Developing a model of the global and strategic impact of information technology

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Abstract:
In today's intensely competitive world, many firms have developed applications of information technology (IT) that provide a significant global competitive advantage. Most evidence of such IT use is anecdotal; the global competitive impact of IT has not been studied from a rigorous theory building or empirical perspective. This article reports progress toward the development of a model (called GLITS) to measure the strategic global impact of IT on an international firm. The underpinnings of the model are based on domestic and international literature; and it has undergone extensive refinement through statistical evaluation and validation. The model and its accompanying instrument can be used to identify specific strategic IT factors for a company and a contingency analysis can be conducted to determine the importance of various factors based on organizational characteristics. This foundational model should have significant utility for both practitioners and researchers.
Keywords: Global information technology; IS Instrument; Strategic information systems; Competitive advantage; International information systems; Reliability and validity

Article:
1. Introduction
Many reports have been published on the use of information technology (IT) in enhancing a firm's competitiveness. Normally, competitiveness is assumed to apply to the operations of the firm within its national borders. However, it is now generally recognized, as was also a key finding of the Landmark MIT study [2], that IT is now a vital resource for competing in the global marketplace. Today, many organizations (e.g. American Express, Dow Chemicals, Federal Express, DEC, GM, Texaco) consider IT an essential component of worldwide corporate strategy.

However, while there are several anecdotal cases of success, the larger American and worldwide business communities have no validated models for analyzing the strategic impact due to the global application of IT.

This work is an extension of the research conducted by Mahmood and Soon [30]. They developed a model and instrument for assessing the strategic impact of IT in a business organization. Their model was in the national/domestic context. We explicitly extend their model to assess the strategic impact of IT on a global[1] organization engaged in international business. We refer to our model as the GLobal *IT* Strategic (GLITS) model.

Global IT research is in its embryonic stage. Guidance and research are urgently needed in the application of IT in global firms. With increasing business globalization, the model proposed and developed here has a direct bearing on corporate chief executives and information officers. The model provides a validated process for explaining and measuring the strategic and competitive impact of IT at the global level. It can also show the strengths and weaknesses of IT deployment in a firm and reveal promising areas for future development.

2. A review of the literature

There are two streams of literature that have a bearing on the development of the GLITS model. The first is the general literature on the use of IS as a competitive weapon. Strategic IS for competitive advantage (SIS) have been developed and studied largely from a domestic U.S. perspective [35, 48, 54]. Widely reported examples of such systems include American Airlines' SABRE reservation system, Merril Lynch's Cash Management Account, and American Hospital Supply's order-processing system.

Several researchers, led by Michael Porter, have contributed by providing several frameworks (e.g. [6, 34, 42, 47]) for the application of SIS. Porter's framework [46] consists of three dimensions for targeting SIS: strategic target (supplier, customer, competitor), strategic thrust (differentiation, cost, focus, innovation, growth, alliance), and strategic mode (offensive, defensive). Ives and Learmonth [22] have suggested a 13-stage customer resource cycle for identifying SIS opportunities. Many of the other frameworks build on Porter's basic dimensions.

However, none of these frameworks have been developed into explanatory models, nor have been validated, nor led to specific guidelines for making strategic decisions. As per Bakos and Treacy [3], the development of a comprehensive model out of the frameworks should be a major research agenda. Based on many of the above works, Mahmood and Soon have developed a model for the potential IT impact on domestic strategic variables.

The second stream of research relevant to the GUTS model pertains to international IS. This stream of research is relatively new and exploratory, and is currently largely devoted to identifying fundamental issues. For example, Deans et al. [14] identified the key international IS issues of U.S.-based multinational corporations. Ives and Jarvenpaa [211] explored the issues in managing global information technology and identified the business drivers for global IT, that included both operational and strategic variables. Manheim [31] discussed global IT issues and strategic opportunities due to technology. Porter [45] described competitive forces and general business strategies in international business. Recently some authors have proposed frameworks for global IT: for example, King and Sethi [26] provided a framework for the study of various issues associated with transnational systems, and Alavi and Young [1], and Jarvenpaa and Ives [24] proposed frameworks to align global IT structure and strategy with international business strategy. Simon and Grover [51] examined the strategic use of IT in international business using an integration—responsiveness framework. Finally, several studies have appeared discussing IT issues in specific countries/regions (e.g. [12, 18, 40, 43, 50, 53]).

General information about international IT issues can be found in some recent books. In 1992, books by Deans and Kane [13], and Roche [49] provided an introductory summary of the subject. Two edited books by Palvia et al. [44], and by Bradley et al. [8], were collections of chapters written by several authors dealing with specific aspects of global IT. Very recently, Palvia et al. [41] have provided an edited collection of chapters dealing with contemporary issues. In most of the cited literature, it is worthwhile to note that many of the strategic issues overlap or extend domestic strategic concerns.

Once again, the international IT writings, frameworks or exploratory findings have neither been developed into explanatory models nor been validated. However, the ground work has been laid for such an undertaking. The domestic strategic and the international MIS literature combined together provide the basic building blocks for developing an initial GLITS model.

3. The GLITS construct development

In order to generate global organizational factors that IT may impact, the literature was carefully reviewed. As the literature was segmented into two streams, the construct development generally followed these same two streams. It should be noted, however, that a few variables generated from the international case were found to be equally applicable to the domestic case and have therefore been listed under the domestic heading.

3.1. Variables from the domestic SIS literature

The domestic SIS literature provides many variables that are also applicable at the global level. These can be grouped into organizational, and industrial levels. Examples of organizational variables include new entrants, entry barriers, customers, competitors, suppliers, etc. Examples of industrial variables include products and services, economies of production, and pricing. Mahmood and Soon's model captured twelve such variables in the preliminary model; they reduced them to ten in the final mode1.[2]

We used Mahmood and Soon's preliminary model as the starting point. However, the literature was further culled to extract additional domestic variables and thus augment those identified by Mahmood and Soon. This was because our study was intended to develop an entirely new model/instrument for IT in the global context, and also because Mahmood and Soon's study was only an exploratory one.

The variables used from the domestic SIS literature are listed in Table 1. All twelve from Mahmood and Soon's preliminary model are included. In addition, five more were identified as applicable in the domestic context. These are: economies of scope, business risk reduction, downsizing and outsourcing, learning curve and knowledge transfer, and flexible operations. Economies of scope are obtainable from the synergistic benefits gained through multilateral exchange of resources, competencies, and know-how among organizational units or divisions [52]. IT can be used to reduce business, market and technical risks [37]. Further, IT permits the rapid acquisition and transfer of knowledge 117, 28]. IT can also provide the requisite flexibility in locating and relocating operations and in scheduling manufacturing operations [7]. Finally, IT provides an organization the opportunity to downsize the IT function as well as other functions profitably, and outsource its activities [29, 32].

It is worth emphasizing that all these variables are in the global context, which puts them in a somewhat different perspective from the original domestic variables.

Table 1
Relevant variables from the domestic SIS literature [a]

1.	New entrants
2.	Entry barriers
3.	Customers
4.	Competitive rivalry
4.	Suppliers
6.	Search costs and switching costs
7.	Market
8.	Products and services
9.	Economies of scale
10.	Economies of scope
11.	Internal organizational efficiency and effectiveness
12.	Interorganizational efficiency
13.	Pricing
14.	Business risk reduction
15.	Downsizing and outsourcing
16.	Learning curve and knowledge transfer
17.	Flexible operations

[a] Except for variables 10, 14, 15, 16, and 17, all variables were used by Mahmood and Soon in their initial model.

3.2. Variables from the global IT literature

Many variables from the global IT literature duplicate the domestic variables; therefore we do not repeat them. Only the new variables unique to the international environment are included. These typically exploit the location or country-specific comparative advantage that can be obtained by conducting business worldwide [27]. For example, a firm can gain a strategic cost advantage by locating its operations in a country with low labor costs. In the same vein, it can profitably exploit strategic targets in its value chain. Different countries and regions in the world have inherent advantages and disadvantages in their endowed resources and developmental infrastructure, and these can be used to the firm's advantage. Value chain activities can now be located in different parts of the world. The following quote [44] succinctly demonstrates this trend:

In today's shrinking world, in order to achieve and sustain a competitive advantage, a multinational corporation may have to buy raw materials from one country, use finances from another country, procure human resources from yet another country, and sell the finished products wherever possible... information technology has been a key factor in propelling and accelerating the globalization of businesses.

Specific examples of globalization in which IT has played a major role include foreign outsourcing of software, production of microprocessor chips, and development of new markets in Eastern Europe.

Six new variables were identified from the global literature (see Table 2). Worldwide resources were divided into two categories: physical resources and human resources, as each is worthy of study in and of itself. Two additional variables deal with the unique and sometimes formidable country and government requirements, which can substantially impede (or sometimes facilitate!) a firm's entry into a foreign market. IT can be used successfully to address such requirements. The variable 'time zone' refers to the different time zones in which countries operate: time differences present obstacles in conducting business, as well as make it possible for the organization to run operations during all 24 hours of the day [33].

3.3. Technology Variables
In addition to variables from the domestic SIS literature and the global IT literature, there are some that cut across both. Closer examination revealed that these variables are related to the unique advantages IT can provide in almost any domain of business activity. These technology variables are shown in Table 3. For example, a fundamental purpose of IT is to improve coordination among business units, and facilitate integration. While these aspects may seem somewhat mundane and be taken for granted in a domestic environment, they assume special significance in the international context. By the same token, responsive global systems and special purpose IS provide competitive advantages that were previously inconceivable. For example, the provision of online international databases and global executive support systems are providing powerful business tools to international executives.

Table 2
New variables from the global IT literature

1.	Worldwide physical resources
2.	Government requirements
3.	Country requirements
4.	Human resources
5.	Alliance with local partners and growth
6.	Time zones

Table 3
Technology variables

1.	Coordination
2.	Integration
3.	Responsiveness
4.	Information systems

A final comment about the variables. In the preliminary construct, there could be overlap and redundancy among the variables. However, they provide a starting point for model building. Moreover, redundancy minimizes the possibility of exclusion of key variables, thus providing greater comprehensiveness. Redundant variables were eliminated during the analysis process.

4. The research process
The preliminary model was used for generating the GLITS instrument. Later, during the analysis process, variables were combined, eliminated, and modified. The various steps of the research process can be grouped into two major stages.

4.1. Preliminary instrument and pilot study
1. The literature on competitive aspects and international applications of IT was used to generate items for the first draft of the GLITS instrument. This extensive review provided 255 specific items under 27 categories (also called variables or factors, as listed in Tables 1,2 and 3). An additional category called 'Overall impact of IT on global competitiveness' was created and 6 items were included in it. This category is especially useful in instrument refinement and validation. Besides the instrument items, several demographic items were included in the questionnaire in order to be able to conduct detailed analyses. The questionnaire at this stage was quite long.

It became apparent that the instrument, while comprehensive, was too long to be likely to generate any reasonable response rate in a survey. It was clear that the objectives of `comprehensiveness' and 'research implementation' were conflicting. A conscious decision was made not to curtail the scope of the model/instrument (i.e. not arbitrarily reducing the factors), and that any reduction in size was to be achieved by removing specific items within a factor.

2. A self-examination by the researchers for redundant, duplicate, or marginal items led to the reduction of the instrument to 209 items in 24 categories, plus the overall category with 6 items. Changes made included merging the 'new entrants' category with 'entry barriers,' merging 'searching and switching costs' with 'buyers and customers,' and combining 'government requirements' and 'country requirements' into one category.

3. The instrument was pilot-tested in two stages. In the first stage, the instrument was given to several faculty members and graduate students for completion and asking for suggestions for changes, improvements, and reductions. Many items were removed, combined, moved from one category to another, reworded, and so on. 'The instrument after this stage had 156 items in 24 categories, plus the overall category with 6 items.

4. In the second stage, five senior MIS executives of large companies were requested to provide detailed feedback on the instrument. The instrument was once again revised as a result. This instrument had 129 items in 23 categories, plus 5 items in the overall category. The main change was that items in the 'responsiveness' category were absorbed by other categories, and the 'responsiveness' category was eliminated. This preliminary instrument was packaged as a questionnaire along with questions on demographics and characteristics of responding firms. This questionnaire was used in the full study and for final refinement of the instrument.[3]

4.2. Full study
The final questionnaire was administered to 213 companies in a large tri-state metropolitan area of the United States. These companies were engaged in international business as reported in a published report; in fact 'international activity' was the company selection criterion. The questionnaire was sent to a senior executive, and if possible to an executive responsible for international business operations. Eleven questionnaires were returned as either undeliverable or because the companies no longer had international activity, in effect reducing the target sample size to 202 companies. After a three week wait, a written and telephone follow-up was conducted to increase the response rate.

A total of 36 responses were received providing a response rate of 18%. While a higher response rate[4] is desirable in any research endeavor, this response rate is reasonable, given the comprehensiveness and length of the instrument. Moreover, for quantitative analysis, samples in excess of 30 are considered adequate for most exploratory research 1201 In spite of this, some readers may be concerned about the significance of the results due to the small sample. The following reasons explain further the rationale for the small sample.

1. The expected sample size was about 50. However, two factors may explain the lower response. One is the length and comprehensiveness of the instrument; arbitrary reduction of the instrument would have defeated its purpose. Second, we asked that senior strategic international managers respond to the questionnaire; such managers are not readily available.

2. The research is exploratory and new in international IS. The primary purpose is to identify the global organizational variables for the successful application of information technology. A small sample is quite suitable for exploratory analysis [4].

3. The homogeneous sampling method used here (i.e. involving senior strategic international managers) has the effect of actually increasing the power of a test.

4. In order to further increase validity, we used very low levels of significance.

5. Analysis and results

The analysis was conducted in several stages. First, the reliability of the whole instrument as well as each variable was computed. Next, the construct validity of each item was assessed in relation to the overall construct, and items were eliminated on this basis. Items were further subjected to validity, based on their relationships to their own underlying variables. Next, items were retained and eliminated based on the criterion of optimizing the reliability of each variable. Items were then examined for convergent and discriminant validity. In the end, the final set of items was evaluated one more time for overall reliability and individual variable reliabilities.

Each variable of the instrument was given a two letter code for easy reference (see codes in Table 4). The number of items within each variable is also listed in Table 4. Each item is labeled by its variable code, followed by a sequential number. While the initial instrument is not included for space reasons, the final instrument is included in Appendix A. Those items in the initial instrument that were eliminated from the final instrument will be listed, along with the phase in which they were eliminated.

5.1. Initial reliability

The internal consistency method was used to verify model reliability. Cronbach's α [11] was computed for the entire model as well as for each of the multi-item variables. The reliability coefficient for the 129-item instrument (i.e. not including the 5 overall items) was quite high at 0.990. The reliability coefficients of the individual variables, as shown in Table 4, range between 0.820 and 0.949. These scores are high enough to warrant further validity investigation. Sub-sequent validity analysis was aimed at making the instrument compact by eliminating redundant items, while maintaining high reliability.

Table 4
Cronbach's reliability coefficients for the 129-item, 23-variable initial model

Variable (Variable code)		Number of items	Cronbach's α
1.	Entry barriers (EB)	2	0.836
2.	Customers (CS)	9	0.831
3.	Competitive rivalry (CR)	5	0.902
4.	Suppliers (SU)	7	0.900
5.	Market (MK)	10	0.926
6.	Products and services (PS)	7	0.851
7.	Economies of scale (SL)	8	0.860
8.	Economies of scope (SP)	3	0.819
9.	Internal organizational efficiency (EF)	13	0.939
10.	Interorganizational efficiency (IO)	4	0.863
11.	Pricing (PR)	5	0.889
12.	Business risk reduction (BR)	3	0.914
13.	Downsizing/outsourcing (DO)	4	0.866
14.	Learning curve/Knowledge transfer (LK)	5	0.918
15.	Flexible operations (FO)	9	0.944
16.	Resources (RS)	4	0.945
17.	Government and country requirements (GC)	8	0.936
18.	Human resources (HR)	5	0.900
19.	Alliance and growth (AG)	2	0.895
20.	Time zones (TZ)	2	0.902
21.	Coordination (CD)	5	0.932
22.	Integration (IG)	5	0.905
23.	Information systems (IS)	4	0.926
	Entire instrument	129	0.990

5.2. Overall construct validity

The validity of each of the 129 items was examined in relation to the overall construct. The following two methods were employed.

5.2.1. Correlation with corrected item total

In this method, the correlation of each item to the total item score was examined. Each item was actually correlated with the total score minus the item score in order to avoid a spurious part-whole correlation [10]. An item was eliminated if its correlation with the corrected-item total is less than 0.44. There are no accepted 'absolute' standards for the cutoffs; the choice is based on judgment, p values, the purpose of the study, and prior studies. For our sample, the correlation cutoff of 0.44 retains only those items that are significantly correlated to the total at a p value of less than 0.01. Note that a low p value increases the strength of the test, a

characteristic especially desirable with a small sample size. Also note that this cutoff is comparable to those used by other MIS researchers (e.g. [15, 23, 301) in instrument preparation.

The following five items were eliminated from the instrument. The instrument then had 124 items.

Variable	Item	Item description
Customers	CS6	Helps to provide adequate responses to customers' inquiries.
Market	MK5	Helps the firm reduce marketing costs.
Economies of scale	SL1	Reduces the cost of designing new products/services.
Economies of scale	SL2	Reduces the cost of modifying existing products/services.
Internal organizational efficiency and effectiveness	EF11	Reduces telecommunication costs (e.g. mail, telephone, etc.)

5.2.2. Criterion-related validity
Next, a measure of criterion-related validity [25] was examined to identify items that are not closely related to the overall construct. Initially there were the following 5 items in the overall category:

Variable	Item	Item description
Overall	OA1	Provides an international competitive advantage to the firm.
Overall	OA2	Supports the firm in becoming a global business.
Overall	OA3	Helps in building an organization that is effective, responsive, and flexible.
Overall	OA4	Provides a domestic competitive advantage to the firm.
Overall	OA5	Helps in the overall profitability of the organization.

Two of these relate directly to the use of IT for globalization; the other three were included for purposes outside the scope of this paper. The two items: °Al and 0A2 measured the overall impact of IT on international business and their sum was used as the criterion scale. The correlation coefficient between each item and the two-item criterion scale provided a measure of criterion-related validity. Items were retained if correlations were significant at the 0.01 significance level, others were eliminated. For this p value, the correlation cutoff point is 0.44. The following 34 items were eliminated:

Variable	Item	Item description
Entry barrier	EB2	Captures distribution channels and thereby increases the cost and difficulty to enter a new or existing market segment.
Customers	CS7	Provides historical customer profiles to improve customer services.
Competitive rivalry	CR1	Helps differentiate firm's products and services from its competitors
Suppliers	SU1	Reduces transaction costs by simplifying the order process.

Suppliers	SU2	Reduces supplier transaction costs by facilitating the purchasing process.
Suppliers	SU3	Reduces uncertainty in lead time for order procurement.
Suppliers	SU6	Assists the firm with `make versus buy' decisions.
Suppliers	SU7	Monitors the quality of products and services received from suppliers.
Market	MK10	Helps prepare project proposals in response to market opportunities.
Products and services	PS5	Helps highlight the unique and special features of the firm's products.
Products and services	PS7	Helps build customized products rapidly.
Economies of scale	SL3	Improves productivity of workers.
Economies of scale	SL4	Improves productivity of sales force/ marketing efforts.
Economies of scale	SL5	Improves the utilization of machinery.
Economies of scale	SL6	Helps achieve economies of scale in production.
Economies of scale	SL7	Reduces the order cycle time (time from customer order to delivery).
Economies of scale	SL8	Reduces product design and development time.
Economies of Scope	SP1	Increases number of products/services that can be generated with existing resources.
Internal organizational efficiency and effectiveness	EF2	Improves internal meetings and discussions.
Internal organizational efficiency and effectiveness	EF3	Enhances international communication within the organization.
Internal organizational efficiency and effectiveness	EF4	Improves the evaluation of budgets.
Internal organizational efficiency and effectiveness	EF5	Permits centralized decision making.

Internal organizational efficiency and effectiveness	EF7	Permits decentralized decision making.
Internal organizational efficiency and effectiveness	EF8	Reduces administrative costs.
Internal organizational efficiency and effectiveness	EF9	Reduces logistics/distribution costs.
Internal organizational efficiency and effectiveness	EFI10	Reduces the firm's inventories.
Pricing	PR1	Helps the firm to provide price reductions.
Pricing	PR2	Tracks market response to discounts, promotions, etc.
Pricing	PR3	Provides necessary information to help in price setting.
Pricing	PR4	Helps identify the price of competing products/services.
Business risk reduction	BR1	Reduces risk associated with currency conversions.
Downsizing/ outsourcing	DO1	Allows to reduce operations and workforce while maintaining output and quality.
Flexible operations	FO2	Facilitates flexibility in scheduling operations/manufacturing.
Government and country requirements	GC8	Alleviates barriers due to cultural differences between countries.

Note that one category ('Economies of scale') was completely eliminated. Two categories had only one item left in them, that is, 'Entry barriers' and 'Pricing.' While single item variables can be legitimate, they were examined further to see if they could be logically grouped under another variable so that each variable would have multiple items. It seemed natural to include the item EB1 (Raises the barrier to competitor entry into new products/services through investments in complex software and hardware), presently under 'Entry barrier', into the 'Competitive rivalry' category, and giving it a new code name CR6. By the same token, the item PR5 (Manages change in organization's pricing strategy), presently under the 'Pricing' category, was moved to the 'Market' category with a new code name MK11.

With these item deletions and changes, the instrument had 90 items in 20 categories plus 2 items in the overall category; that is, it became a 90 + 2-item instrument.

5.3. Item-variable correlation
The item-variable correlation of an item is derived by computing the item's correlation with the corrected total of all the items in the item's category (i.e. the variable it represents). The purpose is to retain only the

significantly correlated items within each group. Items were to be removed from the group if this correlation was less than 0.44 (p value > 0.01). Based on this criterion, none of the items from any of the groups was removed, and it remained a 90 + 2-item instrument.

This instrument is fairly good in terms of overall reliability and individual variable reliabilities. However, its length may still seem excessive for some organizations, in terms of its practicality. In order to reduce the size of the instrument further, more tests were undertaken. While all subsequent analyses are reported for the purpose of generating a smaller instrument, we emphasize that an organization may elect to use the larger 90 + 2 version and obtain more detailed information.

5.4. Optimal variable reliabilities

Each variable and the items within it were further investigated to maximize the reliability coefficient of the variable as well as eliminate redundant items within it. In Mahmood and Soon's method, items within a variable are arranged in descending rank order by the correlation between the item and the corrected item total. A reliability coefficient is then computed for the first two items in the ranked list (i.e. the two items with the highest and next-highest correlation). The next item in the ranked list is then included in the reliability coefficient computation. This procedure is continued until all the items within the variable are included in the computation.

The sequence of reliability coefficients generated in this manner was plotted on a graph[5] for each variable. The objective is to select the highest reliability coefficient for each variable. Different patterns of graphs are possible. The central idea is that the highest reliability coefficient can be achieved with fewer items than all the items contained in the variable. We superimposed another criterion on top of this: the pairwise correlations between items within a variable should also be significant in order to ensure variable purity.

Using these two criteria, 20 additional items were excluded from the model. All pairwise correlations are then significant at the 0.05 level for all variables with the exception of the variable 'Customers.' The 'Customers' variable therefore required further analysis. For this variable, the highest items on the ranked correlation list were CS4 and CS8. The reliability coefficient increased with the addition of CS9 and CS2, but then decreased with the addition of CS3. It subsequently increased with the addition of CS1 and CS5. Examination of the correlation matrix indicated that several correlations were significant. Items that were the least correlated pairwise were: CS1, CS3, and CS5. Their elimination led to all correlations being significant. The effect on the reliability coefficient was only a slight reduction. With the exclusion of these three items, a total of 23 items were eliminated, as listed below. The resulting instrument had 67 + 2 items.

Variable	Item	Item description
Customers	CS1	Helps the firm to learn more about worldwide customers.
Customers	CS3	Allows to implement software (e.g., order entry) in customer's computer system.
Customers	CS5	Increases customers' cost of switching to other suppliers.
Competitive rivalry	CR6	Raises barrier to competitor entry into new products/ services through investments in complex software and hardware.
Market	MK11	Manages change in organization's pricing strategy.
Internal Organizational efficiency and effectiveness	EF1	Improves the process and quality of decision making.

Internal organizational efficiency and effectiveness	EF13	Supports maintenance and trouble shooting in various countries.
Learning curve and knowledge transfer	LK3	Helps the firm to learn about new processes/technologies much faster.
Learning curve and knowledge transfer	LK4	Expedites the employee's learning of organizational and business knowledge.
Learning curve and knowledge transfer	LK5	Supports worldwide transfer of knowledge between identical/ similar operations.
Flexible operations	FO3	Provides support for 'just in time' inventory and manufacturing systems.
Resources	RS1	Allows procuring raw materials from the most beneficial worldwide resources.
Resources	RS4	Provides quick financial support to host country subsidiaries.
Government and country requirements	GC1	Helps deal with government/regulatory/legal requirements of other countries.
Government and country requirements	GC2	Assists in working with international organizations.
Human resources	HR1	Makes the use of unskilled labor from other countries possible.
Human resources	HR2	Makes the use of technical/ management manpower from other countries possible.
Human resources	HR3	Allows physically distant employees to work together.
Coordination	CD1	Allows coordination of business activities worldwide.
Coordination	CD4	Provides control of logistics/ distribution activities.
Coordination	CD5	Allows responsiveness to specific needs of other countries.
Information systems	IS3	Provides rapid worldwide access to company databases and information.
Information systems	IS4	Provides rapid worldwide access to external databases and information.

5.5. Convergent and discriminant validity

The multitrait-multimethod matrix (MTMM) approach [9] was applied to evaluate the convergent and discriminant validity of the mode1.[6] Convergent validity determines whether correlations between measures of the same group are higher than zero and large enough to proceed with discriminant validity analysis. In the present case, for every single variable, the correlations in the validity diagonal (i.e. items of the same variable) are higher than zero. Of the total 111 correlations between items within the variables, 109 were significant at the 0.01 level, the other two were significant at the 0.05 level. The smallest within-variable correlations for the various variables are CS: 0.428, CR: 0.608, SU: 898, MK: 0.404, PS: 0.346, SP: 0.921, EF 0:.816, IO: 0.549, BR: 0.906, DO: 0.742, LK: 0.904, FO: 0.650, RS: 0.934, GC: 0.662, HR: 0.827, AG: 0.814, TZ: 0.823, CD: 0.900, 0.455 and IS: 0.948.

In the MTMM approach, discriminant validity for each item is tested by counting the number of times *(k)* an item correlates higher with items of other variables than with items of its own variable. For example, the lowest own-variable correlation for CR2 is 0.608, and only 2 of the 63 correlations of CR2 with items of other variables are greater than 0.608, that is, the number of violations $k = 2$. Campbell and Fiske suggest that for discriminant validity, the number of violations should be less than 50% of the potential comparisons. We retain the items where violations are less than 50% according to this criterion, and reject items where violations are greater than 60%. We treat items in the 50-60% violation range as borderline and retain them because they have undergone extensive reliability and construct validation in previous steps to merit inclusion and perhaps more importantly, because it is desirable to include at least two items per variable; this criterion allows us to retain at least two items in each variable. With these deletions, the following nine items were eliminated:

Variable	Item	Item Description
Customers	CS8	Helps serve a customer who is traveling from one country to another.
Market	MK4	Enhances sales forecast accuracy.
Market	MK6	Facilitates distribution channels for the product worldwide.
Market	MK7	Quickly obtains local market knowledge of the host country.
Market	MK9	Provides assistance/flexibility in the choice of worldwide markets.
Products and services	PS1	Provides opportunities for products/ services innovation.
Integration	IG2	Helps build an integrated worldwide operations/ manufacturing network.
Integration	IG4	Provides integrated one-stop services to the customers.
Integration	IG5	Permits formation of integrated design teams that include design, engineering, and manufacturing.

Having conducted convergent and discriminant validity analysis, the instrument is 'final'.[7] It consists of 58 specific items contained in 20 variables, and 2 overall items. The final instrument is included in Appendix A.

5.6. Final reliability analysis for each variable

Table 5 shows the reliability of the 58-item final instrument, and reliability coefficients for all 20 variables. Compared to the initial instrument, reliabilities of 10 variables have increased, reliabilities of three variables have remained the same, and reliabilities of seven variables have decreased. However, the reliability of the entire instrument is remarkably high (0.987) and has remained practically the same as that of the initial instrument. The overall instrument is highly reliable, despite a 55% reduction from its initial size. Even the

individual variables exhibit high levels of reliability. Nunnally [38] has suggested a minimum reliability of 0.80 for basic research and 0.90 for applied research. Except for the variable 'customers,' all other variables have adequate reliabilities. The 'customers' reliability is 0.77, which is a considerable improvement over 0.67 that Mahmood and Soon could achieve.

Table 5
Cronbach's reliability coefficients for the final 58-item, 20-variable final instrument

Variable (Variable code)		Number of items	Cronbach's α
1.	Customers (CS)	3	0.770
2.	Competitive rivalry (CR)	4	0.898
3.	Suppliers (SU)	2	0.946
4.	Market (MK)	4	0.897
5.	Products and services (PS)	4	0.828
6.	Economies of scope (SP)	2	0.959
7.	Internal organizational efficiency (EF)	2	0.899
8.	Interorganizational efficiency (IO)	4	0.863
9.	Business risk reduction (BR)	2	0.950
10.	Downsizing/outsourcing (DO)	3	0.916
11.	Learning curve/Knowledge transfer (LK)	2	0.949
12.	Flexible operations (FO)	7	0.956
13.	Resources (RS)	2	0.966
14.	Government and country requirements (GC)	5	0.936
15.	Human resources (HR)	2	0.903
16.	Alliance and growth (AG)	2	0.895
17.	Time zones (TZ)	2	0.902
18.	Coordination (CD)	2	0.947
19.	Integration (IG)	2	0.836
20.	Information systems (IS)	2	0.973
	Entire instrument	58	0.987

We believe that the 58-item instrument, having undergone extensive evaluation and validation, represents significant progress toward the development of a standard instrument for measuring the strategic impact of IT at a global level. Moreover, the instrument is both comprehensive and precise. Nevertheless, we would encourage other researchers to continue to enhance the model.

6. A comprehensive model for global and strategic

6.1. Impact of information technology

Based on previous analysis, a comprehensive model for measuring the global and strategic impact of IT on an organization is presented in Figure 1; the accompanying instrument is furnished in Appendix A. The validated model consists of 20 variables, which in turn are made up of 58 specific items. There are two additional overall items. Some comments are in order about the model.
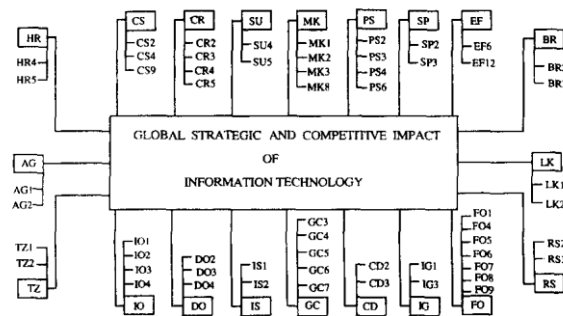

Fig. 1.

First, the model/instrument is more comprehensive than Mahmood and Soon's model. They had 10 variables; we have 20. This was not unexpected as we were extending the model to global firms. As pointed out by Emery [16], in today's world, the global organization is the norm and the domestic firm is a special case. The GLITS model therefore has current relevance for multinational organizations and has potential future relevance for organizations seeking to be global. There are many variables in the model that are especially meaningful in the international context only; for example, physical resources, country requirements, human resources, flexible

operations, time zones, and knowledge transfer. Even the traditionally domestic variables assume a different significance when viewed from a global perspective.

This is not to say that the model is not applicable to domestic firms. In fact, the model and the relevant variables for domestic firms are a subset of the complete model, and these variables can be extracted easily by simple examination. Most of the variables (seven of ten) reported by Mahmood and Soon in their domestic model have been retained. The ones not included are: search and switching costs, pricing, and economies of production. Items related to search and switching costs, while not retained in the final model, can be at least considered to be some part of the 'customers' variable. By the same token, 'pricing' can be considered to be part of the 'market' variable. Presumably, 'economies of production' was not included, because it refers largely to the operational and efficiency aspects of IT and not strategic aspects.

What is especially noteworthy about the new model is its comprehensiveness, as evidenced by the provision of several additional variables that can be used even in the domestic context. The additional variables in the domestic context include: economies of scope, downsizing and outsourcing, alliance and growth, coordination, and integration. In order to use the instrument in the domestic context, we recommend that items that are strictly international simply be eliminated. In essence, then, one model/instrument can serve the needs of any organization.

6.2. Applications and conclusions

This article has extended the previous work on the strategic impact of IT in a single-country domestic setting to a global environment. A model has been developed based on the identification of a large number of variables and specific items from the literature.

The model was carefully crafted using extensive evaluation and validation procedures. While there will always be potential for improvement, the current work signifies major progress toward the creation of a standard IT impact measurement model and instrument.

The model has practical as well as theoretical and research applications. Applications are described in detail in Ref. [39]. In terms of practical applications, a validated model provides an important tool for asses-sing the role of IT in the global competitiveness of a firm. By taking an inventory of the items contained in the instrument, a firm can determine whether IT can be used at an international level for financial gain or competitive advantage, or for preventing the firm from sliding into competitive disadvantage. In addition, if the firm wishes to capitalize on specific impacts of IT, it can measure specific variables; for example, customers, products or services, resources, flexible operations, etc. Another practical application for an organization is to evaluate itself against industry practices. If the instrument is administered periodically to a representative cross-section of companies and the results made public, then this information can be used by a company to assess its relative position and take necessary corrective actions.

Several research endeavors may be based on this work. One is to continue to refine the model and instrument. Another would be to conduct a detailed examination of the specific variables. It may turn out that some variables are more meaningful for certain firms or industries, and further insights into these may be of interest. For example, if the variable: 'down-sizing and outsourcing' is identified as an important factor for several firms, specific hypotheses related to it may be formulated and tested. An illustration of such a hypothesis may be that 'IT related global outsourcing is facilitated by heavy investments in telecommunications technology'. Another area for research would be to investigate the relationship between actual organizational strategic performance and IT competitive impact. The corroboration of a positive relationship between the two should encourage higher IT investment.

Finally, we recommend that a contingency analysis of the impact variables be undertaken. What are the contingency factors which drive the impact of each variable, and what is the amount of the impact? Some

possible factors are: global organizational structure [5], business strategy [36], industry, firm size, and country culture [19]. The knowledge of these factors and their effects could have enormous consequences for conducting business in the global economy of today and tomorrow.

Appendix A
Final model
A.1 Instrument to measure global strategic and competitive impact of information technology (The GUTS instrument)

Definition: Information Technology (IT) includes all aspects of computers (hardware and software), information systems, telecommunications, and office automation.

Q 1 . From your own firm's point of view, to what extent do you think Information Technology (IT) can provide or can assist in providing the following strategic and competitive advantage over other firms on an international level. Do not be concerned about IT's current role, but its potential role in your firm. Please circle one choice using the following scale.

Scale: 1 = No extent, 2 = Little extent, 3 = Some extent, 4 = Great extent, 5 = Very Great extent

Customers (CS)
CS2: Makes the products/services database avail-able to worldwide customers.

CS4: Helps provide administrative support (such as billing, collection, inventory management) to worldwide customers.

CS9: Helps serve customers in different countries with different needs.

Competitive rivalry (CR)
CR2:   Helps to make first/preemptive strike against competitors (i.e. a new product/service).

CR3:   Helps the firm provide substitutes before competitors do.

CR4:   Helps the firm match an existing competitor's offering.

CR5:   Assists in overcoming the home-court advantage of local firms in host country.

Suppliers (SU)
SU4:   Helps the firm identify alternative supply sources on a worldwide basis.

SU5:   Helps the firm locate substitute pro-ducts/services on a worldwide basis.

Market (MK)
MK1:   Makes new business technologically feasible worldwide.

MK2:   Identifies worldwide market trends.

MK3:   Discovers and develops new and profitable worldwide market.

MK8: Aids in selling the product in different parts of the world.

Products and services (PS)
PS2:   Enhances product/service performance and quality.

PS3:   Allows the firm to bundle more information with products/services.

PS4:Allows the development of new pro-ducts/services.

PS6: Enhances the after-product sale services and activities.

Economies of scope (SP)
SP2:   Increases number of markets that can be tapped with existing resources.

SP3:   Increases number of countries business can be conducted in with existing resources.

Internal organizational efficiency and effectiveness (EF)
EF6: Improves strategic planning.

EF12: Facilitates organizational change in the firm.

Interorganizational efficiency (RD)
IO1: Improves communication/coordination with worldwide businesses (e.g. suppliers, wholesalers, retailers).

IO2: Improves communication/coordination with worldwide customers.

IO3: Permits communication/formal agreements with other organizations worldwide.

IO4: Facilitates the making of worldwide financial investments.

Business risk reduction (BR)
BR2:   Reduces risk by allowing to work with multiple global traders and suppliers.

BR3:   Reduces risk by allowing to conduct business in multiple global markets.

Downsizing/outsourcing (DO)
D2:   Allows to profitably contract/outsource activities to firms in its own country.

D3:   Allows to profitably contract/outsource activities to firms in other countries.

D4:   Allows to consolidate operations all over the world.

Learning curve/knowledge transfer (LK)
LK1:   Allows foreign subsidiaries to learn technical and business knowledge much faster.

LK2:   Helps the firm to learn about subsidiaries much faster.

Flexible operations (FO)
FO1: Allows flexibility in locating and relocating worldwide operations.

FO4: Allows the manufacture of different parts in different countries.

FO5: Eliminates duplication of effort in other country subsidiaries.

FO6: Provides for rapid adjustments to the firm's logistics/distribution network.

FO7: Allows the firm to share facilities across the world.

FO8: Allows the sharing of computer software across multiple world facilities.

FO9: Allows the firm to utilize excess capacity in any part of the world.

Resources (RS)
RS2:   Assists in procuring semi-finished/finished goods from the most beneficial worldwide sources.

RS3:   Allows financing arrangements from the most desirable world sources.

Government and country requirements (GC)
GC3: Assists in the advancement and social policy objectives of host countries.

GC4:   Helps address accounting/financial/internal control requirements of countries.

GC5:   Helps deal with different currencies/physical units of other countries.

GC6:   Helps address taxation requirements of other countries.

GC7:   Helps address language barriers in other countries.

Human resources (HR)
HR4:   Facilitates the coordination of global research and development efforts.

HR5:   Allows to assign work to underutilized employees across the globe.

Alliance and growth (AG)
AG1:   Facilitates the formation of spinoff companies in other countries.

AG2:   Permits alliances/acquisitions/joint ventures in other countries.

Time zones (TZ)
TZ1:   Overcomes barriers due to time differences in various countries.

TZ2:   Expands the time during the 24 hour day to conduct international business.

Coordination (CD)
CD2:   Provides information support to subsidiaries.

CD3:   Permits better monitoring and control of subsidiary operations.

Integration (IG)
IG1: Allows worldwide integration of business with suppliers, distributors, wholesalers, or retailers.

IG3: Helps build an integrated worldwide logistics/distribution network.

Information systems (IS)
IS1: Expedites transfer/development of operational information systems in other countries.

IS2: Expedites transfer/development of decision support/expert/strategic systems in other countries.

Overall (OA)
0A1: Provides an international competitive advantage to the firm.

0A2: Supports the firm in becoming a global business.

Notes:
1The terms 'global' and 'international' are used in this article in a generic sense. A global or international firm is involved in some type of international business (IB) activity, for example, it may have international customers, international operations, etc. By contrast,1B researchers have labeled international companies differently based on the type of activity and organizational structure (e.g. [5, 13]).
2The two variables eliminated were: New Entrants, and Entry Barriers.
3Space considerations do not permit the inclusion of the full questionnaire. Specific parts will be included and discussed as necessary. The final 58-item instrument is included in Appendix A.
4Note that the Mahmood and Soon study that is being extended here is based on responses from 31 executives.
5Graphs are not included due to space limitations. Readers, if interested in the graphs, may contact the author.
6The correlation matrix between all items was the basis for conducting the MTMM analysis. The correlation matrix is too large to include here. Once again, the interested reader is referred to the author.
7The instrument is 'final' based on investigation and analysis to date. In a purist sense, an instrument is never final and is subject to further validation and refinement based on new evidence.

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