Measuring the Relative Efficiency of Global Delivery Models in IT Outsourcing

Marko Nöhren and Armin Heinzl

University of Mannheim, Business School, L15, 1-6, 68161 Mannheim, Germany
{noehren,heinzl}@uni-mannheim.de

Abstract. The days of IT offshore outsourcing are gone. Due to changing industry economics and intensified competitive pressures, common IT service delivery strategies are out-dated these days. We see an increasing shift from traditional single-location outsourcing to a more evolved and sophisticated global sourcing model. Within just a few years, leading IT providers ramped up their delivery capabilities in multiple geographically dispersed countries. This determines the development of a business strategy referred to as global delivery model (GDM). Despite the emergence of GDMs to become a preferred strategy in IT outsourcing, little is known about the performance of these novel network structures. Drawing upon the resource-based view of the firm, we offer a structured approach to evaluate relative efficiencies of GDMs and show how to compare these business models with each other.

Keywords: data envelopment analysis, global delivery model, resource-based view of the firm, relative efficiency.

1 Introduction

Within recent years, the information technology (IT) service market has been subject to tremendous changes. Gone are the days of the "hub-and-spoke" outsourcing model when India was the world's primary IT offshoring location. Starting in 2009, we saw an increasing shift from this single location outsourcing to sourcing across a range of global locations. Several market changes are driving this migration [1]. With the economic collapse in 2009 and a sudden downturn in IT budgets, a large number of clients start renegotiating rates with their service providers [2]. At the same time, a growing global demand for IT experts has led to salary increases on the Indian subcontinent. This forced IT companies to seek for alternative locations to ramp up their delivery capabilities. In addition, an increasing availability of skilled human resources in Eastern Europe, South America, and the Asia-Pacific Region along with the development of advanced communication technologies has made sourcing opportunities possible, which were impossible before.

The expansion of the global presence of international IT providers led to the emergence of a new business strategy. The so-called global delivery model (GDM) describes a "*service delivery and provision strategy where IT vendors integrate*

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multiple geographically dispersed resources such as skills, expertise, and knowledge through a network of onshore, nearshore, and offshore locations in order to maximize service delivery performance and to provide clients with seamless solutions" [3]. This strategy combines an IT onshore with an IT offshore outsourcing model. Onsite service and support centers (SCs) in direct customer contact cooperate with a network of globally dispersed development centers (DCs) spread out across the globe.

Several streams of research are concerned with IT offshoring. For example, research on IT outsourcing (ITO) success identified best practices to design service level agreements and to improve delivery performance [4, 5, 6, 7, 8]. Furthermore, several issues related to relationship management have been studied [9, 10, 11, 12, 13, 14, 15] and the impact of cultural and country-specific factors on outsourcing performance has been examined [16]. Previous contributions on globally distributed work and development have focused on knowledge exchange processes between employees [17], socio-cognitive aspects of communication [18], and the impact of process-based learning on performance [19]. In addition, there has been some contribution to GDM success research. For instance, a study by Ang and Inkpen who investigated the impact of cultural intelligence on ITO success [20] as well as a single-case study by Mastakar and Bowonder who analyzed the GDM capabilities of an Indian ITO provider [21]. For detailed information on the status quo of ITO research, see Dibbern, Goles, Hirschheim and Jayatilaka as well as Lacity, Khan, Yan and Willcocks [22, 23].

These studies have enhanced our understanding of offshore-related challenges and the management of globally distributed IT projects. However, we still lack a deeper understanding of the how to compare existing GDMs with each other and how to evaluate their relative efficiency. Our study seeks to reduce this research gap by posing the following key research questions:

(1) How do the providers' global delivery resources impact market performance?

(2) What is the relative efficiency of GDMs deployed by global ITO providers?

In order to answer the first question, we developed a conceptual framework based on the resource-based view of the firm (RBV). With respect to the second research question, we assessed the appropriateness of several efficiency measurement approaches and decided to apply data envelopment analysis (DEA) in our study. DEA is a linear programming procedure, which compares production units in transforming multiple inputs into multiple outputs [24]. The fact, that this methodology is not very common in IT research, raises our third research question:

(3) Is DEA an appropriate method to evaluate relative efficiency of GDMs?

The paper proceeds as follows. Drawing upon the RBV, we introduce our conceptual framework in the next section. Subsequently, we classify efficiency measurement approaches and introduce DEA methodology. To answer research questions two and three, we apply DEA to GDMs in IT outsourcing. The data collection procedure is presented in chapter four. We provide the key findings in the fifth chapter of our study. Finally, we conclude with the theoretical and practical importance of our findings and by discussing implications for future research.

2 Conceptual Framework

Drawing upon the RBV, we study the relationship between the global delivery resources a provider deploys and its competitive position. RBV defines a resource as "*an asset or input to production (tangible or intangible) that an organization owns, controls, or has access to*" [25]. Such resources are mandatory to fulfill a firm's task and to generate competitive advantage [22, 26].

A considerable part of literature on RBV is concerned with the identification and description of corporate IT resources and their impact on companies [27, 28]. To the best of our knowledge, RBV has not been adapted to the context of global delivery so far. Thus, we first had to define the global delivery resources an IT provider owns. Barney classified three types of corporate resources [26]. Physical resources are assets like a company's technology and its' geographical position [26]. As described in the previous section, a GDM is a combination of an onsite and an offshore model. Onsite SCs provide local support for clients. They manage and coordinate ongoing relationships and acquire new customers. Globally dispersed teams in networks of DCs execute IT-related tasks. With such centers at multiple locations, providers are able to access several valuable resource markets and minimize country-specific risks. Thus, we presume that the most important physical GDM-resources of ITO companies are their global reach with SCs and DCs.

Organizational resources are assets such as a firm's internal coordinating systems as well as sophisticated processes to satisfy customers [26]. With the adoption of a GDM, the corporate culture needs to be aligned on global delivery of services. In order to overcome negative issues related to globally distributed work such as social boundaries [29], knowledge transfer problems [17], and cultural differences [15, 16], employees need extensive training and advanced service delivery processes need to be implemented [18, 19]. In general, there are two major difficulties in assessing the quality of such organizational GDM resources. First, processes are intangible in nature. Thus, they are hard to observe, quantify and measure from outside an enterprise. Second, they are difficult to compare between different companies. Thus, we have to rely on common quality signals like CMMI and ISO certifications as well as expert ratings.

Human resources are skills and capabilities of employees within an enterprise [26]. They include IT-related technical and managerial knowledge [27, 30] as well as not IT-related soft skills like employees' cultural intelligence, their experience and loyalty, as well as language skills [31, 32]. Widely used quality signals for IT-related skills of employees are the Six Sigma method, the ITIL framework, and the P-CMM certification. Like organizational GDM resources, comparable data on soft skills are difficult to gather. Thus, we recommend relying on expert rankings.

IT providers differentiate themselves on the basis of their GDM. Providers that are able to combine physical, organizational, and human resources in an effective manner can create superior capabilities that contribute to high performance outcomes. In our study, we distinguish between intermediate and final performance outcomes (see figure 1).

Fig. 1. Conceptual Framework

We measure the intermediate performance outcome by customer satisfaction. This construct is defined as "*a positive affective state resulting from the appraisal of all aspects of a firm's working relationship with another firm*" [33]. Customer satisfaction is widely used for assessing the success of ITO [11, 12, 13, 34, 35]. It has a positive impact on customer loyalty [36, 37] and increases the intention to continue and expand an engagement with a provider [11, 38, 39]. Moreover, satisfied clients tend to a positive word-of-mouth which supports the acquisition of new customers [37, 38].

Against this background, we recommend to measure final performance outcomes by these positive effects attributed to customer satisfaction such as market penetration, customer retention, customer loyalty, changes in the development of sales as well as the providers' achieved business performance measured either by objective or perceptual indicators [40].

3 Methodology

In answering our second research question, we first have to clarify the concept of efficiency. In economic literature, there are different understandings of this term. In general, efficiency is defined as the ratio of outputs to inputs. Thus, efficiency is a quality indicator measuring the performance of transforming inputs into outputs. Due to the fact that the aim of this study is to evaluate relative efficiencies, we describe the term in line with the definition of technical or rather Pareto-Koopmans efficiency. A production unit is called efficient if one of the following conditions is met [41]:

1. It is not possible to reduce any input of this unit without increasing at least one other input or reducing any output.
2. It is not possible to increase any output of this unit without reducing at least one other output or increasing any input.

3.1 Efficiency Measurement Approaches

Productivity measurement approaches can be classified into five categories (see figure 2) with respect to their consideration of inputs and outputs [42]. Class 1 and class 2 evaluation techniques are pure approaches that compare one input or one output against performance goals [42, 43]. Due to the fact, that they do not compare inputs with outputs, they are not appropriate for our endeavor. Class 3 approaches consider inputs and outputs simultaneously. These methods offer the opportunity to rank-order units under observation, but do not explicit compare one unit with its peers [42].

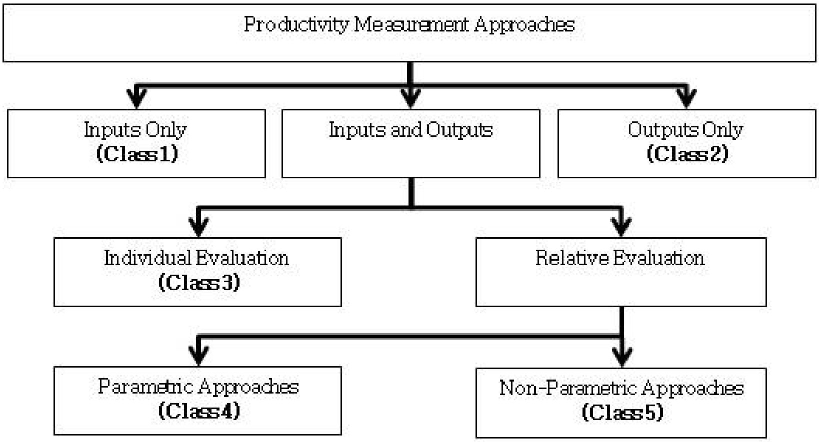

Fig. 2. Productivity measurement approaches according to Boles et al. [42]

There are two types of approaches to evaluate relative efficiencies. Non-parametric models like data envelopment analysis and free disposal hull differ from parametric models, such as regression analysis and stochastic frontier analysis in that they do not rely on an a priori defined shape of the production function. An efficient frontier is estimated based on observed data only [44].

In general, both types of relative evaluation techniques are applicable to assess the relative efficiency of GDMs. In this paper, we decided to apply DEA. This methodology provides for the following advantages compared to non-parametric approaches: First, due to the fact, that an efficient frontier is determined based on observed data instead of relying on a priori specified structural form [45], DEA is less prone to specification errors if the actual shape of the production function is unknown [46]. Second, DEA is able to handle multiple inputs and multiple outputs simultaneously [24]. The above-mentioned parametric approaches can only consider one dependent variable in efficiency measurement. Finally, analyzed DMUs only have to be functional homogenous. That means, they undertake the same activities (inputs) to produce comparable products or services (outputs) in varying quantities [47].

Due to the attractive properties of DEA, this approach can be applied to different contexts such as efficiency evaluation of institutions, subsidiaries, and processes [24, 48, 49] and to support corporate decision making in outsourcing and vendor selection [50, 51]. In IT research, DEA was applied to assess the impact of investments in IT on the development of countries [52] and on corporate productivity [53]. Further, the relative efficiency of e-commerce users [54], ERP software products [55, 56], and web sites [57] was analyzed.

3.2 Data Envelopment Analysis

DEA is a non-parametric evaluation technique of production units, referred to as decision making units (DMUs). The proposed methodology can be described as follows. Consider a situation, where DEA is applied to assess the relative efficiencies θ_i of $i=1,...,n$ DMUs in transforming $j=1,...,k$ inputs x_j into $h=1,...,m$ outputs y_h. Each DMU is described by an input-output configuration (X_i, Y_i) with a vector of observed inputs $X_i=(x_{i1}, x_{i2},..., x_{ik})$ and outputs $Y_i=(y_{i1}, y_{i2},..., y_{im})$ [58, 59]. DEA assumes that the underlying production possibility set, denoted by $\Psi=\{(X,Y) | Y\geq 0$ can be produced from $X\geq 0\}$, satisfies the following postulates [24, 58]:

1. **Free disposability.** If $(X_i, Y_i)\in\Psi$ and $X_i'\geq X_i$, then $(X_i', Y_i)\in\Psi$ and if $(X_i, Y_i)\in\Psi$ and $Y_i'\leq Y_i$, then $(X_i, Y_i')\in\Psi$ [60]. This postulate asserts that if an output vector Y_i can be produced by an input vector X_i, then, it can be produced ceteris paribus by employing more of at least one input (overuse of inputs) or by decreasing at least one output (underproduction of outputs) [57].
2. **Convexity**. If $(X_i, Y_i)\in\Psi$ and $\lambda_i\geq 0$ are nonnegative scalars such as $\sum_{i=1}^{n}\lambda_i=1$, then $\left(\sum_{i=1}^{n}\lambda_i X_i, \sum_{i=1}^{n}\lambda_i Y_i\right)\in\Psi$ [61].
3. **Constant returns to scale** (ray unboundness). If $(X_i, Y_i)\in\Psi$ then $(\eta X_i, \eta Y_i)\in\Psi$ for any $\eta>0$ [58, 61].
4. **Minimum extrapolation.** Ψ Is the intersection set of all $\overline{\Psi}$ satisfying postulates 1, 2, and 3 and subject to the condition that each of the observed vectors $(X_i, Y_i)\in\overline{\Psi}$, $i=1,...,n$ [58, 61].

The identification of DEA efficiencies is equivalent to the identification of lowest input with the highest output. The relative efficiency θ_o of a particular DMU $o\in i$ is obtained by solving the following fractional programming problem [24]:

$$\min_{\lambda_{io}} \theta_o \tag{1}$$

subject to

$$\sum_{i=1}^{n} \lambda_{io} y_{hi} \geq y_{ho} \qquad \forall h = 1,...,m$$

$$\sum_{i=1}^{n} \lambda_{io} x_{ji} \geq \theta_o x_{jo} \qquad \forall j = 1,...,k$$

$$\lambda_{io} \geq 0 \qquad i = 1,...,n$$

This program is computed independently for each of the i DMUs to determine the optimal weights λ_{ii} and generate individual efficiency scores θ_i with values ranging from 0 to 1.00. A DMU with an efficiency score of $\theta_i = 1.00$ is classified as efficient and is therefore a part of the efficient frontier. Inefficient units receive a value of $0 \leq \theta_i < 1.00$, where $1.00 - \theta_i$ shows the individual degree of inefficiency of DMU i.

4 Data Collection

We conducted a study to evaluate the relative efficiency of GDMs deployed by global ITO providers (research question 2) and to test the appropriateness of DEA for this endeavor (research question 3). In order to apply DEA, we first need to define the population of DMUs. At the time of the data collection, we identified 30 IT providers that had implemented a GDM strategy. Vendors with less than three globally dispersed DCs were not included in our analysis. We ask all 30 providers to take part in our study. Of these, 22 companies agreed to participate.

Once the DMUs were identified, we had to collect data on their inputs and outputs. All data for our study were gathered in cooperation with an independent international market research company. In this study, we only considered the intermediate outcome dimension. We issued an online survey to collect data on customer satisfaction in an international expert panel of large, small, and medium-sized ITO clients of different industrial sectors. We assessed customer satisfaction with

(1) the delivery performance against the contracted service level agreements
(2) the relationship management
(3) the ability to deliver innovation and continuous improvement
(4) the price competitiveness against performance
(5) the flexibility with respect to price model evolution, volume and scope changes.

We measured these items using a 5-point Likert scale from 1 (very dissatisfied) to 5 (very satisfied). Out of the 22 IT providers, four companies achieved less than 75 customer responses and were therefore excluded from our analysis. Thus, our final dataset consists of 18 IT providers with six vendors that are headquartered in Europe (EU), six in India (IN) and six in the United States of America (US).

Data on input variables were collected by telephone interviews with ITO providers' senior management staff. We were able to gather comparable data on seven global delivery resources. As physical GDM resources, we include the global reach of service centers and the global reach of delivery centers describes the number of countries in which a provider operates such centers. With respect to organizational resources, we consider vendors' CMMI-level and ISO certifications as well as a rating of providers' GDM process maturity by experts of our cooperating partner. Due to inconsistent responses on human assets, we could not include a single IT-related resource in our study. However we were able to gather data on employee loyalty and to consider an expert rating of employees' language skills. Both subjective ratings were measured using a 5-point Likert scale from 1 (very bad) to 5 (very good).

5 Results

We calculated the relative efficiency of the 18 GDM providers in our final dataset using DEA (see table 1). Out of these, nine vendors (50.00%) were classified as efficient. In each region, three providers (EU1, EU2, EU3, IN1, IN2, IN3, US1, US2, US3) achieved an efficiency score of $\theta_o = 1.00$. The remaining nine providers were classified as inefficient with individual inefficiencies ranging from $1-\theta_{US4} = 0.0082$ (0.82%) to $1-\theta_{IN5} = 0.3316$ (33.16%). The average efficiency across all units in the dataset is 91.11%. The lowest theta value had been assigned to the Indian vendor IN5. In this study, we will not go into more detail on each provider's individual efficiency but present three provider clusters in order to derive implications for future research.

Table 1. DEA efficiency scores

DMU	Efficiency	DMU	Efficiency	DMU	Efficiency
EU1	1.0000	US1	1.0000	IN1	1.0000
EU2	1.0000	US2	1.0000	IN2	1.0000
EU3	1.0000	US3	1.0000	IN3	1.0000
EU4	0,7111	US4	0.9918	IN4	0.9532
EU5	0.9786	US5	0.7382	IN5	0.6684
EU6	0.7065	US6	0.8372	IN6	0.8155

5.1 Cluster 1: Deployment Strategy

The providers in our study differ with respect to their staff assignment. Four providers rely on an onshore staffing strategy, with more than two thirds of DC-headcount in Western Europe and North America. Of these, three providers are headquartered in Europe. Nine vendors rely on an offshore staffing strategy, with more than two thirds of the DC-employees in offshore locations like Africa, the Asia-Pacific, Eastern Europe, and South America. All six Indian ITO companies are part of this cluster. The remaining five providers rely on a balanced staffing strategy. The results presented in table 2 indicate that efficiency and customer satisfaction are substantially higher in offshore and balanced setting. Four out of the five providers in the latter cluster were classified as efficient.

Table 2. Average DEA efficiency scores and average customer satisfaction with respect to providers' staff assignment

Staffing	Group size	Average efficiency score	No. of efficient providers	Average customer satisfaction score
Onshore	4	0.8137	1	3.2
Balanced	5	0.9476	4	3.7
Offshore	9	0.9342	4	4.0

These findings indicate, that providers' deployment strategy impacts global delivery performance. The vendors in the offshoring and the balanced group primarily source their offshore human resources from the Indian subcontinent. Looking at the five output dimensions, we found that the offshore cluster achieves considerably higher customer satisfaction with price competitiveness against performance (4.0) than providers with a balanced (3.2) and an onshore staffing strategy (2.8). Members of the worst performing onshore group source most of their DC headcount in Eastern Europe. Thus, we propose:

Proposition 1: India provides superior human GDM resources at low costs.

5.2 Cluster 2: Business Familiarities

Business familiarities are defined as "*the extent to which a provider has prior experience and/or understanding of the client organization's business and technical contexts, processes, practices, and requirements*" [23]. Previous studies found, that business familiarities positively impact ITO success [23, 62]. In our study, we took a closer look at the providers' service delivery background. Despite the fact that all vendors in our study offer a wide range of services, they differ with respect to their service offering history. Eight providers were former system integrators (System), and had been "*responsible for the overall system design and integrating product and service components supplied by a variety of external suppliers into a functioning system*" [63]. The business of six vendors was the development and distribution of customized enterprise software (Software). Additionally, four vendors used to be pure IT infrastructure service providers (Infrastructure).

We found that the service delivery background impacts global delivery performance. Software vendors and system integrators received substantially higher DEA scores than providers in the infrastructure cluster (see table 3). With an average customer satisfaction score of 4.2, vendors in the software cluster stand out from the rest. Five out of six companies within this group are classified as efficient.

Table 3. Average DEA efficiency scores and average customer satisfaction with respect to providers' background

Background	Group size	Average efficiency score	No. of efficient providers	Average customer satisfaction score
Infrastructure	8	0.8317	2	3.4
Software	6	0.9693	5	4.2
System	4	0.9830	2	3.9

We argue that providers differ with respect to their business familiarities. Software vendors and system integrators are used to provide customized solutions to their clients'. Thereby, they gain deep insights about specific needs and requirements of their clients. In contrast to this, infrastructure service providers offered tangible and standardized IT products and services like hardware and network technologies. Such services require less domain-specific knowledge and less interaction with customers. We propose:

Proposition 2: Software vendors and system integrators have higher business familiarities than infrastructure service providers.

5.3 Cluster 3: Global Delivery Headcount

GDMs are networks of globally dispersed DCs in which customer-related services are provided. One major advantage of such networks is their possibility to benefit from economies of scale. Due to the fact that scalability grows in the number of employees, we assume a positive impact of the headcount on global delivery performance. Four vendors in our data set are large providers with a delivery headcount of more than 100,000 employees (Large). Eight providers employ between 20,000 and 100,000 people in their global delivery centers (Medium-sized). The global delivery workforce of the remaining six ITO companies is less than 20,000 (Small).

In our study, the medium-sized cluster received the highest average efficiency score followed by the cluster of the small companies (see table 4). Only one vendor in the large group is classified as efficient. The fact that these companies achieved poor efficiency values in comparison to other GDM vendors can be attributed to their greater input usage.

Table 4. Average DEA efficiency scores and average customer satisfaction with respect to providers' delivery centre headcount

Headcount	Group size	Average efficiency score	No. of efficient providers	Average customer satisfaction score
Large	4	0.8400	1	3.9
Medium-sized	8	0.9529	4	3.9
Small	6	0.9029	4	3.5

However, when looking at the output values, we found that large and medium-sized providers outperform small vendors. Companies with large delivery headcount received a remarkably higher customer satisfaction with the delivery of innovation and continuous improvement (4.0) than their small (3.3) and medium-sized (3.5) competitors. Therefore, we propose:

Proposition 3a: The size of a delivery center positively impacts the ability to deliver innovation and continuous improvement.

Vendors' ability and willingness to change service level agreements during an ongoing relationship is one key success factor in ITO [64, 65]. Our study found that providers' contract flexibility is negatively correlated (-.29) with its' global delivery workforce. This result leads us to our next proposition:

Proposition 3b: The size of a delivery center negatively impacts contract flexibility.

6 Conclusion

In this paper, we offer first insights into global deliver performance by posing three research questions. With respect to our first research question, we developed a conceptual framework for evaluating the relative efficiency of GDMs. We specified a set of physical, organizational, and human GDM resources, drawing upon the RBV. Due to the fact that we conduct a non-parametric efficiency measurement, we were not able to empirically test their impact on the intermediate outcome customer satisfaction. We aim to address this limitation in our future research in order to identify capable input variables and to refine our conceptual framework when needed.

In order to answer our second research question, we conducted a relative efficiency measurement in the area of global delivery. Despite the fact, that we were not able to collect data on all GDM resources defined in our conceptual framework, this study provides valuable initial insights into global delivery performance. The findings presented in cluster 1 and 2 might be indicators for the existence of valuable human resources on the Indian subcontinent. A huge body of literature is concerned with IT offshoring to emerging countries [22]. Over a long period of time, India was the world's primary offshoring country [20]. Thus, little research is concerned with an investigation of other global locations. However, with the emergence of GDMs to a preferred delivery strategy in ITO, we assert that a broader investigation and comparison of different global locations is necessary. Based on the findings in our study, we developed four propositions, which we aim to test in our future research.

Regarding our third research question, we found that DEA is a sufficient approach for measuring performance in global delivery, if the following conditions are met. First, DEA does not test for statistical dependencies between variables. Thus, as mentioned above, we aim to analyze the relationship between inputs and outputs in a subsequent study. Second, the proposed approach measures relative efficiency of DMUs based on observed data only. Therefore, to make general statements about performance within a specific market, all DMUs have to be considered in DEA [66]. Third, as we have pointed out, the ITO market is changing rapidly. We aim to address dynamic aspects in our future research by calculating the Malmquist Index a DEA-based approach that measures variations in productivity with respect to a base year [67].

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