Impact of Supply Chain Information Integration on Operational Performance of Pharmaceutical Firms: Mediating Role of Information Leakage

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Aims: The aim of the current study is to investigate the mediating role of information leakage on the relationship between supply chain information integration and operational performance of pharmaceutical firms.

Study Design: Survey approach was used. Primary cross-sectional data was collected from 151 firms.

Place and Duration of Study: Unit of analysis was organizations; population of the study was managerial staff, territory managers, field managers, area managers of firms. Total 200 questionnaires were distributed and 150 completed questionnaires were used in the analysis. Data was collected from Pfizer, Abbot, GSK, Mark, and Sanofi Aventis in 2020-2021.

Methodology: Partial Least Square Structural Modeling Equation (PLS-SEM) was used for analysis. Measurement model and structural model were developed and tested. Majority of the respondents were male followed by female staff members. All the respondents belong to managerial and administration side/positions.

ABSTRACT

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**Results:** results of measurement model consist of loadings >0.7, Cronbach alpha >0.7, AVE>0.5, CR>0.7, revealed that scales used in the current study are reliable and valid. Results of structural model revealed that there is direct impact of supply chain information integration on information leakage and operational performance as well as indirect effect of information leakage upon supply chain information integration and operational performance of pharmaceutical firms.

**Conclusion:** it is concluded that in pharmaceutical firms there is leakage of information. Accidental information leakage has some consequences as well as intentional leak of information is more harmful. Firms have to strengthen their network in order to attain competitive advantage over their competitors and sustainable operational performance.

*Keywords: Supply Chain Information Integration; Accidental information Leak; Intentional Information Leak; Operational Performance; Pharmaceutical Firms.*

### 1. INTRODUCTION

Operational performance and leakage of confidential information is the main problem of the pharmaceutical firms. Organizations are taking keen interest to enhance their operational performance and for this purpose supply chain information integration might be helpful and help the firms to attain competitive advantage over their competitors in the market. Sharing information through e-systems is defined as supply chain information integration. Due to revolution in the industries and market competition the sharing and transfer of knowledge and expertise among supply chain partners has been increased. This sharing of information, knowledge and expertise increases the operational performance of the firms. There are several advantages of sharing information but it has some consequences, organizational members could leak some information and it may cause serious damages to pharmaceutical firms [1]. Leaking of information is illegal whether accidental or intentional therefore, firms have to strengthen their supply chain so that they might be able to keep the confidential information for the benefits of the firms. In the last decade more than 60% information related with products, pricing, transportation, consumers were leaked through electronic channel. These kinds of leak of information not only increase the expenses and cost but decrease the operational performance of the firms. It can negatively harm the image of the corporation, reputation, trademark [2]. According to researcher’s best knowledge limited literature is available about the supply chain information integration and operational performance with mediating role of information leakage. Moreover, the area of pharmaceutical was overlooked by researchers which need immediate attention as this time due to (COVID-19) (C-19) pandemic, pharmaceutical firms and medical practitioners are working as front line workers. Supply chain information integration (SCII) defined as exchanging the information with supply chain (SC) partners through electronic linkages, while operational performance means the product quality, presale services, cooperation with customers and delivery time, moreover information leak happens due to negligence of employees and lack of control of management over their employees. The relationship between SCII and operational performance is reported in previous studies but this relationship is needs intervening variable to understand this relationship in better way [3].

Now a days in order to obtain competitive advantage in the business, organizations use supply chain information integration as a tool for success. Supply chain information is used to exchange the information through electronic linkages and channels. Supply chain information integration (SCII) help firms to increase accuracy of their operational performance. Despite of having several benefits of SCII there are some risks associated with SCII [4]. Risks associated with financial matters, operations and other confidential matters pertain in the organizations. Leak of these confidential and important matters can cost the firm, in results there might be reduction in effect of SCII on operational performance. Therefore, organizations need to take care of their secret matter while going to share any important information with their supply chain (SC) partners. Firms also need to strengthen their SCII to enhance operational performance [5]. Supply chain information integration is well discussed but limited is known about the information leakage. Leak of information can increase the cost of products; decrease the quality of products and services, reduce the income, reduction in operational performance. Previous studies have focused on SCII and information quality, information sharing but leak of information was overlooked [6].
Limited studies have reported the important role of information leakage on SCII and operational performance [7]. In addition past studies have focused on manufacturing sector but pharmaceutical sector has potential to contribute a major role towards economy of a country that was the reason and motivation for conducting such study and it was essential to empirically test the model of SCII, operational performance with mediating role of information leakage on pharmaceutical firms through the lens of resource orchestration theory (ROT) and RBV theory. To fill the gap in the literature the new model of supply chain information integration, operational performance with mediating role of information leakage is investigated in PSL-SEM.

This study has tried to answer the following research questions:

RQ1: How does supply chain information integration affect operational performance?
RQ2: How does information leakage mediated between SCII and operational performance?

To answer the above research questions the theoretical framework was developed (see Fig. 1) which is based on ROT & RBV. This framework justifies the variables and their relationship.

2. LITERATURE REVIEW

2.1 Supply Chain Information Integration

SCII means sharing information among partners via electronic link. It is believed that if firms have close relationship with their partners who can enhance their operational performance. It is reported in the past studies that direct connection between SCII and operational performance is weak which always needs integration of some intervening variables which could help them to increase their association [8]. Further, SCII help firms to reduce risk, uncertainty, time, and cost and increase quality of products and services, more productive and help firms to increase their profits as well as performance. Effectiveness of organizations can be judged by the integration of information between SC partners but this effectiveness does base on correct and accurate provision of information. Misleading or disinformation may lead to poor operational performance and results in loss of reputation, image, quality, and low operational performance. If the information received by the firms about its customers, consumers, creditors and suppliers the firm becomes able to do planning, thinking in advance by formulating it strategies. The planning leads toward reduction in transportation cost, production cost, labor cost, time, and increase operation performance of the pharmaceutical firms [9].

2.2 Information Leakage

Organizations share their information in order to attain some objectives. Their relationship with their SC partners and trading partners is based on trust. It has several advantages. When information which was not supposed to share with the trading partners flows outside the boundaries of the organization it has some serious consequences. This is called leakage of information and this act is unethical and unlawful. Leak of confidential matters is might be intentional or accidental both are undesirable [10]. Due to negligence of human behavior or employees when information is leaked it is called accidental while information leaks by employee intentionally to harm the organizations it is called intentional leak of information. Leak of information is due to lack of control by organizations over their employees. In addition when employees are dissatisfied from their job, no trust, lack of motivation, power and politics are the reasons for leaking information.

2.3 Operational Performance of Pharmaceutical Firms

Operational performance includes cooperation with customers while providing services, presale services, quality of the products and services, products support, volume flexibility, speed of the delivery or delivery time dependence of the delivery are all included in operational performance. On the basis of these indicators one can measure the effectiveness and operational performance of the firms [11].

2.4 Theories and Contributions

There are number of theories which were applied previously in SCII and operational performance. Some of the most useful theories are given below in the chart.

Combination of theories such as theory bridging could be useful for investigating the subject matter. Theories mentioned above in the Table 1 are dominant theories which are used and applied by the researcher to support their studies in supply chain literature. Resource based view and resource orchestration theories are most dominating theories. It is believed that only
sufficient resources are not able to give organizations a competitive advantage, orchestration and managerial acumen is essential. Therefore the current study contributed towards SCII and operational performance with intervening role of information leakage. Resource orchestration theory claimed that generating better results and leveraging capabilities on the other side creating barriers for competitors to enter in competition. This may lead to high operational performance and competitive advantage [11].

**Chart 1. Theories with Author Names**

| Author Names               | Theories                                      |
|----------------------------|-----------------------------------------------|
| Tseng & Liao 2015          | Resource Based View (RBV)                     |
| Wong et al 2015            | Organizational information processing Theory  |
| Liu et al 2016             | Resource Orchestration theory, RBV Theory     |
| Brugue camara et al 2016   | Knowledge management & Social Capital Theory  |
| Qi et al 2017              | Resource dependence theory & organizational capability |
| Lu et al 2018              | Transaction cost, contingency & Social Exchange theory |
| Wei et al 2019             | Agency theory                                 |

*Source: Vafaei-Zadeh et al., (2020).*

**Table 1. Measurement model**

| Variables                  | Items  | Loadings | AVE  | CR   | Alpha |
|----------------------------|--------|----------|------|------|-------|
| Supply                     | SCII1  | 0.702    |      |      |       |
| Chain                      | SCII2  | 0.753    |      |      |       |
| Information                | SCII3  | 0.796    | 0.591| 0.878| 0.826 |
| Integration                | SCII4  | 0.808    |      |      |       |
|                            | SCII5  | 0.778    |      |      |       |
| Accidental Information     | IIL1   | 0.777    |      |      |       |
| Leak                      | IIL2   | 0.796    | 0.621| 0.867| 0.796 |
| Intentional Information    | OPPF1  | 0.840    |      |      |       |
| Leak                      | OPPF2  | 0.781    |      |      | 0.897 |
| Operational Performance    | OPPF3  | 0.781    | 0.618| 0.919|       |
| of Pharmaceutical Firms    | OPPF4  | 0.774    |      |      |       |
|                           | OPPF5  | 0.804    |      |      |       |
|                           | OPPF6  | 0.759    |      |      |       |
|                           | OPPF7  | 0.763    |      |      |       |

SCII> supply chain information integration; Ail> accidental information leakage; Iii> intentional information leakage; OPPF> Operational Performance of Pharmaceutical Firms

**Fig. 1. Theoretical framework**
2.5 Hypotheses Development

Previous studies have reported that supply chain is responsible for increasing the operational performance of the firms but this relationship was found weak, therefore there is immense need to introduce some intervening variables which could play their effective role in increasing the relationship between supply chain and operation performance. If the correct information between partners is shared it could enhance the operational performance [12]. Information about stakeholders, suppliers, employees, creditors, must be shared accurate and correct [13]. It will reduce the production and transportation expenses. Therefore the following hypotheses are developed:

H1: information leakage (accidental & intentional) has direct impact on operational performance.

H2: Supply chain information integration has direct influence on information leakage.

H3: Supply chain information integration directly impact operational performance.

Firms want to achieve their objectives on time and for this purpose the firms develop and formulate the policies. In order to achieve objectives and implement the strategic policies supply chain plays important role. Information leak is defined as providing information beyond the boundaries of organizations. This is unethical and unlawful. This leak of information might be sometimes accidental or intentional. Accidental leak of information is due to negligence of human behavior and employees while intentional leak of information has several reasons might be no control over the employees, conflicts among employees and management of the pharmaceutical firms may lead to this situation. During meetings employees leak the confidential data to their partners which they were not supposed to do so [14]. While intentional leak of data and information might harm the reputation of firm and unauthorized person can use it for illegal purpose [15]. This intentional leak might be the result of dissatisfaction from job, no trust, politics and power, no promotion chances, unattractive salary packages etc. This has negative impact on operational performance firms could not attain competitive advantage over their competitors. Therefore, on the basis of above discussion it is hypothesizes that:

H4: information leakage has mediating role between supply chain information integration and operational performance.

2. MATERIALS AND METHODS

The survey approach was used. Primary data also called cross-sectional data was collected. Population of the study was pharmaceutical firms and unit of the analysis was organizations. Managers, senior managers, area managers, territory and filed managers were contacted and selected as sample of the study. Non-probability convenience sampling technique was used. Total 200 questionnaires were distributed out of which 150 completed questionnaires were used in the analysis yielding 75% response rate. Majority of the respondents were men [75%] while 25% female participants also participated in the survey. All the scales were adopted from previous studies and measured in seven point scale 1-7 (strongly disagree to strongly agree) by Ritala et al., Vafaei-Zadeh et al., Wong et al., Yu et al., [16-21, 22-24]. Supply chain information integration (SCII) has five items; the items were related with "exchange of information with trading partners", exchange of information with trading partners is timely, accurate and standardized". Information leakage has four items and items were asked from respondents to know about “employee accidently leak business critical information to partners, and employee accidentally leak business critical information in other situation such as code committees, fairs, exhibitions etc". While operational performance of pharmaceutical firms has seven items. Items were related with cooperation with customers, delivery time, delivery dependability, pre sale customer services, volume flexibility". PLS-SEM was used [13]. It is second generation software to deal and handle non normal and small data sets. Measurement model and structural models were developed and tested. Measurement model consist of loadings must be >0.7, average variance extracted AVE>0.5, composite reliability >0.7 and Cronbach alpha >0.7.

3. RESULTS AND DISCUSSION

Table-1 revealed the results and findings of measurement model. It is evident that all factor loadings are >0.7, all AVE values are higher than threshold 0.5 and composite reliability also met the cut off level i.e. 0.7 and cronbach alpha also >0.70. It is assumed that the scales used in the study are found reliable and valid because convergent validity and reliabilities are established.

Table 2 and Fig. 2 revealed the direct and indirect impact of structural model. Hypotheses
were tested using bootstrapping at 5000 resample run rate. For first hypotheses $\beta=0.360$, $t=4.80$, $p<.01$, and there is no zero between BCIUL and BCILL it means one unit change in information leakage could be responsible for 36% change in operational performance of pharmaceutical firms. In addition second hypotheses $\beta=0.745$, $t=12.01$, $p<.01$, and no zero exist between BCIUL and BCILL one percent change in supply chain information integration could be responsible for 74.5% change in information leakage thus $2^{nd}$ hypotheses also substantiated. For $3^{rd}$ hypotheses $\beta=0.84$, $t=20.09$, $p<.01$ explained that 86.4% change occurs in operational performance if pharmaceutical firms focus more on their supply chain information integration. 4th hypotheses $\beta=0.267$, $t=4.68$, $p<.01$ shows that beta value is reduced with inclusion of information leakage, thus it is stated that leak of information whether accidental or intentional has reduced the operational performance of pharmaceutical firms. This $H_4$ is also substantiated. $R^2=0.813$ coefficient of determination. It means that supply chain information integration and information leakage explained variance of 81.3% upon operational performance of pharmaceutical firms. Previous studies also explained the positive and significant relationship among supply chain information integration and operational performance [19-20]. The mediating role of information integration is also in line with the Vafaei-Zadeh et al [22-23].

4. DISCUSSION

The purpose of the existing study was to investigate the mediating role of information leakage between supply chain information integration and operational performance of pharmaceutical firms (OPPF). For this aim direct and indirect relationships were tested through bootstrapping in PLS-SEM. Four hypotheses were formulated. First hypothesis was to check the impact of information leakage on operational performance. It was found that there is positive and significant influence shown by information integration and information leakage and operational performance of pharmaceutical firms (OPPF)

![Fig. 2. Structural mediation model for operational performance of pharmaceutical firms](image)

All numbers in above figure are above threshold $t$-stat $>1.96$

| Relationships | $\beta$  | S.E  | $T$  | $P$  | BCIUL | BCILL | Support |
|---------------|---------|------|------|------|-------|-------|---------|
| H1: IL $\rightarrow$ OPPF | 0.360   | 0.075 | 4.80 | 0.000 | 0.516 | 0.226 | Yes     |
| H2: SCI $\rightarrow$ IL | 0.745   | 0.062 | 12.01| 0.000 | 0.843 | 0.598 | Yes     |
| H3: SCI $\rightarrow$ OPPF | 0.864   | 0.043 | 20.09| 0.000 | 0.926 | 0.757 | Yes     |
| H4: SCI $\rightarrow$ IL $\rightarrow$ OPPF | 0.267   | 0.057 | 4.68 | 0.000 | 0.392 | 0.173 | Yes     |

SCI> supply chain information integration; IL>information leakage;; OPPF>Operational Performance of Pharmaceutical firms
leakage on operational performance. These results are consistent with the findings of Liu et al [17], argued that leak of information either accidentally or intentionally both have effect on operational performance of pharmaceutical firms. Operational performance might be reduced and competitors may take advantage of the information. Therefore H2 is accepted. Second hypotheses investigated the impact of supply chain information integration (SCII) on information leakage. It is evident from the results that SCII significantly predicted leak of information. It means that while collaborating with trading partners at exhibition, code committees meetings etc employees might leak some important and confidential information. These findings are in line with the findings of Lu et al [18]. Hence H2 is substantiated. Results of 3rd hypotheses revealed that SCII has significantly predicted operational performance of pharmaceutical firms. It means that exchange of ideas, information, and expertise gives competitive advantage to firms by keeping confidential information as a secret. Ti is the most dominant effect shown in the study. The findings are in line with Vafaei-Zadeh et al [21]. 4th hypotheses explained the mediating effects of information leakage on supply chain information integration and operational performance of pharmaceutical firms. It is evident that with inclusion of mediator or intervening variable the relationship between predictor and criterion variables is reduced. This implies the complementary mediation effects Hair et al [13]. Findings of mediation got support from Vafaei-Zadeh [21-25] also reported the significant effects. It implies that leakage of confidential information may lead to increase cost, time, and compromise on quality of services and products, delay in delivery time, no cooperation with customers, and thus results in poor operational performance of the pharmaceutical firms. Hence H4 is accepted.

5. CONCLUSION

The findings revealed that there is significant mediating role of information leak on the relationship between SCII and operational performance. This theory investigated the theoretical framework with the lens of ROT and RBV. All the four hypotheses are accepted. The most dominant and important role played by SCII on operational performance followed by SCII and information leakage. The beta values explained that one percent change in SCII could positively bring change in operational performance and informational leakage. When we see the mediating results it is evident that by adding mediating variable the relationship among predictor and criterion is reduced. This means that leak of information has consequences and there are several complexities that need immediate action by the management of pharmaceutical firms. It is concluded that pharmaceutical firms has to strengthen the supply chain information integration mechanism in their firms so that while meeting with their partners no confidential information should be leaked and no harm is faced by the firms. This study has contributed in the theory of resource orchestration theory. Managers have to efficiently handle their information for their competitive advantage. The findings revealed that leak of information whether accidental or intentional is not good for the reputation of the pharmaceutical firms. Firms have to invest on the training of their employees and managers so that they may be able to keep the things confidential and help the firms to boost their operational performance. To the best of author’s knowledge this is the one the primary studies conducted in pharmaceutical sector.

PRACTICAL/managerial/policy making implication

The current study has some implications for management of the firms. The leakage of the firms’ secret has some risk associated with it the management has to keep its eagle vision on while dealing with supply chain partners. Managers have to monitor the activities while dealing with their supply chain partners. Information leak happened due to negligence of managers’ behavior. Practitioners can raise the importance of the SCII, information leakage and operational performance in seminars, conferences and workshops. Policy makers can implement strict encryption policy; it could reduce the chance of leak of important information.

LIMITATION AND FUTURE SCOPE DIRECTIONS

The study has few contributions as well as few limitations. The sample size used is small it is recommended that future studies may use big, longitudinal data or mix method data to have better understanding of subject matter. In addition the same model could be investigated by adding more mediators and moderators such
as trust in management, use of information technology and skills could play their effective role. The 3rd limitation is sector, the data was collected from pharmaceutical firms, one must be careful in generalizing the findings to other sector, thus future studies could apply the same model to other sectors as well.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

ETHICAL APPROVAL

It is not applicable.

CONSENT

Participants consent was taken before data collection and they were informed that data will be used for academic purpose also they can withdraw form study any time. Totally depend on the participant.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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APPENDIX I

Questionnaire/Scales Adopted in the Current Study

| Variables | Items | Authors |
|-----------|-------|---------|
| SCII      | Sci1: Our organization exchanges information with our trading partners electronically. Sci2: Our organization works with our trading partners electronically on cross-organizational business activities (e.g., coordinating the flow of goods in our supply chain). Sci3: Electronic information shared between our organization and trading partners is accurate. Sci4: Electronic information shared between our organization and trading partners is timely. Sci5: Electronic information shared between our organization and trading partners is standardized. | [21, 23] |
| IL        | All1: Our employees accidentally leak business-critical information to our partners. All2: Our employees accidentally leak business-critical information in other situations, such as professional fairs, exhibitions, code committees, and other formal or informal occasions, including during the employees’ free time. IlI1: Our employees leak business-critical information on purpose to our partners. IlI2: Our employees leak business-critical information on purpose in other situations such as professional fairs, exhibitions, code committees, and other formal or informal occasions, including during the employees’ free time. | [19, 21] |
| OPPF      | OP1: Customer Service Level. OP2: Overall Product Quality. OP3: Product Support. OP4: Delivery Dependability. OP5: Presale Customer Service. OP6: Delivery Speed. OP7: Volume Flexibility. | [24, 21] |

SCII> Supply chain information Integration; OPPF> Operational performance of pharmaceutical firms; IL> Information Leakage; All> Accidental information Leak; IlI> Intentional Information Leak

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