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REFeasibility: Designing a mobile application for initiating feasibility analysis

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Feasibility applications for mobile devices may provide consultants and aspiring developers with an appropriate tool to make informed decisions regarding the pursuit of a development proposal. Furthermore, through testing numerous proposals and witnessing the resultant returns in real-time, users of the applications may even employ a higher level of cognitive activity and enhance their functioning learning of how feasibility analysis works. This research relates to the design and development of a mobile application to enable prospective developers to efficiently assess the feasibility of a proposed project and enhance their learning of feasibility analysis. This paper presents a review of published research into feasibility studies and the related emergent technologies, standards, guidance notes and information papers, to define the organisational problem. With the problem defined, a design science research method is applied as a problem solving paradigm to create an innovative artefact.

Keywords: design science; feasibility study; functional knowledge; mobile application; constructivism

Introduction

This paper presents as the primary written communication mechanism detailing the design and development of the Real Estate Feasibility, or REFeasibility, application. The paper commences with a background discussion and critique of published research to identify the organisational problem and motivation for the research study and to define the objectives for a solution. With the problem defined and product objectives set, the application of design science as a problem solving paradigm and research method is addressed. Design science is discussed in conjunction with the supportive base feasibility model and the applied learning and teaching theory of constructivism.

The design and development stage commences with an evaluation of proprietary mobile feasibility applications. In the absence of a proprietary artefact that meets the product objectives a new feasibility application is designed. REFeasibility is tested as a prototype with results assessed against a base model prior to deployment on Apple's application Store. The formal demonstration and evaluation of the application, to support the attainment of the product objectives is proposed to take place as a subsequent research project.

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Background

During the 1970s and 1980s valuation tables and portable calculators were the dominant tools for assessing the financial viability development project. To carry out an efficient appraisal during that era detailed feasibility calculations had to be simplified and as a consequence residual appraisals were developed as hybrids of the static and more dynamic Discounted Cash Flow (DCF) approaches. The hybrid models principally resembled a simple static analysis where revenues and costs were accounted for to determine the envisaged profit (feasibility analysis) or worked back to provide a price or residual value for the land. To overcome a series or shortcomings, specifically the quantification of time value of money, the hybrid approaches were modified to include non-market-based assumptions and calculations, so that they more closely reflected the results of the more accurate and explicit DCF approach.

As technology advanced in the ensuing decades, it was envisaged that the DCF approach may take the place of the hybrid approaches. Havard presents this view speaking of the related trends 'push[ing] us towards cash flow models that are constructed on computers' (Havard, 2014, p. 11). While the extant research supports the use of DCF in development viability studies, the hybrid residual appraisal remains most popular. Furthermore, Coleman, Crosby, McAllister, and Wyatt (2013) found that non-market-based techniques and assumptions inherent in the hybrid approaches are entrenched in industry practice, being passed down generation to generation and applied in the DCF-based development assessments undertaken today.

Ironically, further advances in technology have seen the re-emergence of mobile devices with advanced computing capability and connectivity and a respective push away from computers. The trend is evident during the past decade where shipments of desktop personal computers (PCs) peaked in 2007 before being overtaken by notebook PCs (Meeker, 2014). In continuation, shipments of notebook PCs and netbooks commenced a decline in 2011 just prior to the popular emergence of tablets in 2013. According to Morgan Stanley Research, 80 million tablets were shipped in the last quarter of 2013, being roughly equal to the combined shipments of desktop and notebooks PCs. Despite growth in tablets being unprecedented, smart phones still represent a shipment market four times larger in terms of units shipped globally (Meeker, 2014).

Smart phones and tablets retain a level of PC functionally and it is theoretically possible to run a dynamic DCF feasibility on such a device, albeit the operating systems are distinct and hardware is not suited to view or amend spreadsheets. With respect to proprietary feasibility software, Estate Master (2013) has managed to retain some native control across platforms with Development Feasibility (DF) and the associated Microsoft .net framework, reportedly functioning on the Windows Phone operating system. Windows Phone does, on the other hand, represent less than 5% of the smartphone operating market share with iOS (Apple) and Android dominating the remainder of the market (Meeker, 2014).

In order to select, design or develop an appropriate mobile feasibility application, this research commences with a review of previous research into property development and feasibility analysis to further define the organisational problem.

Literature review

Property development

Development property may be defined as 'any type of real property that is either in the course of construction or where construction is contemplated' (International Valuation

Standards Committee 2014, p. 3). In considering the development potential of real property there are a myriad of property-specific considerations, both tangible and intangible, to be balanced and tested against the perceived benefits of the proposed development. In property valuation practice these considerations form part of the assessment of Highest and Best Use, or 'the most probable use of a property which is physically possible, appropriately justified, legally permissible, financially feasible, and which results in the highest value' (Australian Property Institute (API) 2012, p. 137).

Financial feasibility and analysis

As with business ventures, a profit in property development is reached when the revenues exceed expenses or costs. Coleman et al. (2013) refer to Ricardo's Law or Rent, in stating development appraisal, or valuation, methods 'are based on the premise that the value of a development project or site is taken as the monetary residual or surplus available once a site has been developed' (Coleman et al., 2013, p. 146). As such, the fundamental development profitability equation may be simply represented as: profit equates to revenue less costs. In expanding the equation, API (2007b) proposes that economic feasibility is indicated when the market value, or gross realisation, of a project upon achievement of a stabilised condition equals or exceeds all costs of production.

In an aim to better forecast profitability and in turn make more informed decisions regarding the likely financial success of a property development scheme, there have been detailed feasibility models developed and employed. Broadly the models used to value development properties and forecast returns from proposed development projects in Australia may be classed as either Static or Dynamic Analysis (API, 2012). Static Analysis is defined within the Australia and New Zealand Real Property Guidance note as:

> Static Analysis - With this approach costs are generally summated as at the date of completion of the project and income is assessed as at the same date with allowances for vacancies and letting up periods. This is the less complex financial analysis which is suitable for preliminary feasibility studies and for calculating profit and risk or land value. A 'static analysis' assumes no change in prices or costs during the period of development. (API, 2012, p. 173)

Dynamic Analysis allows for potential movements in prices and costs over the period of the development (API, 2012). This, more complex, form of financial analysis is most accurately applied through the Discounted Cash Flow (DCF) method. Cash flow models more accurately represent the actual timing of revenue and expenditure over the development period (Coleman et al., 2013; Wilkinson & Reed, 2008) and extend the ability of operators to model more complex developments with more sophisticated funding arrangements (Havard, 2014).

With advances in technology and education, DCFs have arguably become the preeminent industry tool for valuing complex development projects of a staged or longer-term nature (Coleman et al., 2013; Havard, 2014). Support for the use of DCF models in valuing larger development property with phased schemes is noted in the Australian Property Institute's text *Valuation Principles and Practice* (API, 2007a) and the Feasibility Studies guidance note of the *Valuation and Practice Standards* (API, 2012). In valuing englobo land, subdivisional land, API (2007a) places the onus on the valuer to select the appropriate primary valuation methodology with the generalisation,

'...as projects become larger and more complex, greater weight will be put on Discounted Cash Flow Analysis' (API, 2007a, p. 180).

Regardless of the merit of dynamic DCF-based assessments, static analysis and the hybrid variants remain the dominant approach to assess feasibility, especially for initial viability studies. Despite Havard (2014) speaking of the potential for single proprietary system, such as Argus Developer and Estate Master DF, to apply to both initial and detailed feasibility the envisaged efficiency gains are unlikely to be realised in the early project initiation stage. With respect to market process, Hefferan (2013) and API (2012) characterise the initiation stages of a project as forming ideas and testing scenarios, for example whether to acquire one property over another or even which of the multiple potential uses is the highest and best. Such scenario testing may necessitate a multitude of brief feasibility studies of which one or none may be advanced. As such the relative benefit of being able to advance a project through the same system is likely to be outweighed by the relative added cost and time associated with cash flow modelling on personal computers.

In the pursuit of efficiency others have tried to replicate the results of a dynamic DCF in a static analysis and have, as a consequence, created new hybrid models. The hybrid models gained popularity, with the assumptions and non-market techniques becoming part of industry practice. In a study of development appraisal in the English planning system Coleman et al. (2013) found generalisations from simple residual approaches applied onerously in commissioned feasibility analyses. They conclude poorly theorised and overly simplified models:

> …seem to have become embedded in UK real estate markets. [Their] research suggests that [the] techniques are being passed on to each generation of real estate professionals. Professional institutional guidance also codifies [the] approaches and assumptions with no acknowledgement that there are weaknesses in model composition (Coleman et al., 2013, p. 163).

Coleman et al (2013) make specific reference to the inaccurate assumption of 100% financing which, while not reflective of market practice in the United Kingdom or internationally, was one of the few consistent assumptions across each of their commissioned studies. Similarly, in Australia and New Zealand, the static analysis model has been subject to modifications to account for the models inability to address the quantification of time or time value money concept (Gamby & Bendall, 2004). In discussing land subdivision analysis, Gamby and Bendall (2004) note the deficiencies of the static residual approach, or 'hyposub', in their research as justification for the DCF. Specifically Gamby and Bendall (2004) speak of the methodological advantage of DCF analysis to address the concept of time value of money concept stating:

> Modifications to the hyposub approach such as split profit and risk/interest calculations and staged calculations have been attempted by practitioners to overcome methodological deficiencies. However, all modifications suffer from the disadvantage of attempting to deal with the time value of money (TVM) without addressing the deficiencies inherent in the static hyposub model methodology. (Gamby & Bendall, 2004, p. 3)

In review of the previous findings, it is conceivable that the inauthentic assumption of 100% finance, witnessed in the study by Coleman et al. (2013) and supported by the respective Australia and New Zealand Real Property Guidance note (API, 2012), is a hangover from modifications attempting to make the static analysis more sensitive to duration changes.

Findings

As witnessed in the Coleman et al. (2013) study of development appraisals in the United Kingdom, there are weaknesses in residual model composition and assumptions relating to over simplification of the more detailed and dynamic DCF. The problem extends to Australia and New Zealand where inauthentic modifications of the static analysis have ensued to try and make the model better account for time value of money and more closely reflect the results of the DCF.

While the ultimate remedy may require the wider adoption of DCF analysis, such a detailed approach is impractical for initiation, or early stages, of assessing multiple development opportunities. Similarly, even though technology advances from the 1980s have supported the development of more complex and dynamic spreadsheets, more recent advances in technology have seen a re-emergence of mobile devices and a respective push away from computers.

The advances in technology present an opportunity to re-introduce a theoretically sound static feasibility model, for a mobile device, to enable users to assess both the residual land values and the returns associated with a proposed project. By providing consultants and aspiring developers with an appropriate feasibility application it is envisaged that they will be better equipped to make informed and defendable decisions regarding the pursuit of a development proposal. Furthermore, through testing numerous proposals and witnessing the resultant returns in real-time, users of a mobile feasibility application may even employ a higher level of cognitive activity and enhance their functioning learning of how the analysis works.

Research method

This research relates to the procurement or design of a mobile application to enable prospective developers to assess the feasibility of a proposed project. The project utilises principles (Hevner, March, Park, & Ram, 2004) and processes (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2008) of design science, a novel approach in the property discipline, although a soundly based paradigm in Information Technology. The ultimate result of the research is to create a 'purposeful…artefact created to address an important organisational problem…, described effectively, enabling its implementation and application in an appropriate domain' (Hevner et al., 2004, p. 80).

In applying design science to disciplines such as property it is necessary to consider that the paradigm, and associated artefact, are not exempt from explanatory theories, on the contrary, as Hevner et al. (2004) propose, design science relies on existing theories that are 'applied, tested, modified, and extended through the experience, creativity, intuition, and problem-solving capabilities of the researcher' (Hevner et al., 2004, p. 75). Models and theories assigned to this project include a base static feasibility model, and constructivism, as the learning and teaching theory.

Base static model

The model which underlies this research into mobile application selection and design is not novel. Rather the spreadsheet is principally modelled on the 'Turner Approach', relating to considerations of case law in the 1940s and 1950s (API, 2007a) and demonstrated by API (2007a) and Reed and Simms (2015). The base model is a static analysis (API, 2012) as it assumes no change in prices or costs. It presents in two forms, being a feasibility analysis, or study, and a residual analysis. The distinction between the feasibility and residual analyses relate to the assumption of a land purchase or a margin, or Profit and Risk Allowance. In each scenario the models commence with a gross realisation and subtract anticipated expenses to arrive at either a margin or residual land value, depending on the form viewed. The structure of the static analysis illustrating the feasibility and residual forms is depicted in Table 1.

Constructivism

Constructivism, as adopted in this research, underlines the idea that knowledge is not transmitted to the student, but rather constructed through activity or social interaction (Biggs & Tang, 2009; Vos, van der Meijden, & Denessen, 2011). As Constructivists warn, knowledge that is 'transmitted may not be the knowledge that is constructed by the learner' (Jonassen, 1991, p. 12). Similarly, it is proposed in this research project that, through testing numerous proposals on an appropriate mobile application and witnessing the resultant returns in real-time, users of the application may employ a higher

Table 1. Base model forms.

Ref.	Feasibility	Residual
R	Revenue	Revenue
R1	Gross Realisation	Gross Realisation
R2	*Less* Selling Expenses	*Less* Selling Expenses
R3	*Less* GST	*Less* GST
NR	Net Realisation	Net Realisation
M		*Less* Allowance for margin
C	Costs	Costs
C1	Land Purchase	
C2	Acquisition Costs	
C3	Professional Fees	Professional Fees
C4	Construction Costs	Construction Costs
C5	Contingency	Contingency
C6	Statutory Charges/ Contributions	Statutory Charges/Contributions
C7	Land Holding Charges	Land Holding Charges
TC	Total Costs (Exc Finance)	Total Costs (Exc Finance and Exc Land related)
I	Finance (Interest)	Finance (Interest)
I1	Interest (Land &Acq.)	
I2	Interest (Construction)	Interest (Construction)
TF	Total Finance	
TCI	Total Costs Including Finance	
F		Funds available for Purchase
F1		*Less* Interest (Land &Acq.)
F2		*Less* Acquisition Costs
P	Profit (incl. Finance)	
M	Margin *(Profit / Costs Including Finance)*	
RLV		Residual Land Value *(Funds available for Purchase – Interest (Land &Acq.) – Acquisition Costs)*

Source: API 2007a and Author.

level of cognitive activity and enhance their functioning learning of how feasibility analysis works.

Design science research methodology

Through a review of prior research Peffers et al. (2008) designed a methodology tasked to serve as a commonly accepted framework for carrying out research based on design science principles. The resulting process, or framework, as described comprises six activities leading from problem identification, definition of solutions, design and development, demonstration and evaluation, as depicted in Table 2.

Design science for the research problem

The application of Peffers et al. (2008) six activity design science research methodology framework, leading from problem identification, definition of solutions, design and

Table 2. Design science activities.

Activity	Description
1. Problem identification and motivation	Define the specific research problem and justify the value of a solution.Resources required for this activity include knowledge of the state of the problem and the importance of its solution.
2. Define the objectives for a solution	Infer the objectives of a solution from the problem definition and knowledge of what is possible and feasible. Resources required for this include knowledge of the state of problems and current solutions, if any, and their efficacy.
3. Design and development	Create the artefact. This activity includes determining the artefact's desired functionality and its architecture and then creating the actual artefact. Resources required for moving from objectives to design and development include knowledge of theory that can be brought to bear in a solution.
4. Demonstration	Demonstrate the use of the artefact to solve one or more instances of the problem. This could involve its use in experimentation, simulation, case study, proof or other appropriate activity. Resources required for the demonstration include effective knowledge of how to use the artefact to solve the problem.
5. Evaluation	Observe and measure how well the artefact supports a solution to the problem. This activity involves comparing the objectives of a solution to actual observed results from use of the artefact in the demonstration.It requires knowledge of relevant metrics and analysis techniques. At the end of this activity the researchers can decide whether to iterate back to activity 3 to try to improve the effectiveness of the artefact or to continue on to communication and leave further improvement to subsequent projects. The nature of the research venue may dictate whether such iteration is feasible or not.
6. Communication	Communicate the problem and its importance, the artefact, its utility and novelty, the rigor of its design and its effectiveness to researchers and other relevant audiences such as practicing professionals, when appropriate. In scholarly research publications, researchers might use the structure of this process to structure the paper, just as the nominal structure of an empirical research process is a common structure for empirical research papers. Communication requires knowledge of the disciplinary culture.

Source: Peffers et al., 2008.

development, demonstration and evaluation and communication, to this project may be described as follows.

Problem identification and motivation

The problem extends from the review of published research where it is found that inauthentic modifications of the static analysis have resulted in hybrid feasibility models with weaknesses in model composition and assumptions. The ultimate remedy may lead to the wider adoption of the DCF however the approach is impractical for initiation or early stages of assessing development opportunities. Similarly, even though technology advances have supported the development of more complex and dynamic spreadsheets, more recent advances in technology have seen a re-emergence of mobile devices and a respective push away from computers.

Define the objectives for a solution

Advances in technology present an opportunity to re-introduce a theoretically sound static feasibility model for a mobile device to enable users to assess both the residual land values and the returns associated with a proposed project. By providing consultants and aspiring developers with an appropriate feasibility application it is envisaged that they will be better equipped to make informed and defendable decisions regarding the pursuit of a development proposal. Furthermore, through testing numerous proposals and witnessing the resultant returns in real-time, users of the application may even employ a higher level of cognitive activity and enhance their functioning learning of how feasibility analysis works. As such the primary and secondary objectives for the mobile application may be presented as:

> Primary objective: To enable prospective developers to efficiently assess the financial feasibility of a proposed project to make informed decisions regarding the pursuit of a development proposal.
>
> Secondary objective: To encourage repeat interaction to enhance users functioning learning of financial feasibility analysis.

Design and development

The refined research problem and objectives present as a basis to evaluate existing proprietary artefacts, or mobile feasibility applications. As an extension to the primary objective the selection or procurement of an appropriate feasibility application relates to one which is robust and accurate, reflects the practice of the industry and is transparent in a manner where the financial workings of the model may be appraised.

Evaluation of proprietary mobile feasibility applications

In searching the Apple, Android and Windows digital distribution platforms with the term 'feasibility', six mobile applications were uncovered as detailed in Table 3. The application developers predominantly include Australian entities related to property development and consultancy (Commercial & Residential Construction, Developer Network and Grant Muddle). The oldest application is the, United States of America based, Feasibility Study, released in July 2011. The remaining applications, including

Table 3. Proprietary mobile feasibility applications.

Application	Developer	Date	Compatibility	Price	Description
Property Development Feasibility	Commercial & Residential Construction (Australia)	5 June 2013	iOS4.3 or later. Compatible with iPhone, iPad, and iPod touch.	Free	Estimate the feasibility of a property development by entering a few simple figures on your proposed property development project.
QwikFeaso	Developer Network (Australia)	25 Sep 2013 (iOS) Cica August 2013 (Android)	iOS4.3 or later. Compatible with iPhone, iPad, and iPod touch. Android 2.1 and up	Free	…to help… determine the feasibility and profitability of a range of small to medium-sized property development projects.
Real Estate Development Feasibility App - LITE	Grant Muddle and Malyshka (Australia)	4 Jan 2013	iOs 4.2 or later. Compatible with iPad	$1.29	…for investigating the financial feasibility of undertaking property
Real Estate Development Feasibility App	Grant Muddle and Malyshka (Australia)	4 Jan 2013	iOs 4.2 or later. Compatible with iPad	$23.99	development projects.…it calculates key investment performance indicators…
Feasibility Study	dotstripes	21 Jul 2011	iOS4.0 or later. Compatible with iPhone, iPad, and iPod touch	$1.29	Do you need to give quick answer from your board of directors, managers, or colleagues about the proposed projects? Do you have a very good idea that you seek in daily business?
feasoPRO	feasoPRO Pty Ltd 2013	23 Nov 2013	iOS5.0 or later. Compatible with iPhone, iPad, and iPod touch	$2.49	feasoPRO provides profitability estimates for property developments, based on assumptions entered by the user.

Source: Apple Inc. 2014 and Google 2014.

those from Australian developers, were released later during 2013. Apple's iOS is the dominant platform with all of the applications running on iPad and most on iPhone and iPod. QwikFeaso is the only multiplatform application released for Android and iOS around August 2013. There are two feasibility applications available free of charge, with Property Development Feasibility being the only immediately operable. While

QwikFeaso may be downloaded free of charge additional requirements and applications are necessary to activate the application.

Due to technical issues regarding the Real Estate Development Feasibility App, the evaluation associated with this research was limited to four. A similar issue was expressed in the customer reviews where it was noted that the respective application was '…unresponsive and freezes…' (Aka017, 7 August 2014 in Apple Inc. 2014). The sample was reduced further after brief tests of the Australian Property Development Feasibility and the older Feasibility Study, by dotstripes. Property Development Feasibility is more of a benchmarking tool rather that a static model, as the user may only input a few details, excluding construction costs, and the model infers all other costs to determine whether the project would be feasible. Despite this process potentially having relevance in the market it does not meet the primary objective of this research, a view shared through review with a customer speaking of the application being too basic, with '…minimal features to accurately cost a site' (Mickyyyy R, 3 October 2013 in Apple Inc. 2014).

The remaining applications, feasoPRO and QwikFeaso, are rather unique in the approaches applied to feasibility analysis. The feasoPRO application is rather simple providing a series of windows where revenue and costs are entered and a simple 'Revenue and Profit' sheet where a profit estimate is returned along with a return on cost expressed as a percentage. Unfortunately the feasoPRO model did not extend to a residual analysis and there were a significant proportion of manual entries including the requirement to manually re-enter the durations for interest. Besides the identified shortcomings the feasoPRO interface operated effectively with an efficient touch and drill/return capability allowing for a rapid change of assumptions.

QwikFeaso presents with the most favourable customer reviews, while the originators of such reviews may have a bias, Flux, a director at the Development Network, presents a valid perspective promoting the 'completely customisable to suit my own specific strategies…' (Google, 2014) nature of the application. The ability to customise an application may, prima facie, present as a marketable benefit however it also presents an opportunity for the integrity of the model to be interfered with. Such interference could see assumptions and allowances applied in an inauthentic way and even reproduce the underlying methodological issues considered in the study by Coleman et al. (2013).

Design and development of Real Estate Feasibility

In the absence of a proprietary artefact that meets the two product objectives a feasibility application is designed as part of this research. Real Estate Feasibility, or REFeasibility (REF), is an Apple iOS mobile application designed from the base model and forms as discussed by API (2007a) and Reed and Simms (2015) with an intuitive, guided user interface. Additionally the design is influenced by the learning theory of constructivism, underlining the idea that knowledge is constructed through activity or social interaction. The initial selection of iOS as an operating system and optimisation for iPhone related to the dominance of Apple applications with Android development considered for a subsequent project.

Presented in its original form, the base model comprises a computer spreadsheet with three sheets, an assumptions page and both feasibility and a residual sheets. For manipulation on a personal computer the base model serves its purpose, efficiently presenting an analysis tool for prospective developers to assess the financial feasibility of a proposed project. Unfortunately, as with other spreadsheets, efficiency and accuracy of data input are lost when the original form of the model is run on a mobile device. As such the services of an expert application developer were sought in May 2013, to assist with reproducing the functionality of the provided spreadsheet while providing the user with an intuitive, guided interface. In return it was envisaged that the resultant application may enable prospective developers to efficiently assess the financial feasibility of a proposed project to make informed decisions regarding the pursuit on a development proposal.

Following a series of meetings, a whiteboard brainstorming session was scheduled in December 2013 with the intent to design an intuitive, guided interface optimised for an iPhone. The findings of the whiteboard session were then replicated in myBalsamiq, a system for the remote sharing and working on design mock ups (Balsamiq Studios, 2014). Through manipulation of the mock-up a broad layout was formed in such a manner as to not overwhelm the user with text yet provide as few pages as possible. By having too many pages a user may become disoriented and be deterred from further repeat interaction, as sought after in the secondary objective. A total of six pages were settled upon with contents as detailed in Table 4.

Navigation between the pages was achieved through 'back' and 'next' buttons situated at the top of the screen. The navigation presented in a simple and effective manner to allow the user to move forward and backward to test the sensitivity of input changes

Table 4. Real Estate Feasibility pages.

Page	Name	Contents	Ref. (Table 1)
1	Start new project	Starting a new project	
		Accessing an existing project	
2	Project setup	Property and project details	
		Durations	
3	Revenue	Gross realisation	R1
		Selling expenses	R2
		GST	R3
4	Costs	Land purchase	C1
		Acquisition costs	C2
		Construction costs	C4
		Professional fees	C3
		Contingency	C5
		Statutory contributions	C6
		Holding charges	C7
5	Interest	Interest %	I
		Loan %	
6	Feasibility and Residual	Feasibility	
		• Assume land purchase [input]	
		• Indicated profit (ex. interest)	
		• Indicated profit (incl. interest)	P
		• Return on capital	
		• Allowance for margin	M
		Residual	
		• Assume margin [input]	M
		• Land assessment ($/unit) and ($/m2)	RLV
		Email PDF	

Source: Author.

on project feasibility and the residual land assessment and progressively amend and confirm assumptions.

A further functionality introduced relates to 'drilling down' on salient figures to present the dependent figures. Through the explicit representation it was envisaged that the user may explore the more detailed workings and more effectively construct knowledge of financial feasibility analysis through interaction with the application. The drill down function is most prevalent on the final feasibility and residual page. A feasibility example includes, by touching Return of Capital, the ability for a user may view the underlying Indicated profit (ex. Interest) and Development cost totals that relate to the equated return.

With respect to setting the design of the application, a creative brief was prepared for the graphic designer in March 2014. The intent of the brief was to share product objectives and the university, sponsor, design guidelines. In all, the design process was rather effective as the first proposal met the requirements of the sponsors marketing and communications department and the icon, representing a house and calculator met key stakeholder requirements being considered a fair representation of real estate and feasibility, respectively.

In April 2014 the first version of the application was created and shared through TestFlight, an over-the-air platform used to distribute internal applications to team members (Bustly, 2014). On the face of it, the application presented in a complete manner albeit there were underlying calculation issues. The prototype was tested internally for alignment with the original base model and externally to test the user interface. The internal assessment revealed calculation errors and terminology misalignments, however the external test of the interface was well received with an experienced developer and valuer satisfied with the functionality and the short duration required to complete an analysis.

From model inception, the application defaulted to allow for the inauthentic but consistent assumption of 100% finance, as addressed in the review of previous research. In a subsequent review of the assumption a change to the product scope was proposed to allow the user to select the proportion of funding and more accurately represent market practice. The scope change was not without complication as the base model required amendment and the process of restructuring of the application came with further difficulties. Numerous models were then tested through to the end of July 2014, when the application and base model were considered to provide comparatively identical results.

To assure users of model integrity and provide an efficient transition between the application and subsequent more detailed dynamic analysis an export function was included. The export function comprises two actions, a print to Portable Document Format (PDF) and email. The PDF was structured in an explicit manner to provide users with the opportunity to follow the models workings, on a line by line basis, to test the integrity of the calculations. The PDF also provides the benefit of displaying, in a single document, details of the assumptions and measures forming the analysis. Such information may be considered in the development of a later more dynamic, DCF feasibility.

Demonstration and evaluation

Demonstration and formal evaluation of the prototype will ultimately relate to measuring the performance of the application against the two objectives, specifically to see how the intervention enables prospective developers to efficiently assess the financial feasibility of a proposed project to make informed decisions regarding the pursuit of a development proposal. Further, in accordance with the second objective, the testing would extend to see if and how the application may encourage repeat interaction and enhance the users functioning learning of financial feasibility analysis.

The empirical demonstration and evaluation are proposed to take place as a subsequent research project and incorporate a range of testing techniques with questionnaires and rubric scoring. The subsequent testing is beyond the scope of the initial design project. For this specific research project the design testing is supported by two cases studies. The case studies relate to hypothetical development projects on the Sunshine Coast, one comprising the development of an industrial complex, named Page, and another being a medium density residential complex, Yinni. In each case the scenario is modelled on both the base static model and REFeasibility application, with the results of each summarised in Tables 5 and 6.

The variances in each model may be attributed to data entry and rounding. In either case, the variances are never greater than 0.5% percent reflecting the similar nature of the base model and final REFeasibility application.

Communication

This research paper provides the primary non-verbal communication mechanism through imparting or exchanging of information by writing. The form of communication associated with the publication is inherently closed as it depicts the design and research journey as they complete. While there remains scope for peer feedback to inform further research the communication does not, *per se*, inform the journey in the same way the literature and research findings do.

Table 5. Page case study measures and returns.

Page Case Study Measures	Base model	Application	Variance	Variance %
Net Realisation	$3,006,450	$3,006,008	- $442	-0.01%
Total costs incl. interest	$2,963,978	$2,963,469	- $509	-0.02%
Indicated profit (incl. interest)	$42,472	$42,539	$67	0.16%
Return of Capital	5.45%	5.45%	0.00%	0.07%
Margin (Profit and Risk)	1.43%	1.44%	0.01%	0.49%
Land assessment (RLV @ 15%)	$1,186,206	$1,186,318	$112	0.01%

Source: Author.

Table 6. Yinnicase study measures and returns.

Measures	Base model	Application	Variance	Variance %
Net Realisation	$5,138,286	$5,138,287	$1	0.00%
Total costs incl. interest	$4,663,010	$4,663,012	$2	0.00%
Indicated profit (incl. interest)	$475,276	$475,275	- $1	0.00%
Return of Capital	14.76%	14.76%	0.00%	0.02%
Margin (Profit and Risk)	10.19%	10.19%	0.00%	0.00%
Land assessment (RLV @ 15%)	$629,178	$629,176	- $2	0.00%

Source: Author.

Table 7. Design science research methodology activities.

<table>
<tr><th>DSRM Activity</th><th>As applied in the design of the feasibility application</th></tr>
<tr><td>Problem identification and motivation</td><td>Inauthentic modifications of the static analysis have resulted in hybrid feasibility models, with weaknesses in model composition and assumptions. The ultimate remedy may lead to the wider adoption of the DCF, however, the approach is impractical for initiation or early stages of assessing development opportunities. Similarly, even though technology advances had supported the development of more complex and dynamic spreadsheets, more recent advances in technology have seen a re-emergence of mobile devices and a respective push away from computers.</td></tr>
<tr><td>Define the objectives for a solution</td><td>Primary objective: To enable prospective developers to efficiently assess the financial feasibility of a proposed project to make informed decisions regarding the pursuit on a development proposal.
Secondary objective: To encourage repeat interaction to enhance users functioning learning of financial feasibility analysis.</td></tr>
<tr><td>Design and development</td><td><table><tr><th>Application</th><th>Developer</th><th>Date</th><th>Compatibility</th><th>Price</th><th>Description</th></tr><tr><td>Real Estate Feasibility (REFeasibility)</td><td>University of the Sunshine Coast</td><td>14 September 2014</td><td>iOS 6.1 or later. Compatible with iPhone, iPad, and iPod touch. Optimised for iPhone 5</td><td>Free</td><td>Enable potential property developers to assess project feasibility on the move, or out and about. Then export the results and workings, by PDF, for later more detailed analysis</td></tr></table>REFeasibility is a mobile application designed from the base model and forms as discussed by API (2007a) and Reed and Simms (2015) with an intuitive, guided user interface. Additionally the design is influenced by the learning theory of constructivism, underlining the idea that knowledge is constructed through activity or social interaction.</td></tr>
<tr><td>Demonstration</td><td>The design testing is supported by two cases studies. The case studies relate to hypothetical development projects on the Sunshine Coast, one comprising the development of an industrial complex, named Page, and another being a medium density residential complex, Yinni. In each case the scenario is modelled on both the base static model and REFeasibility application. The variances in each model may be attributed to data entry and rounding. In either case the variances are never greater than 0.5%, reflecting the similar nature of the base model and final application.</td></tr>
<tr><td>Evaluation</td><td>Formal evaluation of the prototype will ultimately relate to measuring the performance of the application against the two objectives, specifically to see how the intervention enables prospective developers to efficiently assess the financial feasibility of a proposed project to make informed decisions regarding the pursuit on a development proposal. Further, in accordance with the second objective, the testing would extend to see if and how the application may encourage repeat interaction and enhance the users functioning learning of financial feasibility analysis.The formal demonstration and evaluation is proposed to take place as a subsequent research project and incorporate a range of testing techniques with questionnaires and rubric scoring.</td></tr>
<tr><td>Communication</td><td>This research paper provides the primary non-verbal communication mechanism. To encourage further communication and empirical testing it is intended that this research paper is presented as an accompaniment to the application.</td></tr>
</table>

Source: Author.

In practice the research and design associated with this research are founded on previously published studies and the research as disclosed however, as discussed by Sein, Henfridsson, Purao, Rossi, and Lindgre (2011), in design science due consideration is given to interaction with organisational elements. As such engagement activities over the past four years, since inception of the idea, have contributed to the refinement of the research problem and scope. The engagement activities range from informal discussions with property organisations to more formal feedback relating to grant applications.

To encourage further communication and empirical testing it is intended that this research paper is presented as an accompaniment to the application. In such a way researchers and industry persons may share an understanding the applications development and the associated methods and approaches informing the design. Similarly feedback may be captured and shared through traditional systems as well as informal reviews posted on Apple's App[lication] Store and more formal research papers.

Design Science summary

The salient details from the design science research method (DSRM) activities and how they are applied in this research project is depicted in Table 7.

Conclusion

As witnessed in the Coleman et al. (2013) study of development appraisals in the United Kingdom, there are weaknesses in residual model composition and assumptions relating to over simplification of the more detailed and dynamic DCF. The problem extends to Australia and New Zealand where inauthentic modifications of the static analysis have ensued as users have attempted to make the model better account for the time value of money and more closely reflect the results of the DCF.

Even though the ultimate remedy may relate to the wider adoption of the DCF, it is an impractical approach for initiation or early stages of assessing multiple development opportunities. Similarly, even though technology advances from the 1980s have supported the development of more complex and dynamic spreadsheets, more recent advances in technology have seen a re-emergence of mobile devices and a respective push away from computers.

As evidenced in this research project, the advances in technology present an opportunity to re-introduce a theoretically sound static feasibility model, for a mobile device, to enable users to assess both the residual land values and the returns associated with a proposed project. By providing consultants and aspiring developers with an appropriate feasibility application it may be asserted that they will be better equipped to make informed and defendable decisions regarding the pursuit of a development proposal. Furthermore, through testing numerous proposals and witnessing the resultant returns in real-time, users of the application may even employ a higher level of cognitive activity and enhance their functioning learning of how feasibility analysis works.

Further research

Demonstration of the prototype will ultimately relate to measuring the performance of the REFeasibility application against the two objectives, specifically to see how the intervention enables prospective developers to efficiently assess the financial feasibility of a proposed project to make informed decisions regarding the pursuit on a development proposal. Further, in accordance with the second objective, the testing would extend to see if and how the application may encourage repeat interaction and enhance the users functioning learning of financial feasibility analysis.

This research presents a mobile application as an intervention to enable efficient assessment of financial feasibility. Complementary research would investigate how contemporary developers engage with their mobile devices and whether mobility is a significant contributing factor to the efficient assessment of project viability.

Limitations of this research

This research relates to the design of a mobile application to enable prospective developers to assess the feasibility of a proposed project. A defining and controversial aspect in qualitative research, of this nature, relates to the active role of the researcher and potential to influence the design and results of the study. With the intention of mitigating the influence of bias and misrepresentation, a soundly based research approach, design science, is incorporated. The paradigm sets principles and processes to add rigor and guide the presentation of the research in a reliable and repeatable manner.

While the prototype testing sufficiently informs the design activity, the evaluation approach limits the explanatory significance of the author's observations. As such, subsequent empirical testing of the REFeasibility application is recommended as a standalone research project.

Notes on contributors

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Steven is currently a Divisional Councilor of the Australian Property Institute (API) and the Chair of the Sunshine Coast's API Discussion Group in addition to being part of the committee for the region's Property Council of Australia (PCA).

Since 2001 he has been active in property funds management, valuation, consultancy and education. During the past 10 years Steven was part of the Property Operations team at a Brisbane based funds manager before moving to the Sunshine Coast in 2007 to manage a local commercial valuation practice. During his industry employment Steven was involved in the valuation and consultancy assignments for large scale developments including master planned communities, and the redevelopment of a regional city centre.

He is a confirmed PhD candidate and has a Master of Property Economics, Postgraduate Diploma in Property Economics (Development) and a Bachelor of Applied Science (Property). Steven is a certified Valuer in Queensland, a registered Specialist Retail Valuer in Queensland and is a Fellow of the API. His research interests extend across property, project management, higher education and learning through serious gameplay.'

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