architecture is what they are trained to do. Their style is how they build a reputation, it reflects a higher level of thinking, feeding further ideas and it reflects contemporary life enabling designs to develop and break new ground – and should not be compromised. These misconceptions about ESD can extend through to architects’ attitudes which results in a lack of commitment to the concept. For instance, ‘there is a stigma associated with ESD...and many architects still believe that you either take ESD seriously or design seriously’ (Owen, 2002). This sort of attitude is a major problem and if a designer thinks like this then how can a client be convinced about the benefits of ESD? The design of the Melbourne City Council House (CH2) is a recent example of what can be achieved in terms of design and performance at a commercial scale when the right balance is achieved. Aesthetically interesting, the proposed building embraces a range of environmental factors, whilst maintaining a corporate image and style. Although only at the early construction stages, the building has the potential to set new ground in terms of performance and aesthetics. Based on a holistic approach to functions and systems the design has received a preliminary six star rating from the Green Star rating tool.

The Green Building Council of Australia (GBCA) suggests that the reason for the lack interest in the sustainability of commercial buildings is that ‘at the moment, the industry can’t define green, can’t measure it and can’t translate it into a commercial return’ (Sinclair Knight Merz, 2003). As a result, the GBCA has put forward an industry owned and developed rating tool to encourage a consistent approach to environmental design and to increase the inclusion of ESD at the design phase. However, what impact will this rating tool have on the architectural design process? Design is a complex procedure that constitutes a series of steps, involves many participants and requires the consideration of many issues. Will the inclusion of a rating tool provide unnecessary complications to this process? The timing and scope of issues considered, the cost of decisions made and the effect on other participants involved all require serious consideration to optimise a design’s performance. How will a rating tool be incorporated into this process in order to provide real benefits? Throughout the process itself information accumulates and varies as a design progresses. Thus, the questions arise: where will a rating tool fit in and at what stage of the design process should the rating be performed so that it provides realistic and accurate predictions of performance without compromising the design’s intent? In order to answer these questions, it is necessary to understand the architectural design process itself and what is involved so that a successful method of integrating rating tools into the design process can be achieved.

2. TRADITIONAL ARCHITECTURAL DESIGN PROCESSES

There have been several maps of the design process that have been developed and adopted by architects. One of the first attempts to describe an actual design process was published in the Royal Institute of British Architects (RIBA) 1965 Handbook. The process was broken into four stages (Figure 1) and reflects the simple linear design approach defined by early design models. This type of process is indicative of how a design can theoretically evolve. It gives the architect time to develop ideas, incorporate many aspects and allow a range of inputs to mature into a resolved scheme.

In Australia, the Royal Australian Institute of Architects (RAIA) provides architects with its own documented...
design process. Modeled on the RIBA, the RAIA process suggests a similar system to document a design. However, it has moved from a design process to a scope of services to describe an architect's responsibility. The RAIA Client/Architect Agreement (2000) design process can be divided into four main sections, as follows:

- Stage 1 Schematic Design;
- Stage 2 Detailed Design;
- Stage 3 Documentation; and
- Stage 4 Contract Documentation.

There are many documented approaches to design, none of which perfectly describes what's involved in practice. However, all approaches describe how designs mature and evolve through a process. Models like those suggested by the RAIA also provide a structure and a framework to run a business by setting a quality of design standard. Lawson (1997) suggests that the design process consists of a sequence of distinct and identifiable activities that are ideally negotiated and appropriately balanced. Lawson is trying to establish a process to guide inexperienced designers, but the reality is naturally much more complex. The timing of activities, changes to design aspects, unforeseen circumstances and human nature all mean that the process of designing is not a neat and consistent process, but rather an accumulative, inconsistent and adaptable one, which changes according to client and situation.

The development of ESD has meant further design models have broken the RIBA and RAIA models down to encourage review and synthesis. For example, the International Energy Agency (IEA) suggests that the design process should move from a more traditional linear approach to an iterative approach (Lohner & Dalkowski, 2002). Task 23 of the IEA Solar Heating and Cooling Programme, which focused on the optimization of solar energy use in large buildings, developed a process of more integration and review to enhance the design output (Figure 2).

![Figure 1: The RIBA map of design process](source: Lawson, 1997)

![Figure 2: The International Energy Agency design process](source: Lohner & Dalkowski, 2002)

'Integrated design is a procedure considering and optimizing the building as an entire system including its technical equipment and surroundings and for the whole life span' (Lohner & Dalkowski, 2002) and this process has been introduced to encourage and optimize environmental design features. The issue of environmental quality has become increasingly complex through rapid advances in technology and the changing perceptions of building owners, operators and tenants (Lam et al, 2001). Therefore, by integrating the design process between the players involved, it is argued that a design team has a greater opportunity to optimise output as they strive for a common goal instead of pulling in different directions. However, merely integrating the activities of the various players and providing the opportunity for iteration in the design process does not necessarily mean that ESD will be included or at an appropriate stage.

The above design models indicate the various stages of the process and provide an insight into the level of development required to design a building. However, they do not address the more complex issue of what is involved within a design. Components that need to be considered at each stage require a range of inputs where one decision can significantly affect another. Incorporating the issues of ESD adds an additional consideration to this process and suggests that a new design process model may be required.

### 3. PROPOSED DESIGN PROCESS MODEL

Quality design requires far more than environmentally sustainable practices. The problem with the ESD movement is that buildings are often promoted on the basis of environmental factors alone (such as energy efficiency) instead of being a part of a greater whole. For example, building thermal performance is extremely important, but it is not a sound position on which to entirely base quality architectural design. Quality design requires a great deal more and areas such as planning, form and finish all require due consideration. Lindsay Johnston suggests that 'quality means good planning, good urban design, good building envelope, good interior environment and ecologically responsible energy and resource use' (Johnston, 2002). This view is far more complete and holistic, and is particularly relevant to businesses who invest significantly in a new building, through which they promote their corporate image. Therefore, finding a balance between the many design issues involved is what is required and, regardless of the best environmental intent, other areas of design should not be forgotten. Albert Schweitzer suggests that 'without art the idea of sustainability will fail...because people will not want to keep buildings that are aesthetically inferior' (Wines, 2000). This notion is a good reminder of the importance of balancing design issues.

Figure 3 demonstrates schematically the level of perspective required when incorporating ESD into the design process. This proposed model highlights the need for a design concept to drive the design and indicates that there are a number of aspects that might influence that concept. It is at this level that the environmental design strategies could be included (potentially through the use of a rating tool). The inclusion of 'predictive rating tools at the design stage is important as they allow architects to make crucial decisions before materials are committed' (McLaren, 2004), which in turn has the potential to ensure environmental strategies are incorporated in a design but it must be done without losing overall design intent. The rating tool (effectively representing the ESD component of this model) is required to influence the design, but not act as a design driver on which the entire design is based. If a balance between design driver and design influences can be achieved the chance of creating environmentally sustainable buildings - a prerequisite for modern architecture - is increased. This conceptual model (Figure 3) only deals with the design component and does not address the construction, building operation and demolition components of the building process. An alternative model might be that ESD should inform each of the aspects of the design and, in effect, overlay the whole process. At this stage in the understanding and acceptance of ESD, however, such a concept is still believed to be impractical in the real world of building.
design.

**Figure 3: Conceptual model of the influences on building design**

Using the above model, this research proposes to assess the impact of using a rating tool when adopting a 'whole-of-building' approach in the design process and also on particular aspects of the design. These areas will be determined by the design team.

### 4. PROPOSED RESEARCH METHODOLOGY

The relative infancy of rating tools has meant that previous research into this field is limited. The literature contains descriptions of the various tools and how they work, but there is a limited recording of how they can be applied during the design process and what impact might result. A field study is proposed to evaluate the impact of a rating tool in the design process and the methodology will involve three components. A multi-criteria decision-making tool (MCDM-23) will be used to record the initial design objectives and monitor the additional goals decided in the design team meetings throughout the schematic and developed design stages. The rating tool will be used in the design and several assessments will be conducted throughout the design stages to test the tool in use. Interviews with the design team will record their thoughts on the tool at the conclusion of this phase.

The MCDM-23 program is used to encourage the integration and organisation of information required in the design process in order to assist the decision making for design team members (MCDM, 2002). It works by participation from the design team from which they list, record and rank a project's objectives from the outset. The design team then uses the program to evaluate design scenarios and monitor progress. The MCDM-23 has been used successfully on several projects and it has encouraged an integrated approach to a number of designs in Europe (Balcomb & Curtner, 2000). Results from the decisions made can be graphed to provide a comparison and an understanding of the goals of the project. Figure 4 is an example of the graphed outcome produced from this program. It shows the key criteria set for a project and the level of performance for each component against the best possible and worst case scenarios. The tool is not specifically intended for the evaluation of rating tools. However, through this method the impact of the rating tool on a design project will be determined by recording and monitoring the design targets in order to establish the importance of the environmental strategies for the project.

The rating tool will be used during the design stages (determined by the design team) to measure the environmental strategies and provide a star rating to the project. Design team members will directly apply and test the tool to determine its impact and provide an understanding of how the building performs. The interviews conducted at the end of the design process will then validate the findings from both the rating tool and the MCDM-23 tool. Specific questions related to the project, design process and the rating tool will confirm the design team's intent and perspective (particularly the architect) indicating the impact it had on the process and the effort required to achieve the result. A focus on the design stage of commercial buildings requires the selection of a rating tool that can be applied throughout this process.

**Figure 4: The MCDM-23 star diagram showing criteria and performance**

### 5. THE SELECTION OF A COMMERCIAL RATING TOOL

A range of rating tools have been developed specifically for Australian conditions. The tools target various components of the built environment and have been designed to address a number of performance-related aspects. In general, rating tools can address energy performance of the building fabric and design, appliances and services, individual components (e.g. windows, insulation, wall construction), whole buildings and life cycle impact of the materials (Reardon, 2001). For commercial buildings, rating tools fall into three main categories: simulation models, correlation tools and scorecard tools. Simulation models are computer programs, which are used to generate a performance prediction from calculations, generally based on first principles. The modeled scenario may be compared against previously recorded information to assess performance. Correlation tools, often referred to as labelling or performance-based tools, typically measure a particular element such as energy efficiency or thermal comfort and focus on providing a quick evaluation of a proposed design in the form of a simple indicator. These tools have often been derived from multiple results generated by simulation models. Scorecard programs provide an alternative form of assessment and measure performance through a point-scoring system. Effectively these tools are a checklist, from which points are achieved against a set list of criteria. The performance level corresponds to the points scored, and a rating is given accordingly. Scorecard tools often assess building performance over a range of environmental issues and focus on 'whole-of-building' assessment, encompassing a range of criteria from energy efficiency through to life cycle assessment. Several examples of Australian commercial rating tools include: Green Star (Office Design, Office as Built and Office Interiors), National Australian Building Environmental Performance Scheme (NABERS), the Environmental Performance Guide for Buildings (EPGB) and the Melbourne Docklands ESD Rating Scheme, of
which these tools are all scorecard models. The Australian Building Greenhouse Rating (ABGR) is an example of a correlation model. These rating tools have different functions and address a range of commercial building types. For instance, Green Star primarily focuses on the design stage of projects, NABERS evaluates existing buildings, ABGR measures and evaluates the energy consumption and gas emissions, whilst the Melbourne Docklands Scheme was specifically created by the Docklands Authority for the redevelopment of the Docklands area.

From a designer’s perspective rating tools must be user-friendly and provide design and performance benefits in order to be adopted. Embracing new design techniques is intended to increase the inclusion of ESD in order to create healthy working environments. Therefore, the scorecard system, which is intended to embrace these qualities, provides an opportunity to test this tool in its desired application. Due to the design focus of the research and the potential impact that can occur at the design stage of a project, Green Star (Office Design) is the rating tool chosen for this research. A brief overview of this rating tool and its method of operation is given in the next section.

6. GREEN STAR RATING TOOL

Green Star is intended to provide ‘whole-of-building’ assessment at the design stage of new commercial office buildings. Developed by Sinclair Knight Merz (SKM) and the Green Council of Australia (GBCA), the rating tool was released in 2003. The tool is intended for use by architects, designers, developers and property owners and it uses a scorecard evaluation approach. According to the GBCA (2003), the tool has been created to:

• define green buildings by establishing a common language;
• set a standard of measurement for green buildings;
• promote integrated, ‘whole-of-building’ design practices;
• identify building life cycle impact that can occur at the design stage of a project, Green Star (Office Design) is the rating tool chosen for this research. A brief overview of this rating tool and its method of operation is given in the next section.

A rating is determined by a point scoring system, where credits are awarded in each category depending on the level of performance. Each category contains several components where points are awarded and then summed to determine a final score in that category, depending on the level of compliance and the environmental initiatives. Once a category has been completed and a percentage score has been calculated, it is then weighted (by predetermined figures) to give a single category score. The weightings are internal to the rating tool and can vary depending on the environmental sensitivity of the building’s location. Figure 5 shows the basic calculations used in Green Star.

![Figure 5: Credits and weighting calculation equation of Green Star](image)

The weighted scores are then added together to provide a total single score and rating. The innovation section is treated a little differently. It is not included with the main categories and does not have a weighting system. This is to encourage the inclusion of creative design solutions. The entire process to achieve a final rating is shown below (Figure 6).

![Figure 6: Assessment categories and process of Green Star](image)

Source: (Green Building Council of Australia, 2004)

To earn Green Star certification, a design must satisfy all of the system’s conditional areas and obtain a minimum number of points to attain a particular Green Star rating. Formal assessment is carried out by an accredited certifier and the number of credits achieved determines the overall rating. The significance of the star rating is as follows:

• Four stars Recognises and rewards best practice in building environmental initiatives;
• Five stars Recognises and rewards Australian excellence; and
• Six stars Recognises and rewards international leadership.

The Green Building Council of Australia believes that there are numerous benefits in using an industry developed assessment tool. Perceived benefits include providing a nationwide language for environmental design, setting an environmental standard, providing recognition of achievements, increasing tenant retention levels, reducing renovation and maintenance costs and producing productive healthy working environments (GBCA, 2003). These benefits are potentially significant considering the number of buildings that are currently being constructed or already exist. A tool like Green Star has the potential to set an ESD framework at the beginning of projects and establish goals and objectives to produce healthy buildings. Many of the factors covered by the tool such as water use, waste management and transport requirements would not be considered in many projects. Encouraging design teams to think about these areas of the environment from the outset of a project is beneficial. Planning for these factors also means they might have a greater chance of inclusion in the completed building.

There are, however, several problems associated with Green Star that need to be considered when using this rating tool. The initial concern is the cost of carrying out a Green Star assessment. The price of a formal assessment can vary from $6,500 – $15,000 depending on the work carried out and the size of the project (James, 2004). Large, multi-million dollar projects should not experience a problem with this fee but small projects might be discouraged from using the tool as budgets are tightly controlled and if anything is going to be omitted in
order to save money on a project it is the use of a voluntary rating tool. Green Star has a prescriptive component. The fact that the designer must meet a certain score to achieve certification means the specified data is prescribed to. Conditional requirements such as energy use, land use and ecology also highlight its prescriptive components. This is offset by the range of environmental criteria that is addressed and the inclusion of an innovation section to encourage new ideas. This scorecard system requires credits to be achieved but getting there is at the discretion of the designer or design team. Using the rating tool is time consuming. To achieve the full benefits of Green Star the process can become quite extensive. Often beginning at the briefing stage and ending after documentation, assessment can involve the investigation and monitoring of the sustainable practices and a number of design team members. Tightly controlled time-frames mean that significant planning and a strong commitment by the design team is required to complete the rating. If the design team can’t make a decision or there is incomplete analysis of design options then the assessment could be compromised.

Further problems related to Green Star commonly exists in all rating tools. The voluntary nature of the tool means that not all buildings will be rated. In addition, there is no requirement to check the predicted performance after construction. Unforeseen construction changes can compromise the initial design intent and if new technologies are included, these may not perform as expected. Unless follow-up assessments are carried out it will not be known if the building is performing as predicted. Finally, a rating may restrict a design’s potential. If a proposed design requires a five star rating, then simply meeting this level may limit higher performance standards being achieved.

A field study observing the application of Green Star on a commercial building project will provide an understanding of the impact of this rating tool on the design process, and an insight into how the rating tool works and how it can be applied to real projects. It may also provide some indication of the impact of rating tools in general and confirm these foreseen benefits and pitfalls that may come with this sort of environmental assessment method.

6. A FIELD STUDY

The field study will record the design process from the beginning (sketch design) through to the end point (developed design) (Figure 7). The building being designed is the proposed International Centre and School of Business at Deakin University’s Burwood Campus and the study will involve all the key design consultants in the project. These include; the architect, the mechanical engineer, the ESD consultant, the quantity surveyor and the client.

**Figure 7: Proposed study of the use of Green Star in the design process**

Initial results indicate that the sketch design stage provides an ideal opportunity for the various design consultants to identify goals and objectives. A series of design team meetings, at the beginning of sketch design, enabled the players involved to discuss design options and prioritise areas. It also enabled concepts to be tested so that informed decisions, which would later have a much broader affect on the entire project, could be made. For example, the use of hollow core concrete panels was suggested to be an important component to achieve the desired energy and ventilation levels. Therefore, modeling was carried out on various hole sizes to determine the optimum airflow rates and the most suitable slab to use.

Overall, the consultants identified six main criteria as the priorities for the project. They were: site layout and orientation; lighting; heating and cooling ventilation; architectural quality; environmental performance; and the cost of the project. The importance of each category was relative even between the selected design focus areas at the beginning of the project and the scoring was relatively high with an overall score for the project of 7.97 out of 10. It is an outcome that might be expected due to the early optimism that comes with a new project. However, it indicates that a range of aspects and design targets is required to achieve an ideal outcome. For the environmental component of the design the initial Green Star rating measured the performance and the project achieved a 4.5 star rating. This informed the design team of the current environmental design stage and highlighted that several areas of performance were below expectation. For example, the waste management and the energy performance levels were unsatisfactory and require further consideration. The entire design team is now aware of these issues and if it was not for the assessment tool they may not have been addressed.

**CONCLUSION**

Environmental design strategies are far from being a high priority for commercial buildings but rating tools could provide a structure and a benchmark to define and measure the benefits of sustainability on a commercial scale (Sinclair Knight Merz, 2003). The early stage of the design process provides an ideal opportunity to establish design goals and objectives to optimize a design output. The design team of consultants can convey their ideas in order to set performance standards, whilst the integrated approach towards design enables them to incorporate and discuss a range of design solutions before implementation. The introduction of a rating tool then provides a structure to set and confirm the environmental targets and enables the design’s progress to be monitored in reference to these targets. This initial process will be followed with further progress assessments to record the designs progression and to determine whether the key design focus areas identified in the beginning of the project remain a priority throughout, or whether they are compromised reducing it to a fraction of its original intent. Follow-up Green Star ratings will continue to measure the environmental components within the design and the interviews will be used to determine the success of the tool.

**REFERENCES**


