A BUSINESS CASE TOOL AS DECISION SUPPORT IN EARLY PRODUCTION LOCATION PROJECT STAGES

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Abstract: Globalisation makes companies enter the global market both in sale and production. Previous studies have shown that one of the main reasons for relocation and outsourcing is cost saving. There are also studies showing that companies today may benefit from a decision support model based on costs. This paper provides a business case tool to be used in the scoping phase where different location alternatives are to be roughly analysed for further investigation. The tool is to be used together with strategic analyses and more extensive risk analyses to make a solid information platform for decisions.

Keywords: Location decision, business case, decision support, cost conscious analyses.

1. INTRODUCTION

The strive to expand and develop businesses and meet global competition makes companies relocate and outsource their production. The reasons for change of location or addition of new manufacturing sites are often to reach markets and get cost advantages. Not only large enterprises have the strategic option of acting globally, but small- and medium-sized enterprises (SMEs) also reach for the global market (Asplund and Butsko, 2010; Bell *et* al., 2003; Fillis, 2001; Anderson *et* al., 1998; Kohn, 1997). Some studies show that the decision to relocate is often based on inadequate and uninformed reflections, resulting in manufacturing activities repatriating back to its origin location (Kinkel, 2009; Schulte, 2002). In a survey over German companies (Kinkel *et* al., 2007) the motives for offshoring are compared with the motives for back-sourcing. In both cases the main reason for relocating were cost of production factors: 87 % respective 52 % indicating that these factors were of high importance. The findings in the survey indicate that it is not unusual that companies underestimate production costs and overestimate the benefits of relocation of manufacturing systems. In another study Platts and Song (2010) have interviewed several companies that outsourced to China, finding that the costs ended up 25-50 % higher than the quoted cost. Windmark and Andersson (2012) find in their interview study of Swedish companies that the main reason for starting a location project is to reduce costs. Another finding in the study is that the companies interviewed are using a limited amount of different cost factors when deciding about relocation projects. The motivation for developing a structured location decision support is twofold. First, the difficulties for companies to get accurate cost estimations and second, SMEs often do not have large organisation dedicated to location decisions/reflection.

As put forward in the studies above, one important reason for relocation is costs. There are numerous studies addressing the importance of cost awareness, for example Platts and Song (2010), MacCarthy and Attirawong (2003) and Badri *et* al. (1995), important cost groups are personnel costs, project costs and investments, but no deep through analysis or decision support focusing on the cost influence of the combined financial impact of relocation could be found in the literature. This motivated the initiation of a research project with the aim of developing a structured cost based decision support in production relocation issues, resulting in a three year collaboration project between five companies and two universities. This project resulted in a work procedure to support the decision making in a production location project, and consist of a five step stage-gate model, see

Figure 1, together with a selection of cost based tools and templates, documented in a handbook (Andersson et al. 2013). The purpose of the work procedure is to support the decision process preceding the potential realisation of a production location, and involves selection and comparison of different location alternatives. The user is guided through a series of activities in each step supported by a selection of tools and templates for analysis of e.g. costs and risks in each step. In the initial phases (1 and 2) the main decision issues are to establish a project organisation and to understand the purpose. In the next step the current footprint is analysed, and in the following steps (4 and 5) potential alternative locations are identified and analysed to arrive at a selection among the alternatives. The motivation for this paper is to focus on the cost based support and data acquisition in the initial phases of this work procedure.

In the decision model the gates between each phase could be a decision on to proceed with the project or could be definitions of criteria and goals. To each phase a set of templates and tools are associated to support the activities. The toolbox contains an array of templates and guides together with a set of business case and cost analysis tools with a progression in the level of detail and complexity throughout the work procedure. The process starts with an initiation study with the aim of stating the goals and motivations for the project. During the second phase, different location alternatives are investigated and rough analyses are performed. The analyses both include an initial business case, rough risk analyses, strategy plans and planning of the project organisation. In the Pre-Study phase the analyses get more profound involving more detailed production and supply chain analyses. In this phase the current situation/system is analysed and future needs is investigated. The last two phases are for even more profound analysing of the suggested alternatives including the whole production system concept, select the location and make a business plan. There are both qualitative and quantitative parameters to take into consideration during a location project. In the business case tool presented here, the quantitative parts are included, while qualitative aspects are taken into account in other tools in the decision support model.

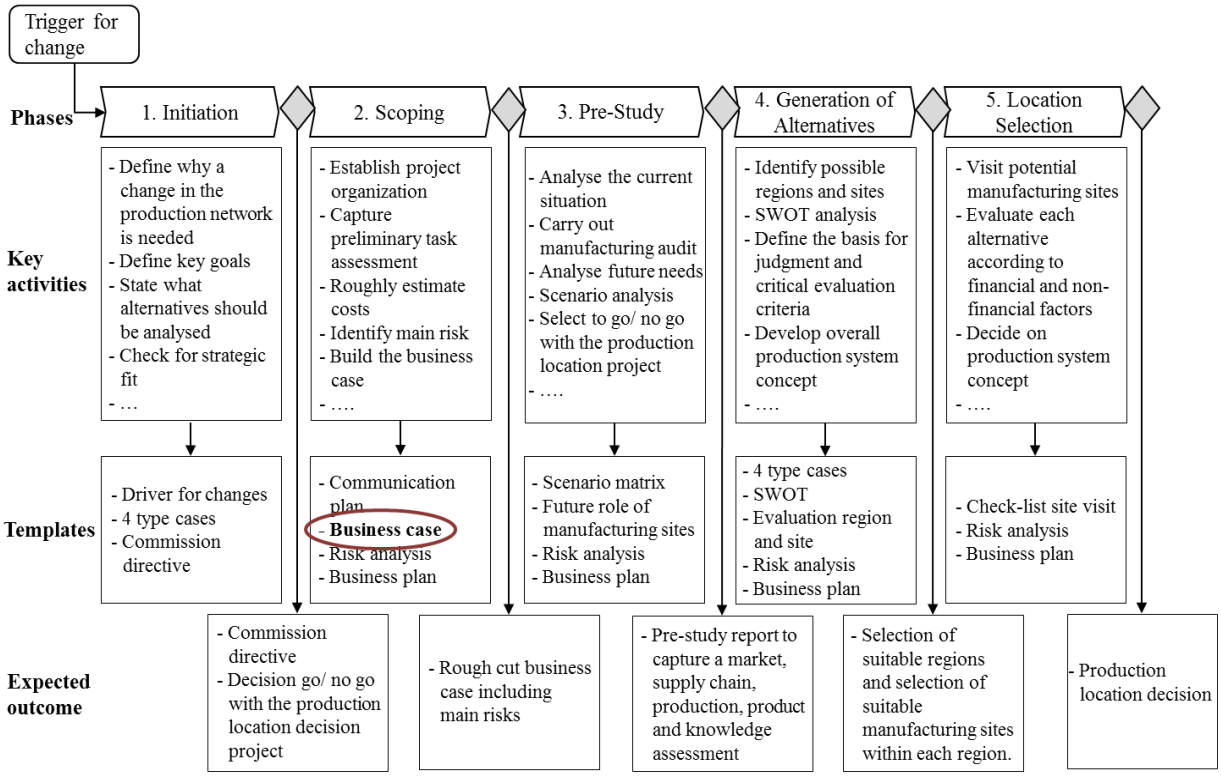

Fig. 1. Decision support process based on figure presented by Bellgran et al. (2013).

To make the decisions foundation complete, the tool presented here has to be complemented by a strategic analyses regarding, legal, cultural and social factors and political and economic aspects. Also proximity to suppliers, to markets/customers, to parent company's facilities, and to competitors has to be taken into considerations (MacCarthy and Atthirawong, 2003). The analyses are important both to understand the characteristic of the location but also for estimating the parameters in the model. There are several challenges not met in the business case tools as prediction of the future, market, sales, competitors, price erosion, increased overhead cost due quality control, logistics delays, agility to market etc. which is further investigated in other tools later on in the process.

The development of the business case tool and check list were made in close cooperation with the participating companies in the project involving interviews and working meeting where the structure of the business case was reviewed. One of the central issues was to establish which information that is required, to initiate a location project in order to make an assessment of future progress. The main question was: Which parameters and key performance measurements should be included in the business case to make it usable and comprehensive? The present paper will propose an initial business case tool to use in the scoping of a location project in connection to the decision support process presented by Andersson *et* al (2013) and Bellgran *et* al. (2013).

In the proposed work procedure the level of detail in both data acquisition and analysis increases throughout the subsequent steps. The information in the early stages is usually rough estimations of costs and revenues and the character of the decisions are mainly to initiate an analysis and decide on whether to proceed or not. The purpose of the decision support procedure is to acquire, categorise and analyse information leading to that the amount and quality of information increases as the work proceeds into phase 3 and 4. This allows for a more detailed and in depth analysis of costs in the latter phases. In Figure 2 the cost tools developed for the different stages in the decision model are presented, showing a progression in level of detail and an expansion in the number of cost analysis tools throughout the decision process.

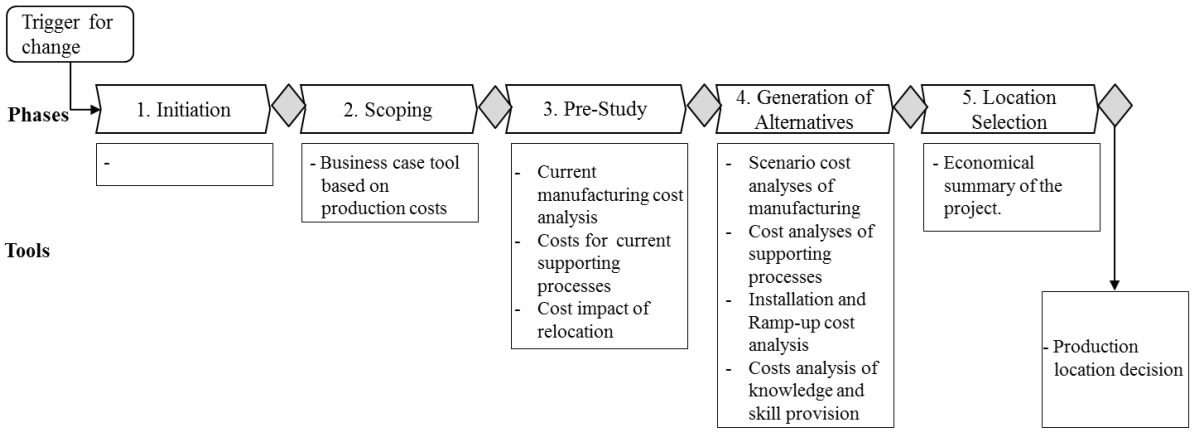

Fig. 2. The cost tools connected to the decision process.

The aim of this paper is to present a *business case tool* for production location to use in *the scoping phase* of a production location project when investigating the cost and benefits of starting a location project. The tool provides a rough estimation of costs and benefits in an early stage to serve as a support for decision on whether to proceed with a deeper analysis of production relocation. The tool presented in this paper is proposed to be used in an initial analysis investigating whether a location project should continue or not.

This paper is structured as follows; first, definitions of the structure of business case models are presented followed by how different budget approaches will affect the scope. Thereafter a presentation of the developed business case tool follows. Finally some discussions regarding the usability of the business case tool and topics for future research are presented.

2. BUSINESS CASE AND LOCATION PROJECTS

A location project is typically a time-sensitive and costly project, involving location identification, facility capacity specification and capital allocation (Owen and Daskin, 1998). A business case is a tool to determine the effects of decisions. It should include cash flow over time and changes in costs and revenues. There should also be focus on internal rate of return and pay-back periods (BusinessDictionary.com). According to Gambels (2009) a business case should involve analyses about benefits, costs and risks for realistic alternatives and an explanation about how the project tasks can be implemented.

When making decisions companies struggles between taking too slow decisions and risks being too late on the market compere to competitors or too fast decisions making the wrong ones (Loch and Terwiesch, 2005). It is therefore important to have reliable information as soon as possible in the decision process, which could support the benefits of having a pre-designed tool for business cases.

There are four main alternative ways to handle a budget, which will affect the project organisation; there are bottom-up and top-down derivations which either have fixed or variable status. If the budget is bottom-up, the budget is primarily very detailed attached to the activities in the project and in the case of top-down the budget is set higher up in the organisation with a high level allocation of funds. Fixed and variable statuses are weather

the budget is fix or variable (Gambles, 2009) during the ongoing project. The management of the location project will be affected depending on which kind of budget process the project has. A top-down budget with a fix amount of money will probably become more strict and controlled by top organisation in the company than if the project has a bottom-up budget which probably will affect the project organisation structure and project planning. The way of using the business case tool will depend on how the company design the project budget.

There are several authors in the literature discussing different cost parameters to take into consideration during a location project (Windmark and Andersson, 2012; Platts and Song, 2010; MacCarthy and Atthirawong, 2003; Badri *et* al., 1995). Some of the most central are parameters connected to start up, operation, project organisation and execution, infrastructure, labour characteristics, government and political and economic factors. The large number of different important factors indicates that the location analysis has to be quite excessive. Badri *et* al. (1995) presents three models for determinate the most important factors for relocating companies, by investigating replies from a survey concerning an industrial park in Dubai, in which 482 companies participated. The paper mainly target developers of industrial parks and firm facilities but also gives a good overview of important factors and parameters to take into consideration when relocating. Some of the factors involve for example infrastructure, cost, worker availability and climate.

Yang and Lee (1997) present a decision model based on analytical hierarchy process, which consists of seven different steps, (0) justifying and identify the facilities, (1) identify location factors, (2) develop priority weight, (3) collect data and rank the potential location, (4) analyse comparative results, (5) identify preferred site(s) and (6) final recommendations. The model uses the fact that there often is no "optimal" location, but sites can have appealing advantages, and after some compromises it is possible to find the best option. The model focuses on the relation between factors for each site and hence, presents the relative information instead of the absolute preference information. One of the difficult steps in the model is to make adequate priority weight, which can be helped with the knowledge about actual facts/costs. The model will also only give the best alternative and not whether it is profitable to move manufacturing to the actual location.

Christodoulou et al (2007) present a decision support for relocation, helping companies with strategies for gathering and evaluating data. It is a wide-rage support, focusing more on qualitative than quantitative parameters and thus are lacking in depth in general manufacturing analyse and in cost calculation and estimations.

In the PMBoK (2008) there are several examples of projects cost estimation tools. Some of them are: cost estimation using similar performed projects costs to determine the current project, using bottom up estimations to summarise detailed cost from lowest level of work package to calculate the entire cost of the project and cost of quality analysis for estimating the cost of the highest quality for each activity in the project.

Although there are several studies address the cost issue in location project, detailed explanations on how to use costs or how to make estimations could not be found. Therefore this paper proposes business case tool to be used in the early phase of developing a decision support for production location projects.

3. BUSIENSS CASE TOOL DESCRIPTION AND IMPLEMENTATION

One of the important gates in the initial phases of the work procedure in Figure 1, is to decide whether to proceed with a location project or not. The information to base this decision support on is often limited estimations about the potential new locations. To support this early "Go / No Go" decision structured business case providing a rough costs and benefits analysis is proposed to support the decision to proceed or not proceed with the location project. Also a checklist for input estimation and acquisition is proposed following the structure of parameter categorisation used in the developed work procedure. The initial business case tool is to be used in the scoping phase, after a project organisation and the purpose of the location process is established. The purpose of the business case tool in phase two (the one presented here) is to give a rough picture of the costs and the benefits of a proposed location project, enough to be able to decide on whether to proceed with the location project or not. The business case model is mainly developed to investigate one main product produced at one site. It is possible to make several analyses of different products and divide the project, facility and operations costs accordingly. If all products are produced alike they could also be treated as one product in this early stage of the project. Important to note is that the business case tool is not designed to be used for final location selection, but as a tool for decision about project continuation. The business case tool is divided in three steps to use in chronological order:

1. Estimation of project organisation time and costs.
2. Estimation of input data by use of a developed checklist.
3. Structure and outcome of the business case.

In the case of uncertain data the business case tool should be used several times for each location alternative with different ingoing value for the parameters in question, this to investigate the economic outcome in the worst, most probably and best case.

3.1. Costs of project organisation

First the project organisation has to be established and the team member allocated to the project. There has to be an idea about who should be involved, how the person should be involved, to what extent and the working task for the employee. Depending on budget strategy, project member are either selected before or after approved budget. The project team should involve personnel form or with insight in all affected departments in the company. When structuring the costs of a project organisation the following cost parameters have to be considered: salary levels, working rate, (full time or part time), travel and accommodation costs, organisation size and structure and project time. There could also be costs connected with experts on site investigating the considered locations.

In the proposed business case tool the estimations on project cost is separated from the total project estimation and is imported as at sum in the tool main page presented in Appendix 1.

3.2. Parameters

To facilitate the execution of the business case analysis, a check list of important parameters connected to a location project is provided as a part of the business tool. The input data for the checklist should be acquired with assistance from employees from different functions in the organisation. Bjelkemyr *et* al. (2013) gives a suggestion on what functions and parameters to include in a location project, on which the parameters in the checklist are based on:

- Sales and Marketing – price on market, market share, costs for market and sale division etc.
- Sourcing and Purchasing – raw material price, costs for purchasing division etc.
- Legal and Finance – interest rate, tax levels, costs for regulation investigations etc.
- Facilities and IT – building costs, costs for hardware and software, costs for infrastructure etc.
- Human Resources – salary costs, insurance costs, move costs, pensions etc.
- R&D incl. Product Development – additional personnel and office costs, move costs etc.
- Operation (Production System) – personnel costs, equipment investments, performance, energy costs etc.
- Installation and Ramp-up (Production System) – travel, living and personnel costs, test costs, installation costs etc.

The checklist is also proposed to include information about who is responsible for gathering the information and for presenting accurate numbers and values. The values from the checklist are imported to the main page of the tool, where the location project costs are summarise.

3.3. The summary sheet

Appendix 1 shows the layout of the summary sheet of the business case tool used in the initial phases of a location project. The tool is divided into four parts. The first is connected to market potential and estimated market share. In the second part operation investments, annual operation costs and project cost is added to the analysis. In part three production capacity and production efficiency is taken into consideration, were overall equipment efficiency (OEE) need to be estimated in the analysis. Last, years of production, market price and raw material price are estimated. The tool result of the cost and benefit analysis is provided both as pay-back time and NPV for the first 10 years of a new facility. The pay-back time is estimated both based on the estimated market volume and on manufactured capacity, to be able to match analyse fluctuation in production volume, and match these with the production capacity. In project management it is common to use cost, time and quality as performance measurements. According to Gardiner and Stewart (Gardiner and Stewart, 2000) Net Present Value (NPV) is a better performance measurement than measures connected to project delivered on time and on budget. The NPV gives a value of the outcome which a project could add to a company and is reviewed more in section 4. The NPV calculations in this tool are based on investments, cash flow and company internal rate. To calculate the NPV production volume each year has to be estimated. Additional annual costs as administration and logistics have to be estimated for each of the year. Also the NPV is calculated for estimated market share and estimated production capacity to make it clear how different volumes impact the final result.

The business case tool can be used for different location alternatives and for different possible outcomes from the alternative. It is important to analyses all possible scenarios from a best/worst point of view.

4. RESULT AND DISCUSSION

The proposed business case tool is a part of a decision support work procedure for production location. The business case tool is primarily taking the production facility and system into consideration. The tool is designed to be used in the early phases of the decision process, together with other support tools to be able to evaluate a complete location project. It is especially important to use the business case tool together with more strategic analysis on qualitative parameters. Another limitation is the shortage of costs connected to possible closures which is handled in other parts of the decision support. The model presented also does not take currency fluctuations and currency stability into consideration. Neither does it include parameters connected to political and social stability. The use of the tool requires involvements from all the function in the company connected to the parameter list in section 4.2. The project team should either consist of members from the functions in the list or the project leader can gather the required data the different company functions. The initial business case analysis is dependent on estimated production efficiency and market share, which could be hard to estimate. The cost analyses are suggested to be combined with risk analyses and an overview of further need of capacity, expanding areas and personnel recruitments. The analyses should be used to make different scenarios to evaluate different possible outcomes from the project in order to select the most suitable location. It is also important to have skilled personnel to estimate the ingoing values which cannot be obtained from measurements, databases and experience.

In the business case tool, two different results presentations are provided. One alternative the costs are divided based on estimated market potential and one based on estimated production capacity. The motivation is to match production capacity with market potential. For example it could be interesting to investigate the different economic outcome if the estimated market share is 210 000 products and the estimated capacity is 180 000 products. The scenario analysis could preferably be made for different production capacities for different location alternatives, since different production system configurations result in different production capacity.

As mention before, it is important to note that the tool presented in this paper is only one of several in the decision support and should be used together with more strategic analyses in the early phases of a location decision. Since it is designed for the early phases of decision, detailed information about different alternatives and costs connected to possible closures is handled in other parts of the decision support. The company using the business case tool must have a clear view of the purpose of the location project. Weather the new location is for lowering costs, getting well-educated personnel, to get close to costumers /suppliers or other strategic reason in order to make adequate analyses. Otherwise the decision could be made on the wrong foundations. There are more cost tool available in the toolbox designed for more in-depth analyses through the decision process. Further work will propose cost analyses decision tool in which this business case tool is a part of. The aim is to provide a complete decision support work procedure for making cost concisions decisions regarding their location projects. Further research should also analyse the applicability of such a decision support in location projects at companies.

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APPENDIX 1

Market		
Potential market	600 000	*units/year*
Market share	35%	*%*
Estimated volume	210 000	*units/year*

Costs		
Total investment	**42 700 000**	*currency*
Machining equipment	16 000 000	*currency*
Automation equipment	13 850 000	*currency*
Facility investment	12 850 000	*currency*
Total operating cost	**9 500 000**	*currency*
Operator wage costs	6 000 000	*currency/year*
Energy costs	2 000 000	*currency/year*
Tools, fluids and additives	1 500 000	*currency/year*
One time cost	7 945 000	*currency*
Project costs	**9 243 000**	*currency*
Additional (contingencies)	2 500 000	***currency***

Project costs

Possible production capacity		
Estimated production hours/year	5 200	*hour*
Manufacturing time/part	2,1	*min*
OEE	60%	*%*
Number of lines/machines	2	
Production Capacity	**178 286**	*n*
Difference (Market-Capacity)	**-31 714**	

Estimated outcome		
Estimated years of production	10	*year*
Estimated market price	290	*currency/unit*
Estimated Raw material price	70	*currency/unit*

Based on market volume		***Based on manufactured capacity***	
Manufacturing part cost	163	*163*	*currency/unit*
Benefit	127	*127*	*currency/unit*
Payback	2,88	*2,92*	*year*

NPV - Net Present Value

Initial investment	-62 388 000	*currency*
Interest rate	10%	*%*

	Volume	*Additional costs/year*	***Profit (market)***	***Profit (capacity)***	
Year 1	110 000	9 000 000	5 016 071	*4 933 246*	*currency*
Year 2	150 000	9 350 000	9 762 824	*9 649 881*	*currency*
Year 3	180 000	9 912 000	13 023 388	*12 887 858*	*currency*
Year 4	180 000	9 912 000	13 023 388	*12 887 858*	*currency*
Year 5	180 000	9 912 000	13 023 388	*12 887 858*	*currency*
Year 6	180 000	9 912 000	13 023 388	*12 887 858*	*currency*
Year 7	180 000	9 912 000	13 023 388	*12 887 858*	*currency*
Year 8	180 000	9 912 000	13 023 388	*12 887 858*	*currency*
Year 9	180 000	9 912 000	13 023 388	*12 887 858*	*currency*
Year 10	180 000	9 912 000	13 023 388	*12 887 858*	*currency*

	Market	Production capacity		Estimate
NPV - Net Present Value	7 661 022	6 894 828	*currency*	

Main page of the business case tool for initial estimations of costs and benefits in location projects.