A fuzzy quantitative VRIO-based framework for evaluating organizational activities

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Abstract

Purpose – The study aims to shed light on how to identify drivers of sustainable competitive advantage under a turbulent and uncertain environment, one of the most crucial challenges faced by resource-based strategists.

Design/methodology/approach – This study introduces a VRIO-based framework to evaluate a firm’s internal activities, in which the fuzzy set and utilities functions are adopted to identify the competitive advantage of available resources based on resource-based theory. A case study is conducted to illustrate how the framework can be applied as a tool for exploring the potential competitiveness of a firm’s core resources.

Findings – The quantitative VRIO-based framework is a useful tool to assist top management to identify a list of potential competitive advantages of the available sources.

Originality/value – The VRIO-based framework is built through the integration of quantitative and qualitative methods, and this innovative approach is proposed to bridge the gap between resource-based theory and its application.

Keywords Resource-based view, Organizational activities, VRIO, Fuzzy set theory, Sustainable competitive advantage, Organizational performance, Resource management

Paper type Research paper

1. Introduction

How to correctly access the profile of a firm’s valuable resources and capabilities is one of the most compelling challenges faced by scholars and strategic managers that are interested in the resource-based view (RBV) of the firm (Andersen, 2011). The
resource-based view argues that an organization can be regarded as a bundle of resources (Barney, 1991) that are valuable, rare, imperfectly imitable, and organizational oriented (VRIO, Barney, 2002). An increasing number of studies in resource management suggest that identification of valuable company resources is the first step to enabling these resources to be successfully managed (Sirmon et al., 2008; Andersén, 2011).

Barney (1991) observed that “the development of tools for analyzing environmental opportunities and threats has proceeded much more rapidly than the development of tools for analyzing a firm’s internal strengths and weaknesses.” It is also found that many executives establish approximate resource evaluations based on the insights and tacit knowledge they have acquired through experience (Castanias and Helfat, 1991). However, Ittner and Larcker (2003) find that while only 23 percent of the 157 companies they surveyed “consistently built and verified the cause-and-effect relationships between the chosen drivers of strategic success and outcomes”, their return-on-assets and return-on-investment were significantly higher than the companies that did not examine these relationships. The finding suggests that managers’ perceptions of their firm’s resources may sometimes be biased. In fact, effective strategic management requires both an understanding of an organization’s resources and capabilities, as well as knowledge of how each of these contributes to the formation of organization’s strengths and ultimately to the development of a firm’s competitive advantage (Andersén, 2011). It is suggested that RBV can help quantify the often fuzzy and subjective process of assessing an organization’s valuable resources. Although the RBV has received considerable attention in academia, actual implementations of the method in real world settings are still limited (Guo, 2007). This is partly due to difficulties in operationalizing the view. In particular, most of the methods used are qualitative (Kraaijenbrink et al., 2010), and Newbert (2007) argues that the integration of quantitative and qualitative methods is one of the new challenges faced by RBV.

Given the above challenge, we propose a resource-based framework that utilizes the activities in value chain analysis to analyze the potential sources of sustainable competitive advantage. The framework implements VRIO criteria when examining an organization’s activities and identifies the capabilities that may enhance a firm’s competitive position in the market place (Andersén, 2011). Due to the uncertain nature of strategic management, previous research has suggested the use of fuzzy set theory to address this issue (Lin et al., 2005). The proposed fuzzy quantitative VRIO-based framework will help create a more solid framework, derived from the insights of the RBV, for evaluating the capabilities hidden in the firm’s organizational activities.

There are three major benefits provided by the proposed framework. First, the framework can help to identify the firm’s most critical capabilities which are the value-creation drivers of the firm. Although there are many studies that adopt the VRIO-based framework in analyzing competitive advantages (O’Sullivan and Abela, 2007; Andersén, 2011), most of them are conceptually-oriented and do not provide details for implementing the method, with only a handful of the studies exploring the applicability of the model (Coman and Ronen, 2009). Second, the proposed framework employs fuzzy set theory to allow quantification of hard-to-quantify resources, such as intangible assets and resources that involve uncertainty. Valuable, rare, and inimitable resources are usually intangible in nature.
and difficult to measure, and thus RBV researchers have attempted to use proxies as measures of intangible constructs, although with limited success (Hoskisson et al., 1999).

Third, better the understanding of a firm’s strengths and weaknesses will assist managers in the strategic decision-making process. The RBV inextricably links a company’s internal capabilities and its external industry environment (Collis and Montgomery, 2008). Thus, the proposed quantitative VRIO-based framework could alleviate the shortcomings of traditional SWOT (Strength, Weakness, Opportunity, and Threat) analysis by focusing on systemic causal issues and offering more perceptive, reliable, and actionable insights, thus complementing SWOT.

Although we aim for a precise mathematic analysis based on a VRIO framework, all the methods employed have their limitations. The VRIO method, for example, does not take into account rapid changes or unpredictable circumstances, which could cause significant changes in the strategy formulation. Thus, it should be adopted with a caution that the VRIO analysis application just only tries to discover factors influencing business competitive advantage at the current developmental state. Facing a turbulent environment, the managers should regularly conduct this kind of evaluation to detect and maintain companies’ competitive advantages.

2. Theoretical background

2.1 Resource-based view theory
RBV theory attributes superior financial performance to resources and skills that are firm-specific, rare, and difficult to imitate or substitute, and have an organizational orientation, also known as the VRIO framework (Barney, 2002). In contrast to the traditional approach that focuses on the external analysis of industrial-organization economics, the RBV emphasizes the internal analysis of the differences in resource endowments across firms, and assumes that outstanding performance comes from the rents accruing to the owners of scarce firm-specific resources rather than the economic profits from product market positioning. It also explains how this resource heterogeneity can be a source of a sustainable competitive advantage (Wernerfelt, 1984). The central premise of RBV addresses the fundamental question of why firms are different and how firms achieve and sustain competitive advantage. A myriad of studies have examined how firm’s specific resources contribute to a company’s competitive advantage (Srivastava and Frankwick, 2011).

RBV theorists have identified a number of important resource attributes (Newbert, 2007), and the key to the RBV is that sustainable competitive advantage can be achieved by appropriate allocation of resources and capabilities that are VRIO (Barney, 2002). Andersén(2011), Arend and Levesque (2010) and Barney (2002) have averred that the possession of a valuable, rare, inimitable, and organizational oriented resource is a necessary but insufficient condition for explaining a firm’s competitive position, and suggest that a resource can only contribute to this end when it is paired with an appropriate dynamic capability or organizational context. Thus, in this study, our proposed evaluation framework will be developed by adopting VRIO attributes.

2.2 Capability and organizational activities
It is not sufficiently clear in RBV theory how resources contribute to firm-level value creation, and therefore operationalization is difficult (Priem and Butler, 2001). In this
regard, many studies try to specify the difference among resources, capabilities, and competences (Grant, 1991; Arend and Levesque, 2010; Andersen, 2011). While resources serve as the basic unit of analysis, firms often create competitive advantage by assembling resources that work together to create organizational capabilities, which are rooted in processes and business routines (Sahlman and Haapasalo, 2009). Hence, in this study, organizational activities serve as the basic unit of evaluation, and are the representations of a firm’s hidden capabilities, and it could be appropriate to adopt the Porter’s (1985) value chain model to help identify key company resources through analyzing internal activities (Walters and Lancaster, 2000; Xia and Tang, 2011).

The value chain is a template that helps the firm to understand its cost position and to identify the multiple means that might be used to facilitate the implementation of its business level strategy (Dess et al., 1995). In this study, we assume that capabilities may underlie activities, and follow the recommendations by Barney (2002) and Liu et al. (2009) to use the value chain as a tool to articulate those resources that may provide a competitive advantage. We integrate both RBV and value chain views to develop a fuzzy quantitative VRIO-based framework for evaluating organizational activities to assess the firm’s capabilities and identify the drivers of sustainable competitive advantages.

3. The proposed framework
The proposed framework employs the primary and support activities in value-chain analysis, examines each organizational activity based on VRIO criteria, and in turn identifies the capabilities that may facilitate a firm’s competitive position in its marketplace. This technique takes existing ideas and assembles them into a four-stage decision process that can be easily and efficiently implemented by strategic decision makers. Figure 1 presents the implementation procedures of our proposed framework.

3.1 Stage one: survey the key factors of the proposed framework
The proposed framework is built upon the nine business activities suggested by Porter. During this stage, the evaluators are asked to determine the key factors which could influence the strengths and weaknesses of each primary and support activity of the firm’s value chain.

3.2 Stage two: analyze and determine the type of utility function for each key factor
Stage two is the core contribution of this study, and a mathematic model would be constructed by adopting the concept of utility function based on the VRIO framework. The utility function is developed and formulated for each key factor, to assess its effect

![Figure 1. Process of organizational activities analysis process](image-url)
on company performance, based on the four VRIO criteria. The evaluators also need to
determine the values of the key factors to reflect their relative performances as inputs
in order to formulate the utility functions. These factors can thus be used to form a
hierarchy of the importance of resources based on the comparative potential of
becoming sustainable competitive advantages.

To develop a comprehensive scheme to describe the relative utilities of the activities,
we propose a general function based on the VRIO framework. Previous studies have
suggested that VRIO is an effective method in assessing company performance
(e.g. Sebestova et al., 2007; Arend and Levesque, 2010; Andersén, 2011). We notice that
the first three VRIO criteria are the key elements to distinguish the type of competitive
implication, and the last criterion has no critical impact on the utility function type
(Barney and Hesterly, 2006). Thus, herein only the first three VRIO criteria could be
involved in determining the types of utility function of each factor, and the effect of the
“exploited by the organization” criterion would be used to set the parameter values
later. The following four questions to arrive at the values for the four VRIO criteria:

Q1. Is the factor valuable? (Y/N)
Q2. Is the factor heterogeneously distributed across competing firms? (Y/N)
Q3. Is the factor imperfectly mobile? (Y/N)
Q4. To what degree is the factor exploited by the organization? (1, 2, 3, 4)

Based on the answers of the first three questions (i.e. the first three VRIO criteria), the
utility functions can be categorized into four types of competitive implications
(i.e. disadvantage, parity advantage, temporary advantage, and sustained advantage)
to reflect the different effects of resource type on a firm’s competitiveness (see Figure 2).

![Figure 2. The process to determine the utility function type based on VRIO analysis](image-url)
The range of the utility function \( u(x_{ij}) \) value is set to be between zero and one, where a higher value represents higher performance (Mehrez and Sinuany-Stern, 1983). Previous research has shown that the functional form of the utility function could be nonlinear, especially for complex problems (Hersh, 2006; Luderer et al., 2007). Therefore, excluding the case of disadvantage, the perspective of returns-to-scale is adopted based on marginal effect theory to represent the different competitive implications of different types of utility functions. We assume that a firm with sustained advantages tends to outperform others, and thus the utilities of its resources are higher than those of the others. However, the utility growth has decreasing returns-to-scale due to the decreasing marginal effects. Based on the same concept, a firm with parity competitive implication will under-perform others, and has an increasing returns-to-scale utility function. The temporary competitive implication has utility growth with constant returns-to-scale, and this is because the competitive advantages are temporary, and therefore will not have enough effect to cause the changes in the marginal effect.

A utility function \( U_{ij} = u(x_{ij}) \) specifies a unique value in the range of \( U_{ij} \) for each value in the domain of \( x_{ij} \), where \( x_{ij} \) represents the value of the \( j \)th factor in the \( i \)th organizational activity, where \( i = 1, 2, \ldots, 9 \) and \( j = 1, 2, \ldots, n_i \). The evaluator can decide the number of key factors \( n_i \) for each activity \( i \). Furthermore, we use \( r_{ij} \) and \( \beta_{ij} \) to denote the degree of increasing and decreasing returns-to-scale in the utility functions, respectively. The values of \( r_{ij} \) and \( \beta_{ij} \) can be assigned based on the level of “exploited by the organization” criterion. It is shown that the value of \( r_{ij} \) is low when the level of “exploited by the organization” is high. In contrast, the value of \( \beta_{ij} \) is high when the level of “exploited by the organization” is high.

3.3 **Stage three: transform the linguistic terms to a closed interval of real numbers**

Because using linguistic terms is more suitable for knowledge acquisition of managers’ intuition in identifying the value and importance of factors, herein the fuzzy set theory is used to transform the linguistic terms into real intervals using fuzzy membership function for quantifying the linguistic terms. There are seven linguistic terms being provided to allow managers and domain experts to express the value and importance of the factors, and they are:

1. extremely high;
2. very high;
3. high;
4. moderate;
5. low;
6. very low; and
7. extremely low.

In this study, the commonly used triangular shape fuzzy membership function is implemented to transform the linguistic term to closed interval of real numbers (Chen et al., 2006). Therefore, for example, the terms “extremely high” and “very low” are transformed to be \([6 + \alpha]/8, (8-\alpha)/8\] and \([0 + \alpha]/8, (2-\alpha)/8\], respectively, then for any number \( \alpha \in (0,1] \), the set is called the \( \alpha \)-cut of membership functions.
Since the formation of each utility function contains parameter values and weights from multiple factors, we need to combine the intervals to arrive at an integrated number. This process is called defuzzification, and the general form of the aggregation operation to combine the intervals is shown in Equation (1) (Wang and Lee, 2007):

\[
\inf \tilde{w}_i, \sup \tilde{w}_i = \inf \tilde{w}_{i1}, \sup \tilde{w}_{i1} + \left[ \inf \tilde{w}_{i2}, \sup \tilde{w}_{i2} \right] + \ldots + \left[ \inf \tilde{w}_{im}, \sup \tilde{w}_{im} \right] 
\]

\[
= \left[ \inf \tilde{w}_{i1} + \inf \tilde{w}_{i2} + \ldots + \inf \tilde{w}_{im}, \sup \tilde{w}_{i1} + \sup \tilde{w}_{i2} + \ldots + \sup \tilde{w}_{im} \right] 
\]

\[
(1)
\]

\( \tilde{w}_{im} \) is the interval of \( w_{im} \), which has the lower bound (\( \inf \tilde{w}_{im} \)) and upper bound (\( \sup \tilde{w}_{im} \)).

Defuzzification is conducted by using the Center of Maxima Method, the predominant defuzzification method found in fuzzy control literature (Klir and Yuan, 2005). Therefore, the defuzzified value \( d_{wij} \) can be defined as the average of the smallest and the largest values of [\( \inf \tilde{w}_{ij} \), \( \sup \tilde{w}_{ij} \)], and is depicted as Equation (2), as well as the weights of factors could be calculated by using Equation (3):

\[
d_{wij} = (\inf \tilde{w}_{ij} + \sup \tilde{w}_{ij}) / 2 
\]

\[
w'_{ij} = d_{wij} / d_{wi} 
\]

\[
(2)\quad (3)
\]

### 3.4 Stage four: evaluate and choose a suitable strategy

Companies will select an appropriate strategy by considering developing the activities which have more utility and competitive strength. The following Equations (4) and (5) therefore are proposed to evaluate the relative utilities and competitive strengths of the organizational activities:

\[
U_{ij} = u_{ij} / \sum_{i=1}^{n_i} \sum_{j=1}^{n_j} u_{ij} 
\]

\[
U_i = \sum_{j=1}^{n_i} w'_{ij} u_{ij} / \sum_{i=1}^{n_i} \sum_{j=1}^{n_j} w'_{ij} u_{ij} 
\]

Where \( U_{ij} \) is the relative utility of the \( j \)th factor in the \( i \)th activity, and \( U_i \) is the relative utility of the \( i \)th activity (Hersh, 2006). The relative utility functions allow evaluators to rank the importance of each key factor within a utility function based on its relative utility, and the higher the relative utility, the more important the factor is.

### 4. Case study

In this section, we illustrate how to operationalize the proposed fuzzy quantitative VRIO-based framework to evaluate an organization’s internal activities using a case study conducted at a major chemical company in Taiwan. The company, established in 1955, manufactures agricultural pesticides and is in one of the traditional industries
that still exist in Taiwan. In 1989, the company went public and had its stock listed on
the Taiwan Stock Exchange. Over the past 55 years, the company has diversified from
its original pesticide business to actively engage in producing, researching and
developing, selling and exporting pesticide and intermediate chemicals. In addition, the
company has also expanded its global reach and formed business divisions in France
in 1995 and in Brazil in 2000. Today, the firm continues to aggressively participate in
the global market and is considered as a truly international company.

We designed a worksheet and questions based on the VRIO analysis, and conducted
field in-depth interviews with the top management of the firm to collect data. The data
collected included factor values and weights to evaluate activities in the value chain
model. Subsequently, fuzzy set theory was applied to aggregate the weights to derive
the utility function for each factor. The details of the four-stage process are shown in
Figure 3.

4.1 Stage one
Delphi method (Dalkey and Helmer, 1963) is employed to identify the key factors for
each organizational activity. Before interviewing with the top management or domain
experts of the company, we review the literature to confirm the relevance of the
variables identified in the model and summarize the findings in Table I.

Our framework allows the flexibility for each company to customize the list of key
factors according to its unique situation. We follow the Delphi method and perform two
survey rounds to determine the list of key factors. During the first round, we send the
worksheet and questions to interviewees that include the controller, the manager of the

Figure 3.
The four-stage process of
the proposed framework
<table>
<thead>
<tr>
<th>Activities</th>
<th>Definitions</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Delivery reliability: The rate of frequency of delivering the right things, in the right numbers, at the right time to our firm</td>
<td>Schuh (2006)</td>
</tr>
<tr>
<td></td>
<td>Capacity utilization: The percentage of a company’s production capacity which is actually used</td>
<td>Bansak et al. (2007)</td>
</tr>
<tr>
<td></td>
<td>Defective rate: The ratio of the products that do not fulfill users’ expectations</td>
<td>Hallgren and Olhager (2009)</td>
</tr>
<tr>
<td>Outbound logistics</td>
<td>Delivery accuracy: The rate of frequency of products which are not at the right time, quantity and quality when delivered to customers</td>
<td>Holweg and Miemczyk (2003)</td>
</tr>
<tr>
<td></td>
<td>Damage rate: The rate of frequency of products damaged when delivered to customers</td>
<td>Forslund (2007)</td>
</tr>
<tr>
<td>Marketing</td>
<td>Sales forecasting: The degree that the goods or services satisfy the needs of a sufficiently large number of customers</td>
<td>O’Sullivan and Abela (2007)</td>
</tr>
<tr>
<td></td>
<td>Marketing planning: The degree that the goods or services satisfy the needs of a sufficiently large number of customers and that the enterprise comprehends how customer demand moves up/down in response to lower/higher prices</td>
<td>O’Sullivan and Abela (2007)</td>
</tr>
<tr>
<td>Customer service</td>
<td>Quick response: The degree that the company responds to customer questions in time</td>
<td>Gaiardelli et al. (2007)</td>
</tr>
<tr>
<td></td>
<td>Customer satisfaction: The degree of satisfaction provided by the products of firms as measured by repeating customers</td>
<td>Van Birgelen et al. (2002)</td>
</tr>
<tr>
<td>Firm infrastructure</td>
<td>Equipment support: The degree that equipment can be handled, tested, and maintained to keep a system operational</td>
<td>Ding and Gong (2008)</td>
</tr>
<tr>
<td></td>
<td>Organizational identification: The degree that staff recognize the organizational culture</td>
<td>Glomseth et al. (2007)</td>
</tr>
<tr>
<td>Human resource</td>
<td>Human experience: The ratio of time that staffs engaged in valuable activities</td>
<td>Sullivan (2000)</td>
</tr>
<tr>
<td></td>
<td>Human skill: The ratio of time that staffs attend the training courses</td>
<td>Chen and Klimoski (2007)</td>
</tr>
<tr>
<td>Technology development</td>
<td>R&amp;D intensity: The percentage of R&amp;D expenses divided by firm sales</td>
<td>Zhang et al. (2007)</td>
</tr>
<tr>
<td></td>
<td>Technology maturity: The degree of maturity of the firm’s valuable technology</td>
<td>Schuh and Leviton (2006)</td>
</tr>
<tr>
<td>Procurement</td>
<td>Supplier assessment: The percentage of actual payment divided by purchasing cost</td>
<td>Ryu and Eyuboglu (2007)</td>
</tr>
<tr>
<td></td>
<td>Order fulfillment: The percentage of batches of products in the warehouse divided by total order quantity</td>
<td>Burke et al. (2007)</td>
</tr>
</tbody>
</table>

**Table 1.**

The notations, definitions, and references of the factors
information technology division, and the senior auditor, who have all worked for the
company for more than 15 years and thus have a thorough understanding of its
manufacturing processes. Based on the first round responses, the interviewees added
seven factors:

(1) price sensitivity of bulk material in inbound logistics;
(2) industrial safety;
(3) waste treatment in operation;
(4) storage management;
(5) shortage in outbound logistics;
(6) product registry in marketing; and
(7) loyalty in human resource management.

The only deleted factor is Damage Rate in Outbound Logistics.

During the second round, we modified the worksheet and questions based on the
results from the first round and interviews with the same people in the company to
collect the data which are including the answers of four questions (see in subsection
3.2) and the value and importance of factors. For instance, the results of first factor
“Forecasting accuracy” are “Q1: Yes”, “Q2: Yes”, “Q3: Yes”, “Q4: 4”, “Value: Very high”,
and “Importance: Extremely high”. The whole interview process took about two hours
for each interviewee.

4.2 Stage two

The formula of utility function for each factor can be derived by using the data
collected in stage one based on the rules of categorizing shown in Figure 2. For
instance, the first factor “Forecasting accuracy” is valuable, heterogeneously
distributed across competing firms, and imperfectly mobile. Therefore it belongs to
the type III utility function. By the same token, we derive the utility functions for all
other factors, as shown in Table II.

4.3 Stage three

The linguistic terms are transformed to closed intervals of real numbers by using the
membership function, and then the closed intervals can be aggregated by applying the
Equation (1). For instance, the importance of “Forecasting accuracy”, “Delivery
reliability”, and “Price sensitivity of bulk material” are “Extremely high”, “Very high”,
and “Extremely high”, respectively, so the closed intervals are 
\[
\left[(6 + \alpha)/8, (8-\alpha)/8\right], \left[(5 + \alpha)/8, (7-\alpha)/8\right], \text{ and } \left[(6 + \alpha)/8, (8-\alpha)/8\right],
\]
respectively. The defuzzified values of these

<table>
<thead>
<tr>
<th>Types</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Delivery reliability, industrial safety, storage management, shortage, sales forecasting</td>
</tr>
<tr>
<td>II</td>
<td>Human skill, supplier assessment, order fulfillment</td>
</tr>
<tr>
<td>III</td>
<td>Forecast accuracy, price sensitivity of bulk material, capacity utilization, defective rate, waste treatment, delivery accuracy, marketing planning, product registry, quickly response, customer satisfaction, equipment support, organizational identification, human experience, loyalty, R&amp;D intensity, technology maturity</td>
</tr>
</tbody>
</table>

Table II. The type of utility function for each key factor
three closed intervals are 0.875, 0.75, and 0.875, respectively, which are calculated by Equation (2). By using the Equation (1), the importance of “Inbound logistics” is \([17 + 3\alpha]/8, (23-3\alpha)/8\), and the defuzzified value is 2.5 (i.e. \([17 + 3\alpha]/8 + (23-3\alpha)/8)/2\). Hence, the weights of “Forecasting accuracy”, “Delivery reliability”, and “Price sensitivity of bulk material” can be obtained by Equation (3), and the results are 0.35, 0.3, and 0.35, respectively.

4.4 Stage four

In this stage, we apply Equations (4) and (5) to calculate the relative utilities of the key factors, and compare intuitive and model with absolute utilities. The intuitive utility of the factor is calculated directly from the initial input data, and the model utility is calculated based on the proposed model. The findings will help the firm to reallocate resources more effectively. For instance, “Forecasting accuracy” belongs to the type III utility function, its value \(x_{11}\) is 0.75 and the parameter value \(\beta_{11}\) is 4. Thus, the intuitive utility is 0.75, and the model utility is 0.9973 (i.e. \(u(x_{11}) = 2 - 2^{1-0.75^4} = 0.9973\)). To summarize the utilities of all factors is necessary to obtain the relative utility, so the relative utility from model utility of “Forecasting accuracy” is 0.0471 (i.e. 0.9973/21.1597 = 0.0471), in which, 21.1597 is the model utility of total factors, as well as the relative utility from intuitive utility is 0.0417 (i.e. 0.0417/18), in which, 18 is the intuitive utility of total factors.

We combine the utilities of the key factors for each activity using the weighted total. For example, the intuitive utility of “Inbound logistics” is 0.7875 (i.e. 0.75 *0.35 + 0.875 *0.3 + 0.75 *0.35 = 0.7875) and its relative utility is 0.1168 (i.e. 0.7875/6.7399 = 0.1168). The model utility is 0.9483 and the relative utility is 0.1180.

5. Discussion and managerial implications

The activities can be compared and ranked in Table III based on the values of their relative utilities and categorize the organizational activities into three groups, high, medium, and low, and different strategies to allocate resources can be devised accordingly. For example, the top management can enhance or maintain the firm’s competitive advantage by allocating more resource to those activities with higher relative utilities. Alternatively, the top management can also consider either allocating

<table>
<thead>
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<th>Level</th>
<th>Intuition Activities</th>
<th>Relative utilities</th>
<th>Model Activities</th>
<th>Relative utilities</th>
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<tr>
<td>High</td>
<td>Outbound logistics</td>
<td>0.1178</td>
<td>Customer service</td>
<td>0.1241</td>
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<td></td>
<td>Inbound logistics</td>
<td>0.1168</td>
<td>Technology development</td>
<td>0.1231</td>
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<td></td>
<td>Firm infrastructure</td>
<td></td>
<td>Firm infrastructure</td>
<td>0.1222</td>
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<td>Medium</td>
<td>Marketing</td>
<td>0.1113</td>
<td>Inbound logistics</td>
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<td></td>
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<td>Human resource</td>
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<td>Procurement</td>
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<tr>
<td>Low</td>
<td>Operation</td>
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<td>Operation</td>
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<td>Procurement</td>
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<td></td>
<td></td>
<td></td>
<td>Outbound logistics</td>
<td>0.0911</td>
</tr>
</tbody>
</table>

Table III.

Three levels of relative utilities
more resource to the low relative utility activities to help overcome the competitive disadvantages, or withdraw resources from these to improve overall efficiency.

It is interesting to note that the results of categorizing by managers’ intuition and by the relative utility drawn from our model are different. Based on the results of our model, the company can enhance its competitive advantage by allocating more resources to customer service, technology development, and firm infrastructure activities. However, if the managers use their intuitions, they will perhaps misallocate resources to outbound and inbound logistics.

To ensure the content validity of our model, we compare our results with findings from the industrial life cycle literature (Churchill, 1979). Richard et al. (2006) argued that an organization matures when its routines become established and its goals become inflexible. The company we studied has more than fifty-five years of history and the supporting equipment and techniques have already become routines. Further, the vision and mission of the company are well understood by the employees. Since the organizational culture has a significant impact on the implementation of business activities (Stock et al., 2007), it is reasonable to find that the relative utility of firm infrastructure is high. In addition, Quinn and Cameron (1983) pointed out that organizations in the mature stage of their life cycle usually have multiple product lines, diversified product markets, and are oriented toward R&D, growth, and adaptation. Technology development tends to open new prospects for the company, and is associated with both innovations and improvements that can provide customers with better products. A mature business usually has strong cash flow to invest in R&D and create new products or improve manufacturing processes for increased sustainability (Jawahar and McLaughlin, 2001). Again, the technology development of the firm studied in this work has high relative utility, which is in agreement with the findings in the industrial life cycle literature. To summarize, the key factors with high relative utilities that are identified in this study are consistent with the findings in the industrial life cycle literature. When identifying the most likely source of competitive advantage, managers could further explore, in much more detail, the exact nature of these organizational activities, how they develop and evolve in a firm, and how they can be used to leverage these capabilities to create sustained competitive advantage.

6. Conclusion
The proposed model can thus help firms not only to better understand the performance of their internal activities, but also to distinguish the relative importance of organizational activities so that they can become potential sources of sustainable competitive advantage. The proposed framework can contribute to the field of strategic management in several ways. First, the framework uses an activity-based approach and evaluates performance based on the key factors identified for each activity. This not only allows better understanding of the process by which resources contribute to firm value creation, but also allows easy conversion from strategies into detailed implementation plans. Second, the VRIO-based framework is useful for discovering the potential of firms, detecting changes in capabilities, designing appropriate capability building interventions, and comparing rivals on the basis of relative competitiveness. One of the main features of the framework is to capture the competitive advantages of manufacturing companies, and to use that as the basis for further examining the causes underlying changes in those capabilities. Third, this framework could enhance
a firm’s resource management capability. Only when firms can effectively conduct this procedure and accurately identify the firm’s resource portfolio, can they have the potential to enhance their resource management and dynamic capabilities.

Although the framework emphasizes the importance of company resources in determining competitive advantage, we should not overlook the significance of the role of management, which could have a profound impact on the efficiency of bundling and deployment of resources. Further, although we highlight the important role resources play in determining competitive outcomes, and demonstrate a mathematic framework explaining how to identify the most valuable resources, we did not pay much attention on the role of managers when concerning how a competitive advantage is created and sustained. Due to the importance of resource management, it is suggested that greater consideration should be paid on the contribution of managerial actions in bundling and deployment of resources.

Moreover, the accuracy of the model depends on the quality of the information collected and the cognitive processes used for filtering that information. The quality of the model thus depends significantly on the quality of the estimations by the managers. However, it provides an innovative way to tackle the strategic issues holistically. The proposed framework might be extended to better strategic planning, not limited to internal analysis, such as decision of strategic alliance, merge or acquisition, where the partners’ resources are essential to the success of these activities.

References


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