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# Effect of Information System Strategies on Supply Chain Strategies and Supply Chain Performance

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***Abstract*—**In order to achieve competitive advantage and better performance of firm, supply chain management (SCM) strategy should support and drive forward business strategy. It means that supply chain should be aligned with business strategy, at the same time supply chain (SC) managers need to use appropriate information system (IS) solution to support their strategy, which would lead to stay competitive. There are different kinds of IS strategies which enable managers to meet the SC requirement by selecting the best IS strategy. Therefore, it is important to align IS strategies and practices with SC strategies and practices, which could help us to plan for an IS application that supports and enhances a SCMS. In this study, aligning IS with SC in strategy level is considered. The main aim of this paper is to align the various IS strategies with SCM strategies and demonstrate their impact on SC and firm performance.

***Keywords*—**Information system strategy, alignment, firm performance, supply chain strategy.

## I. Introduction

RECENTLY, some researchers focus on SCMbecause organizations believe that effective SCM is the key to build asustainable competitive advantages for their products and services. In order to manage supply chain, organization must apply and adopt SCM strategy and implement appropriate supply chain management practices. There are different varieties of supply chain strategies in order to meet specific requirements which organizations tend to achieve them such as lean supply chain, agile supply chain, hybrid supply chain, just in time, and so on.

## II. Literature Review

### *A. Lean Supply Chain (LSC)*

Reference [1] suggested that the minimization of total lead-time is an important element of lean supply chain.In fact, excess time is waste and could be eliminated by lean supply chain approach.

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### *B. Agile Supply Chain (ASC)*

Agility is defined as "the ability to cope with unexpected challenges to survive unprecedented threats of business environmentand take the advantages of changes asopportunities" [2].

### *C. IS Strategies*

Information system strategy (ISS) can help firms to implement strategic plans and at the end get the competitive advantages. The traditional domain of ISS is to modify the effectiveness and efficiency of organization [3]. In order to support the operational efficiency, IS is required which helpsto control the cost of product and transaction. This can be achieved through IS that improves and modifies information coordination, reduces errors and administrative cost, and enables the standardization of business process. IS for flexibility is defined in this study as a strategy that is focused on market flexibility and quick strategic decision support. Reference [4]argued that IS leads to flexibility and new product development.

### *D.Supply Chain Performance Measurement*

The flexibility has been defined as an attribute of a system technology for coping with the variety of its environmental requirements [5]. Flexibility in supply chain helps us to change or react with little penalty in time, effort, cost or performance. Supply chain flexibility is able to represent a potential source to improve the company's efficiency and may be a significant measure of supply chain performance [6]. On the other hand,the main aim of applying SCI is to achieve efficient and effective flows of services and products, money and information, to provide maximum value to the customer at the high speed and low cost [7].

### *E. Firm Performance*

Firm performance is the result of strategies the firm employs to achieve market oriented and financial goals. Some factors effect on firm performance, such as innovation (appears to have great effects on work productivity and the overall performance of the organization) and improved technology (decreases cost per unit and therefore improves performance). In this study, the ability of firm to achieve its market-oriented goals and its financial goals is known as firm performance.

*F. Fit as Mediation*

Reference [8] proposed a classificatory framework for the concept of fit, which identified six types of fits. The fit as mediation is used to study the alignment between supply chain management strategy, information strategy, and the impact of each relationship on SCM performance. Fig. 1 illustrates the fit as mediation.

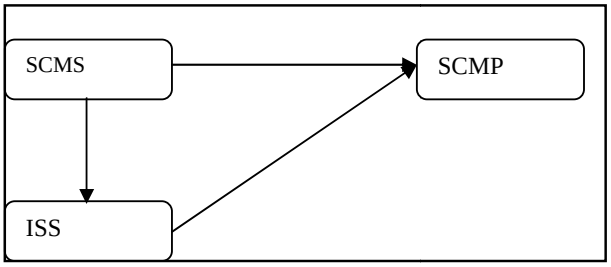


Fig. 1 Fit as mediation

## III. Proposed Research Model

Aligning the supply chain strategy with information technology strategy has a positive impact on SCM performance and leads to better SCM performance. A proposed research model was developed based on a comprehensive literature review. Fig. 2 shows the research model that has been proposed during this research. In this framework supply chain management strategy consists of lean supply chain and agile supply chain. ISS includes IS for efficiency and IS for flexibility. SCMperformance included by supply chain flexibility and supply chain integration. Finally, firm performance consists of market performance and financial performance.

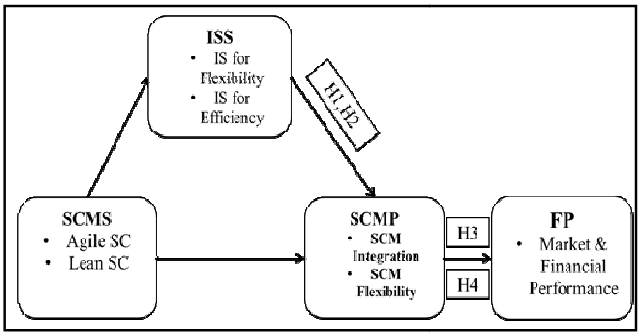


Fig. 2 Proposed research model

## IV. Research Hypotheses

This study used four hypotheses to assess the impact of aligning supply chain strategies with information system strategies on supply chain and firm performance. Those hypotheses are as follows:

*A. Research Hypotheses (H1 & H2)*

Some researchers argued that in order to have an effective information system strategy, supply chain managers should redesign their supply chain strategies based on information technology investment[9].So, this study tries to align IT strategies with SCM strategies which plays an important role in achieving the aims of organization. These two hypotheses are as follows:

H1: IS for efficiency has a positive impact on the relationship between lean supply chain management and supply chain performance, which is measured by supply chain integration.

H2: IS for flexibility has a positive impact on the relationship between Agile Supply Chain (ASC) and supply chain performance, which is measured by supply chain flexibility.

*B. Research Hypotheses (H3 & H4)*

Reference [10] stated that a firm's competitive strategy may need to be proactive while seeking an efficient linkage or integration among its various internal functions and with its suppliers and customers comprising its supply chain. The need to react to market changes is paramount for many companies. The role of SC integration is crucial in meeting this need. The potential benefits of integrating the supply chain can no longer be ignored.

H3: Supply chain integration has a positive effect on firm performance.

H4: Supply chain flexibility has a positive effect on firm performance.

## V. Research Methodology

*A. Item Generation*

The item generation was done through a comprehensive literature review to identify the domain of major construct.

*The instruments to measure are:*

1. Supply Chain Management Performance(SCMP)
2. Firm performance(FP)
3. Supply Chain Management Strategy (SCMS)
4. Information System Strategy (ISS)
5. The alignment between SCMS and ISS

Note also, that, the first two instruments were adopted from previous studies [11],however, they were tested again in the pilot study of this research. Therefore, all the instruments were tested in the pilot test to assess the reliability and validity. In order to develop the instruments for SCMS, ISS, and alignment between SCMS and ISS, three steps were completed: (l) item generation, (2) a pilot study by using Q-Sort method, and (3) data analysis.

*B. Pilot Test (Using Q-Sort Method)*

Q-Sort methodology as a scaling technique first popularized by [12]. Q-Sort method is a method of assessing reliability and construct validity of questionnaire items that are being prepared for survey research. The method was applied at the pre-test stage, which came after the item generation through literature review and before the administering of questionnaire items as a survey.In particular, the lean supply chain was generated based on previous literatures[13]-[15]. Agile supply

chain was generated from [16]-[18].Information system strategy (ISS for efficiency and ISS for flexibility) were generated based on prior studies [19]-[22].Once the items were generatedand items pool was created, they were reviewed by three academician and two practitioners. Eventually, a total 5 constructs and 57 items were created. The precise number of constructs and items has been listed:

*Supply chain management strategy (SCMS)*
Lean Supply Chain Management……..7
Agile Supply Chain Management……...12
*Information system strategy (ISS)*
Information System for Efficiency……...7
Information System for Flexibility……...7
*Alignment between SCMS with ISS..…..…..…..24*

These items and constructs were used in Q-Sort method to assess the validity and reliability. To assess the reliability of the sorting conducted by the judges, two different measures were made. The first one is Moore and Benbasat's hit ratio [23] and the second one is Cohen's Kappa coefficient agreement [24].The Cohen's Kappa (1) is:

$$K = \frac{N_i \times X_{ii} - \sum_i X_{i.} \times X_{.i}}{N_i^2 - \sum_I (X_{I.} \times X_{.i})} \quad (1)$$

where:

$N_i$ : total items

$X_{ii}$ : total number of items on the diagonal (the number of items agreed correctly in the intended category by the two judges)

$X_{i.}$ : total number of items on the $i_{th}$ row of the table

$X_{.i}$ : total number of items on the $i_{th}$ column of the table

According to the Kappa coefficient agreement, no general agreement exists with respect to require a score. However, several studies have considered score greater that 0.65 to be acceptable [25]. Reference [26] provided a more detailed guideline to interpret Kappa by associating different values of this index to the degree of agreement beyond chance. They suggesteda guideline in Table I.

TABLE I
ASSOCIATION OF DIFFERENT KAPPA VALUE TO THE DEGREE OF AGREEMENT BEYOND CHANCE

| Value of Kappa | Degree of Agreement Beyond Chance |
|---|---|
| 0.76_ 1.00 | Excellent |
| 0.40_0.75 | Fair to Good (Moderate) |
| 0.39or less | Poor |

*1) Results of the first sorting round*

In the first round of Q-Sort, two senior managers of two major automobile firms participated in this procedure. The hit ratio score average 71% was achieved (see Table II). Table III shows the Inter-judge raw agreement score of first sorting round.

TABLE II
ITEM PLACEMENT RATIO: FIRST SORTING ROUND

| First Round | Actual Categories | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Theoretical Categories / Constructs | 1 | 2 | 3 | 4 | 5 | NA | Total | % |
| 1 | 12 | 2 | | | | | 14 | 85 |
| 2 | 2 | 20 | 2 | | | | 24 | 83 |
| 3 | | | 10 | 4 | | | 14 | 71.4 |
| 4 | | | 10 | 4 | | | 14 | 29 |
| 5 | | | | 6 | 42 | | 48 | 87.5 |
| NA | | | | | | | | |
| | Total item placement:114 | | | Number of Hits:88 | | Overall Hit Ratio:71% | | |

1. Lean Supply Chain
2. Agile Supply Chain
3. IS for Efficiency
4. IS for Flexibility
5. Alignment between supply chain management strategy and IS strategy

TABLE III
INTER-JUDGE RAW AGREEMENT SCORE: FIRST SORTING ROUND

| First Round | Judge 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Judge 2 / Constructs | 1 | 2 | 3 | 4 | 5 | NA | Total | NA |
| 1 | 5 | | | | | | 5 | |
| 2 | | 8 | | | | | 8 | |
| 3 | | | 3 | | | | 3 | |
| 4 | | | 4 | 1 | | | 5 | |
| 5 | | | | | 18 | | 18 | |
| NA | | | | | | | | |
| | Total item placement:57 | | N of Correct Agreement:35 | | | Correct Agreement Ratio:0.62 | | |

The inter-judge raw correct agreement score average is achieved 62%. The level of agreement between the two judges in categorizing the items has a crucial effect on measuring Cohen's Kappa. This index is used to eliminate chances agreement. Based on the equation, Kappa coefficient is equal by:

$$K = \frac{(57 \times 35) - 439}{(57 \times 57) - 439} = 0.56$$

Cohen's Kappa score achieved is 0.56. Following the guideline for interpreting the Kappa coefficient, the value of 0.56 indicates a poor. Also the hit ratio achieved is 71% and the inter-judge raw agreement scores averaged at 0.62. The lowest item placement ratio value was 29% for the "IS for efficiency" construct, indicating a very low degree of construct validity. In order to improve the Cohen's Kappa measure of agreement, an examination of the off-diagonal entries in the placement matrix was conducted. Overall, 9 items were deleted. The remaining number of items for each construct after the first round of Q-Sort was as follows:

1. Lean Supply Chain Management……..…..……..7
2. Agile Supply Chain Management …….10
3. Information System for Efficiency ……..6
4. Information System for Flexibility ……..5
5. Alignment SCMS with ISS ……..……..20

*2) Results of the second sorting round*

Tables IV and V show the results of second sorting round. The hit ratio score averaged 93%. The inter-judge raw correct agreement scored average 90% and base on the Cohen's Kappa equation, the Cohen's Kappa coefficient value is 0.87.

$$K = \frac{(48 \times 43) - 525}{(48 \times 48) - 525} = 0.87$$

TABLE IV
ITEM PLACEMENT RATIO: SECOND SORTING ROUND

| Second Round | | Actual Categories | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Theoretical Categories | Constructs | 1 | 2 | 3 | 4 | 5 | NA | Total | % |
| | 1 | 14 | | | | | | 14 | 100 |
| | 2 | 1 | 19 | | | | | 20 | 95 |
| | 3 | | | 11 | 1 | | | 12 | 92 |
| | 4 | | | 2 | 8 | | | 10 | 80 |
| | 5 | | | 1 | | 39 | | 40 | 98 |
| | NA | | | | | | | | |
| | | Total item placement:96 | | | Number of Hits:91 | | | Overall Hit Ratio:0.93 | |

TABLE V
INTER-JUDGE RAW AGREEMENT SCORE: SECOND SORTING ROUND

| Second Round | | Judge 1 | | | | | |
|---|---|---|---|---|---|---|---|
| Judge 2 | Constructs | 1 | 2 | 3 | 4 | 5 | NA |
| | 1 | 7 | | | | | |
| | 2 | | 9 | | | | |
| | 3 | | | 5 | | | |
| | 4 | | | | 3 | | |
| | 5 | | | | | 19 | |
| | NA | | | | | | |
| | | Total item placement:48 | | | N of Correct Agreement:43 | | Correct Agreement Ratio:0.90 |

Following the guideline for interpreting the Kappa coefficient, the value of 0.87 indicates excellent. The level of item placement ratio averaged 93%, which indicates the high degree of construct validity. A summary of twice rounds of Q-Sort shown in Table VI.

TABLE VI
SUMMARY OF TWICE Q-SORT ROUND

| Agreement Measure | Round 1 | Round 2 |
|---|---|---|
| Overall Hit Ratio | 0.71 | 0.93 |
| Raw Agreement | 0.62 | 0.90 |
| Cohen's Kappa | 0.56 | 0.87 |
| Placement Ratio Summary | | |
| Lean supply chain management | 85% | 100% |
| Agile supply chain management | 83% | 95% |
| Information system for efficiency | 71.4% | 92% |
| Information system for flexibility | 29% | 80% |
| Alignment SCMS with ISS | 87.5% | 98% |

In order to further improvement of potential reliability and construct validity, an examination of the off-diagonal entries in the placement matrix was conducted. Overall, 9 items were further deleted. The remaining number of items for each construct after the second round of Q-Sort was as follows:

1. Lean Supply Chain Management……6
2. Agile Supply Chain Management……...6
3. Information System for Efficiency……..5
4. Information System for Flexibility……..5
5. Alignment SCMS with ISS……...17

At this point, iterating of Q-Sort stopped at the second round, for the raw agreement score of 0.90, Cohen's Kappa of 0.87 and the average placement ratio of 0.93 were considered as an excellent level of inter-judge agreement, indicating a high level of reliability and construct validity. Base on the results of Q-Sort analysis, the questionnaire forms were provided to send to respondents in order to collect the data.

*A. Data Collection Methodology*

In this study, the respondents who have experience and knowledge in managing supply chain and information system applications in their organizations. The questionnaire forms have been sent via E-mail address. The E-mail address database has been taken from *Industrial Ministry of Iran*.
Sample Size Determination

The quality and accuracy of research depend on sample size. In order to do the survey with high level of accuracy, the method of Cochran's formula has taken into account.The alpha level used in determining sample size in most educational research studies is either 0.05 or 0.01. In general, the alpha level of 0.05 is acceptable for most research [27].Also, the general rule relative to acceptable margins of error in educational and social research is as follows [28].

A.5% margin error is acceptable for categorical data.
B.3% margin error is acceptable for continuous data.
Equations (2),(3) are the Cochran's sample size formulas:

$$n_0 = \frac{t^2 \times (p)(q)}{d^2} \quad (2)$$

where:
t: value of selected alpha level of 0.05 in two tail= 1.96
$p \times q$: estimate of variance = 0.25
d: acceptable margin of error = 0.05

$$n_1 = \frac{n_0}{\left(1+\left(\frac{n_0}{population}\right)\right)} \quad (3)$$

where:
$n_0$: required sample size according to Cochran's formula
$n_1$: required sample size because sample> 5% of population

$$n_0 = \frac{(1.96)^2 \times (0.5)(0.5)}{(0.05)^2} = 384$$

$$n_{1=\frac{384}{\left(1+\left(\frac{384}{100}\right)\right)}=80}$$

*B. Causal Model & Hypothesis testing*

The proposed relationship between variable and those hypotheses are going to be tested. In this study, SPSS software was used in order to assess the analysis of SPSS software on those hypotheses. By SPSS, the strength of the relationship between variable will be tested and analyzed through the value

of T-statistic, ANOVA, R square and the Partial Correlations. The simplified proposed model is shown in Fig. 3.

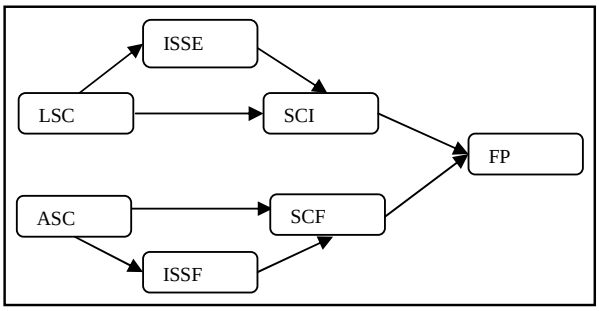


Fig. 3 Simplified proposed model

## VI. Proposed Model Results Using SPSS

The definition and results of the proposed model using SPSS were displayed in Tables VII to X. Three of them are completely significant and the other one is significant.

TABLE VII
SPSS RESULTS FOR H1

Correlations

| Control Variables | | | SCI | LSC | ISSE |
|---|---|---|---|---|---|
| -none-[a] | SCI | Correlation | 1.000 | .668 | .768 |
| | | Significance (2-tailed) | . | .000 | .000 |
| | | df | 0 | 78 | 78 |
| | LSC | Correlation | .668 | 1.000 | .731 |
| | | Significance (2-tailed) | .000 | . | .000 |
| | | df | 78 | 0 | 78 |
| | ISSE | Correlation | .768 | .731 | 1.000 |
| | | Significance (2-tailed) | .000 | .000 | . |
| | | df | 78 | 78 | 0 |
| ISSE | SCI | Correlation | 1.000 | .243 | |
| | | Significance (2-tailed) | . | .031 | |
| | | df | 0 | 77 | |
| | LSC | Correlation | .243 | 1.000 | |
| | | Significance (2-tailed) | .031 | . | |
| | | df | 77 | 0 | |

a. Cells contain zero-order (Pearson) correlations.

As it can be seen from Table VII, IS for efficiency has a positive impact on the relationship between lean supply chain management and supply chain performance which was measured by supply chain integration. It means that, the partial correlation between LSC and SCI is poor while the Zero-order correlation between LSC and SCI is high (0.668) and statistically significant.

From Table VIII and the SPSS results, the correlation value of ASC with SCF achieved 0.373 when the effect of ISSF was removed. It means that that the partial correlation between ASC and SCF is poor while the Zero-order correlation between ASC and SCF is high (0.545) and statistically significant.

It can be deduced from Table IX, this hypothesis is found to be significant (T-value = 6.21, R2 = 0.331) and also the HO is rejected (Sig = .000). Hence, it could be inferred that, supply chain performance measured by supply chain integration has a positive impact on firm performance. Table X shows the results of H4. According to the results, this hypothesis is found to be significant (T-value = 6.01, R2 = 0.316) and also the HO is rejected (Sig = .000). It could be inferred that, supply chain performance measured by supply chain flexibility has a positive impact on firm performance.

TABLE VIII
SPSS RESULTS FOR H2

Correlations

| Control Variables | | | ASC | SCF | ISSF |
|---|---|---|---|---|---|
| -none-[a] | ASC | Correlation | 1.000 | .545 | .472 |
| | | Significance (2-tailed) | . | .000 | .000 |
| | | df | 0 | 78 | 78 |
| | SCF | Correlation | .545 | 1.000 | .594 |
| | | Significance (2-tailed) | .000 | . | .000 |
| | | df | 78 | 0 | 78 |
| | ISSF | Correlation | .472 | .594 | 1.000 |
| | | Significance (2-tailed) | .000 | .000 | . |
| | | df | 78 | 78 | 0 |
| ISSF | ASC | Correlation | 1.000 | .373 | |
| | | Significance (2-tailed) | . | .001 | |
| | | df | 0 | 77 | |
| | SCF | Correlation | .373 | 1.000 | |
| | | Significance (2-tailed) | .001 | . | |
| | | df | 77 | 0 | |

a. Cells contain zero-order (Pearson) correlations.

TABLE IX
SPSS RESULTS FOR H3

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .575[a] | .331 | .322 | .74793 |

a.Predictors: (Constant), SCI

ANOVA[a]

| Model | | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|---|
| 1 | Regression | 21.588 | 1 | 21.588 | 38.591 | .000[a] |
| | Residual | 43.633 | 78 | .559 | | |
| | Total | 65.221 | 79 | | | |

a.Predictors: (Constant), SCI b: dependent Variable: FP

| Model | | Standardized Coefficients | t | Sig. | Correlations | | |
|---|---|---|---|---|---|---|---|
| | | Beta | | | Zero-order | Partial | Part |
| 1 | (Constant) | | 3.732 | .000 | | | |
| | SCI | .575 | 6.212 | .000 | .575 | .575 | .575 |

a. Dependent Variable:FP

TABLE X
SPSS RESULTS FOR H4

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .563[a] | .316 | .308 | .73177 |

a.Predictors: (Constant), SCF

ANOVA[a]

| Model | | Sum of Square | df | Mean Square | F | Sig |
|---|---|---|---|---|---|---|
| 1 | Regression | 19.340 | 1 | 19.340 | 36.118 | .000[a] |
| | Residual | 41.768 | 78 | .535 | | |
| | Total | 61.108 | 79 | | | |

a.Predictors: (Constant), SCF b: dependent Variable: FP

| Model | | Standardized Coefficients | t | Sig. | Correlations | | |
|---|---|---|---|---|---|---|---|
| | | Beta | | | Zero-order | Partial | Part |
| 1 | (Constant) | | 4.030 | .000 | | | |
| | SCF | .563 | 6.010 | .000 | .563 | .563 | .563 |

a. Dependent Variable:FP

## VII. Conclusion

This study tries to explore the mediation alignment between SCM and IS and the impact of this alignment on supply chain

performance and firm performance. Initially, the research look at two different SCM strategies and two different IS strategies, and tries to assesses appropriately - aligned information strategies that is able to meet the supply chain management requirements and would enhance their effectiveness by positively influencing SCM performance and firm performance. According to the work out of this study, it could be inferred that in order to achieve the highest performance level of supply chain strategies, they should be matched with information system strategy which meet their requirements in a best manner.

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