

# Supply Chain Risk Factors' Assessment in the Nigerian Pharmaceutical Industry

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## Abstract

The study assessed supply chain risk factors (SCRF) in the Nigerian pharmaceutical industry. Primary data were sourced for this study through a thematic questionnaire served on 300 randomly selected registered pharmacies. By means of bipolar semantic differential scales, respondents were assessed on semantic spaces, the probability of occurrence as well as projected impact of upstream, internal, and downstream supply chain risk factors. Data collected were analysed using probability-impact matrix, and other appropriate descriptive statistics. The results identified 18 risk factors in the Nigerian pharmaceutical supply chain. The risk factors with the greatest probability of occurrence was "excess stocking of products" (probability of 0.583, industry internal sector average probability was 0.492), followed by "increase in product prices by suppliers" (0.577, industry upstream sector average was 0.491). Risk factor with the greatest impact assessment was from the downstream; it was "failure to deliver products to customers" (4.453, industry downstream average was 4.112). The next was an upstream factor – "supplier product quality problem" (4.411, industry upstream average was 3.341). "Product expiration on the shelf" had the highest criticality rating (2.318), followed by "increase in product price by suppliers" (2.165), while "poor merchandising" (1.239) had the lowest criticality rating. With these findings, pharmaceutical firms in Nigeria are better equipped to manage and perhaps mitigate risk factors in their supply chain.

**Keywords:** Supply chain risk management, supply chain, probability, risk-impact matrix

## 1. Introduction

The pharmaceutical industry like any other industry relies on supplies to carry out its functions effectively. For this industry, the supplies are primarily drugs, nutraceuticals, medical materials and all other drug-related items that promote sound health for individuals and animals. Nutraceutical is a portmanteau of the words nutrition and pharmaceutical. The term is applied to products that range from nutrients, dietary supplements and herbal products, specific diets and processed foods such as cereals, soups, and beverages (Kalra, 2003). Hogerzeil (2006) stated that access to medicine, as a human right, is one of the main objectives of healthcare systems. Purchase of medications by customers and health-related institutions serve as the primary source of revenue to pharmaceutical organisations. Therefore, any good pharmaceutical supply chain should provide medicines in the right quantity, with the acceptable quality, to the right place and customers, at the right time and with optimum cost to be consistent with national healthcare systems. In Nigeria presently, the process of delivering genuine medications to the end user is not only long but also in many cases complicated. Such supply chain (SC) processes are prone to risks and uncertainties.

Companies are more than ever, exposed to a diversity of supply chain risks such as product counterfeiting, short product lifecycle, demand and supply volatility, growing regulatory complexity, etc. The pharmaceutical industry is just one of the many industries that have witnessed a remarkable change in their business environment in particular due to increased competitive pressure and the globalization of markets (Zsidisin, 2003; Wagner and Bode, 2009). A consequence of this reality of a relatively unsteady state of the world and an increased vulnerability of supply chain to disruptions is that organisations are compelled to tackle supply chain risks just as they do other business risks (Elkins et al., 2005). It is pertinent to note that any risk affecting the pharmaceutical supply chain, not only can waste healthcare resources but also threaten the nation's healthcare system and the patients' life by hindering access to quality medicines (Schneider et al., 2010). In addition, risks involved in the process of satisfying the end user must be understood, monitored and managed so as not to adversely affect the health of the populace. These risks are numerous and have varying levels of impact at different stages of the pharmaceutical supply chain. From the manufacturer to the retailer and down to the terminal consumer, different risks have different impacts on the supply chain efficiency.

In view of the issues raised above, this study made attempt to provide answers to the following questions: What are the risk factors present in the supply chain of the Nigerian Pharmaceutical industry? What are the chances that such risks will occur? In case they do occur, how critical will their impacts be, and which of the risk factors has highest criticality rating; thus, requiring more serious control efforts?

This study reviewed the concepts of supply chain, supply chain risks and probability risk-impact matrix. It identified upstream, internal and downstream risk factors in the Nigerian Pharmaceutical supply chain. In addition, the study determined the probability of occurrence and criticality of the risk factors with a view to prioritizing them to engender their mitigation and/or effective control.

## 2. Literature Review

### 2.1 Supply Chain (SC)

Hanaa (2013:201-210) defined supply chain as “a network of manufacturers and services providers that work together to convert and move goods from the raw materials stage through to the end user”. Those manufacturers and service providers are linked together through physical flow of materials, information and money (Bozarth and Handfield, 2006). According to Stevenson (2012) supply chain is the sequence of organisations – their facilities, functions, and activities – that are involved in producing and delivering a product or service to the final consumer. As can be seen from this definition, the sequence begins with basic suppliers of raw material and terminates with the final consumer of the product or service. The facilities may include warehouses, factories, processing centres, distribution centres, retail outlets and offices. Functions and activities include forecasting, purchasing, inventory management, information management, quality assurance, scheduling, production, distribution, delivery, and customer service. Activities in the supply chain that involve inbound and outbound flow of goods, services, cash and information constitute the logistics.

### 2.2 Supply Chain Risk (SCR)

Risk in the supply chain refers to uncertain or unpredictable events that can negatively affect supply chain functionality or profitability (Claypool et al., 2015). Bavarsad et al. (2014) and Tang (2006) defined supply chain risk as the uncertainty of the occurrence of an event that could affect one (or more) partner or link within the supply chain and that could influence (generally in a negative sense) the achievement of company's business objectives. In the view of Christopher and Lee (2008) risks in supply chains could be defined as a variation in the distribution of possible supply chain outcomes, their likelihood, and their subjective value. Decision theory underlines the negative consequences of risks and so do researchers in the field of SCRM, who associate SCR with chances of danger, loss, damage or any other undesired consequence (Wagner and Bode, 2008). Among most supply chain risk management (SCRM) scholars, SCR is associated with negativity and undesirable outcome. According to Claypool et al. (2015), some of the SCR include supplier reliability, quality problems, market/demand risks, manufacturing/production problems, capacity risk, strategic exposure risk, demand forecast risk, inventory management/stockout risk, outsourcing risk, etc.

### 2.3 Supply Chain Risk Management (SCRM)

Supply chain risk management can be defined as the process of developing methods and models to identify, assess and mitigate risks in supply chain in order to reduce the impact of the risks (Claypool et al., 2015). According to Jüttner, Peck and Christopher (2003), SCRM consists of four key management aspects: assessing the risk sources for the SC, defining the SC adverse consequences, identifying risk drivers or factors, and finally mitigating risks for the SC. Tuncel and Alpan (2010) announced that SC risk control involves risk identification, risks assessment, risk management and risk monitoring as the four steps. Managing supply chain, according to Stevenson (2012) involves identifying the risks, assessing their likelihood of occurring as well as potential impact, prioritizing the risks and then developing strategies to manage those them. Abolghasemi et al. (2015) opined that all the proposed process are seeking one goal although they have different implementation stages.

Munyuko (2015) associates SCR with randomness, losses and adverse impact. He is of the opinion that most organisations do not have risk management programs where they identify the potential risk within their supply chain and come up with contingency plans to mitigate them. Vikulov and Butrin (2014) propose a classification that allows identifying risks in specific links of supply chains. They identified risk categories at major supply chain link and business processes thus: (a) suppliers (Delivery, schedule, Prices, Non-delivery/Short-delivery, Poor-quality), (b) transportation (Damage of goods in transit and loss of goods in transit), (c) warehousing (damage of good during storage, changes in taxes and other costs of warehousing), (d) production (quality problems, overproduction, disruptions due to equipment failure, and disruptions due to procurement issues), and (e) marketing (volatile demand, wrong promotion strategy, and failure of networking sales). The items in the brackets are the compositions of the risk factor which they highlighted.

According to Behnezhad et al. (2013) and Abolghasemi et al. (2015) the ultimate goal of supply chain risk management process is to protect the integrity of organisation against the unfortunate events and their consequences in order to gain maximum power and ability to make as much as profit as possible. The lack of effective risk management has caused many organisations to suffer untold loss. For example, Apple and Ericsson suffered over 400 and 300 million euros losses respectively due to poor risk management (Norman and Jansson, 2004).

According to Abolghasemi et al. (2015), Supply Chain Council members have reported that less than half of enterprises have established metrics and procedures for assessing and managing supply [chain] risk. In addition, organisations lack sufficient market intelligence, process, and information systems to effectively predict and mitigate supply chain risks he concluded. This expression agrees with the opinion of Christopher et al. (2011: 68) who said, “Most companies do not have a structured management and mitigation system covering

supply chain risk". Hendrick, Singhai and Zhang (2009) see this as one of the reasons why desired performance is not achieved in supply chains.

#### 2.4 Probability-Risk Matrix

Risk components usually manifest themselves in two forms – Hazards or Harms. Hazards represent the potential source of a harmful event or the cause. Harms are the resulting damages to products, persons, systems, or the environment (the effect). Risk is essentially *cause* and *effect* on a defined scale. Organisations, when trying to quantify these two parameters often consider two metrics namely: severity (impact) and frequency (likelihood or probability) of occurrence (Lozier, 2011). With these metrics, a number of numeric, qualitative (verbal) or both scales can be developed to measure hazard and harm. The numeric scales (1-improbable, 2-seldom, 3-occasional, 4-likely, 5-frequent), and qualitative/verbal (negligible, minor, moderate, critical, catastrophic) are examples of scales that could be developed. When these are graphed with frequency placed on the vertical (ordinate) axis, and severity on the horizontal (abscissa) axis, the result will be a matrix that highlights the risk zones using the product of the numbers on the axes. Dani (2009), and Ouabouch and Amri (2013) suggested a formula that calculates the variable - criticality level ( $C_i$ ) of a risk factor, based on the product of averages of the probability ( $P_i$ ) and impact ( $M_i$ )

$$C_i = P_i * M_i \dots\dots\dots (1)$$

When a risk matrix is developed, it has to be vetted by putting it through the organisation's past historical experiences to see the level of correlation between the risk level by the matrix and reality. This retrospective test or real world honing will help in determining the level of tweaking or fine-tuning the matrix will require before it becomes a reliable bases for decision-making on risk.

### 3. Methodology

Cross sectional survey design was adopted for the study. This generated primary data through the use of a thematic questionnaire. The study covered the downstream sector of the pharmaceutical industry particularly the retail pharmacies registered by the Pharmacy Council of Nigeria. The sample size for the study was 300 randomly selected retail pharmacies in the country. Convenience sampling was used to select the respondents from staff in the category of Directors/Pharmacists, Manager/Pharmacists, Superintendent/Pharmacists, Pharmacists, and Doctors who are employee of the firms being studied. As advocated by previous studies in SCRM, in this study SCR will be grouped into three: Upstream, Internal and Downstream supply chain risks (Ouabouch and Amri, 2013; Vikulov and Butrin, 2014). Upstream supply chain risks factors (SCRf) were: failure of suppliers to deliver products, untimely delivery of products by suppliers, increase in product prices from suppliers, supplier products quality problems. Internal SCRf were: product expiration on shelves, inventory shortage of new items, inventory mismanagement, poor product knowledge, excessive stocking, low stocking, poor merchandizing, poor customer service by employees, outage of IT/computer systems, and accidental product damage. Downstream SCRf were: unexpected consumer demand fluctuations, decline in market prices, untimely delivery of products to customers, and failure to deliver product to customers. Using bipolar semantic differential scales, respondents made an assessment on a semantic space (with 0.1 - 1.0) the probability of occurrence and projected impacts of the above risks factors. The bipolar adjectives used for the probability assessments were from *never* to *always*, and for impact of the risk *no consequence* to *very serious consequence*. The severity or criticality of the risk factor is calculated using equation (1) above:

Criticality of risk factor ( $C_i$ ) = Probability of risk factor ( $p_i$ ) x Impact of risk factor ( $M_i$ )

Data were processed using Microsoft Excel and appropriate descriptive statistics.

### 3. Results and Discussion of Findings

#### 3.1 Response Rate, Respondents' Characteristics and Classification

Three hundred (300) copies of the instrument were distributed but two hundred and eighty (287) properly completed copies were retrieved. This yielded a response rate of 95.7%.

From Table 1, it is evident that all the respondents are pharmacists and over 97% hold a minimum of first degree (B. Sc.) in the discipline. Over 42% has worked for a minimum of one year in the supply chain of the Nigerian pharmaceutical industry and over 49% has at least six months working experience in the chain. The respondents are knowledgeable persons in the industry.

**Table 1. Respondents' Characteristics and Classification (N = 287)**

<b>Educational Qualification</b>	B. Sc.	M. Sc.	Ph. D	Fellowship	Total
	144(50.17%)	137(47.74%)	2(0.70%)	4(1.39%)	287 (100%)
<b>Professional Status</b>	Pharmacist 217 (75.61%)	Superintendent/ Pharmacist 33(11.50%)	Manager/ Pharmacist 13(4.53%)	Director/ Pharmacist 22(7.67%)	Doctor 2(0.70%)
<b>Work Experience</b>	No Response 4(1.39%)	Less than 6 months 21(7.32%)	6 to 12 months 141(49.13%)	1 to 3 years 81(28.22%)	4 years or more 40(13.94%)

### 3.2 Supply Chain Risk Factors and their Probabilities

Table 2 presents eighteen supply chain risk factors present in the supply chain of the Nigerian pharmaceutical industry along with their probability of occurrence as assessed by the respondents. Each of the Upstream and Downstream sectors of the chain has four risk factors while the internal sector has ten risk factors. Upstream Risk Factors (suppliers failure to have or deliver products, untimely delivery of products by suppliers, increase in product prices by suppliers, supplier products' quality problems), Internal Risk Factors (product expiration on shelves, inventory mismanagement, poor product knowledge by branch staff, excess stocking, low stocking, inventory shortage of new items, poor merchandising (product arrangement), poor customer service by branch staff, IT/computer related problems, accidental product damage), and Downstream Risk Factors (unexpected consumer demand fluctuations, decline in market prices (after purchasing from suppliers), untimely delivery of products to customers, failure to deliver product to customers) The most probable risk factor in the upstream, internal and downstream sectors are "increase in product prices by suppliers" (with probability assessment of 0.5763), "excess stocking" (0.5833), and "unexpected consumer demand fluctuations" (0.4909) respectively. The most probable risk factor in the chain is "excess stocking" which has a probability rating of 58.33%. On the average, the sector in the supply chain with most probable risk factor is the internal sector with average probability assessment of 49.19%. This value suggests that on the average, the chance of occurrence and non-occurrence of those ten risk factors in the internal sector of the chain is approximately equally likely.

### 3.3 Impact of Risk Factors

Table 3 reveals the level of impact each risk factor can create according to the respondents' assessments. "Failure to deliver product to customers" – a downstream sector risk factor - created the greatest impact (with assessed value of 4.453 and a rating of "serious consequence") in the chain. The downstream sector had the greatest average impact (assessed to be 4.3728). The risk factor with the second greatest impact is "supplier product quality problems" – an upstream risk factor – with an impact assessment of 4.4111 and a rating of "serious consequence". Each of the four risk factors in the downstream sector of the chain has impact rating of "serious consequence".

### 3.4 Criticality of Risk Factors

Table 4 shows the probability, impact and criticality values of the supply chain risk factors. "Product expiration on the shelf" - an internal risk factor - has the highest criticality value of 2.318 and it is followed by "increase in product prices by suppliers" with a criticality value 2.163 (see Figure 1). "Poor customer service by firm staff" comes third with criticality value of 2.204.

Table 5 presents the eighteen risk factors in the Nigerian pharmaceutical supply chain in a descending order of criticality. This table can be useful to the industry in prioritising risk management and control. "Suppliers' failure to deliver product to customers" has the highest impact (see Table 3) but the lowest criticality of 1.355 (Table 5).

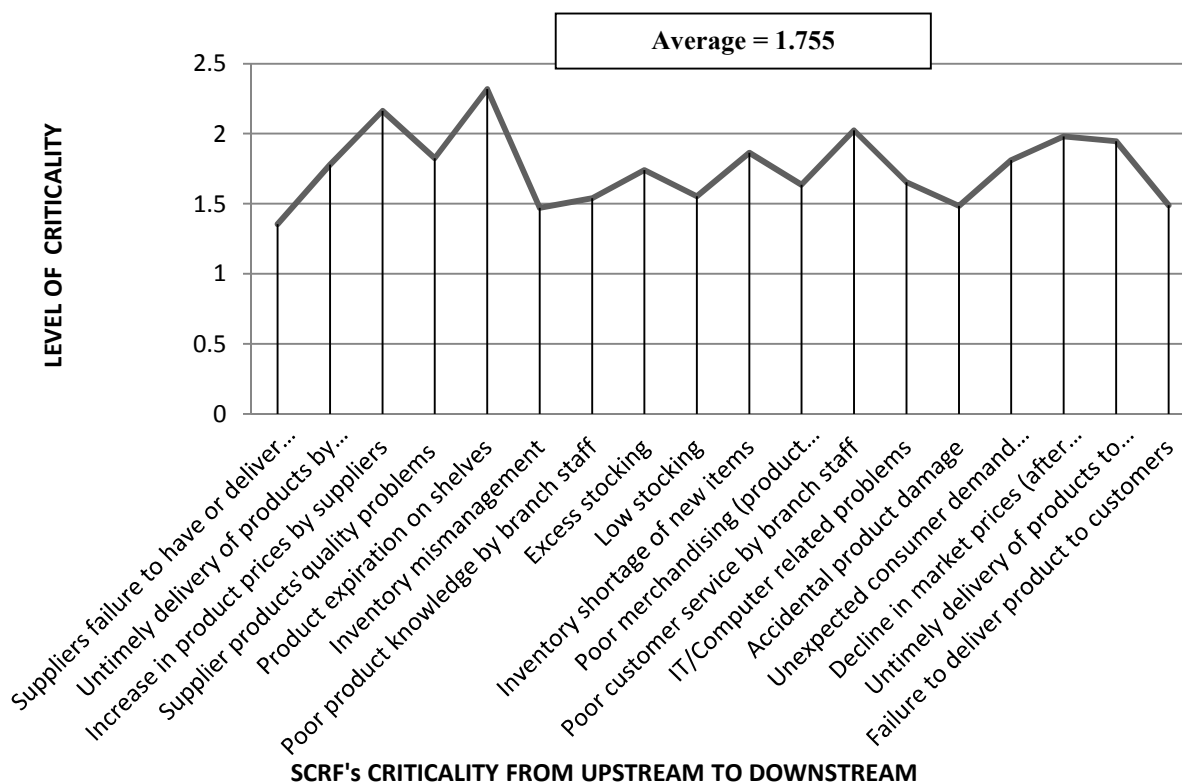


Figure 1. Criticality of Nigerian Pharmaceutical Industry Supply Chain Risk Factors

### 3.5 Prioritizing the SCRFs

Table 5 presents the risk factors in descending order of criticality or severity. Each of the first three factors on the table has a criticality value above two (2). The factors are: product expiration on shelves (2.318), increase in product prices by suppliers (2.163), and poor customer service by branch staff (2.024). From Table 4, one observes that these factors also have high probability of occurrence and high impact as well. These factors are IR1, UP3 and IR8 (IR refers to Internal risk, UP is for upstream risk), they are in the red region of the probability risk matrix – a clear indication that they require careful management and control. The other factors may similarly be investigated.

The risk matrix – Figure 2 - shows the overall picture of the supply chain risk assessment factors in the Nigerian Pharmaceutical supply chain with the probability increasing from left to right and moving towards the upper right corner (red zone), indicating the level of criticality of the supply chain risk factors.

As shown in Figure 2, “failure to deliver product” (DR4) can be considered as the most probable risk factors, while “product expiration on shelf” (IR1) and “increase in product prices by suppliers” (UP3) can be considered to have the greatest impact. However, “supplier products quality problems” (UP4), “untimely delivery of product to customers” (DR3) and “suppliers’ failure to deliver product to customers” (DR4) have higher probability of occurrence, but the impact tends to be moderate. The highest probability was observed in “failure to deliver product” (DR4), while the internal risk factors had the least criticalities. Factors that are located in top right corner or the red area of the matrix are those with very high criticality (high probability and high impact) such as IR1 and UP3. A number of the factors are in this region or very close to it – a clear indication of the severity of risk factors in the Nigerian Pharmaceutical Supply Chain.

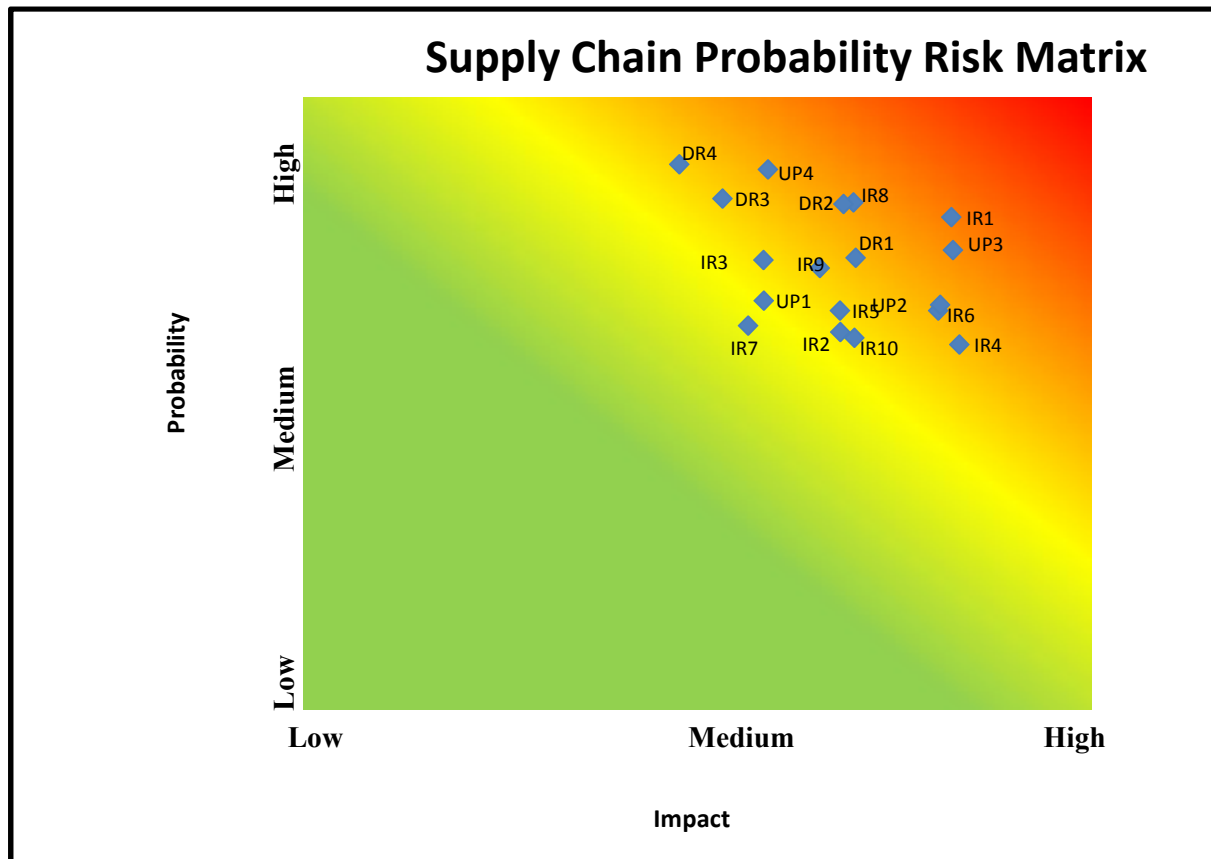
**Table 5. SCRFs in Descending Order of Criticality**

Risk Factor	Criticality
Product expiration on shelves	2.318
Increase in product prices by suppliers	2.163
Poor customer service by branch staff	2.024
Decline in market prices (after purchasing from suppliers)	1.981
Untimely delivery of products to customers	1.946
Inventory shortage of new items	1.863
Supplier products' quality problems	1.826
Unexpected consumer demand fluctuations	1.811
Untimely delivery of products by suppliers	1.780
Excess stocking	1.740
IT/Computer related problems	1.653
Poor merchandising (product arrangement)	1.636
Low stocking	1.553
Poor product knowledge by branch staff	1.540
Failure to deliver product to customers	1.488
Accidental product damage	1.484
Inventory mismanagement	1.470
Failure to deliver product	1.355

Nigerian pharmaceutical industry sources her pharmaceuticals through importation. Thus the availability of products from importers can be a source of risk. However, the findings reveal a relatively low criticality (**1.355**) for availability of products from suppliers. Product expiration on shelves (**2.318**) is the most grave. This severity may originate from three major factors - consumer demand fluctuations, inventory mismanagement and poor product knowledge. Another risk factor that displayed a high criticality is the increase in product prices by suppliers (**2.163**). This did not come as a surprise considering the fact that majority of drug products are imported and the naira exchange rate has experienced a high level of volatility in recent years. Figure 2 above shows graphically that the SCRFs have the tendency to severely affect activities in the Nigerian Pharmaceutical Industry.

#### 4. Conclusion

The study identified supply chain risk factors (SCRF) present in the Nigerian pharmaceutical supply chain (NPSC), determined the probability of occurrence of those risks factors in the supply chain (SC), examined the level of impact of the risk factors; and measured the criticality (severity) of those SCRF with a view to prioritizing them. Eighteen risk factors or risk drivers were identified to be present in the Nigerian Pharmaceutical Industry Supply Chain. This study revealed that the risk factors with the greatest probability of occurrence were excess stocking of products, and increase in product prices by suppliers; while risk factors with the greatest impact assessment were failure to deliver products to customers, and supplier product quality problem. Product expiration on the shelf had the highest criticality rating, followed by increase in product price by suppliers, while poor merchandising had the lowest criticality rating. With these findings, pharmaceutical firms in Nigeria are better equipped to manage and perhaps mitigate risk factors in their supply chain. In their operations, firms in the pharmaceutical industry are exposed to risks that are very critical. The study underscores the need for pharmaceutical firms in Nigeria to promptly develop risk management programs if this is not already in existence. This step engenders effective management and/or mitigation of supply chain risks.



**Key:** DR4 means fourth downstream risk factor; IR1 means first internal risk factor; and UP3, third in the list of upstream risk factors in the same Table 4. The same applies to the other entries in Figure 2.

**Figure 2. Supply Chain Probability Risk Matrix**

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**Table 2. SCRF and their Probability Values (N = 287)**

Risk Factors	Probability Assessment (p) and Frequency (F)										Probability (p) Value = $\frac{\sum P \times F}{N}$
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	
Suppliers failure to have or deliver product	63	45	40	17	44	16	21	16	18	7	0.406
Untimely delivery of products by suppliers	19	15	26	22	79	27	40	26	22	11	0.546
Increase in product prices by suppliers	11	20	18	20	80	25	45	28	20	20	0.576
Supplier products' quality problems	40	47	55	18	52	18	25	18	10	4	0.414
<b>Upstream Risk Factors</b>						<b>Average Probability = 0.486</b>					
Product expiration on shelves	26	26	30	26	17	21	29	51	51	10	0.576
Inventory mismanagement	44	33	30	31	25	43	10	50	19	2	0.477
Poor product knowledge by branch staff	50	35	32	60	22	50	6	24	5	3	0.409
Excess stocking	30	21	36	32	17	19	11	8	104	9	0.583
Low stocking	44	33	30	31	25	43	10	50	19	2	0.477
Inventory shortage of new items	33	8	44	38	22	24	8	12	95	3	0.566
Poor merchandising (product arrangement)	60	30	41	23	52	55	8	11	4	3	0.396
Poor customer service by branch staff	35	32	48	37	18	12	4	90	9	2	0.489
IT/Computer related problems	55	18	36	39	23	57	12	10	30	7	0.459
Accidental product damage	35	32	48	37	18	12	4	90	9	2	0.489
<b>Internal Risk Factors</b>						<b>Average Probability = 0.492</b>					
Unexpected consumer demand fluctuations	11	8	28	126	32	22	18	13	18	11	0.491
Decline in market prices (after purchasing from suppliers)	48	22	38	19	22	25	88	12	7	6	0.480
Untimely delivery of products to customers	62	40	42	22	77	14	10	10	5	5	0.373
Failure to deliver product to customers	89	57	35	26	21	14	16	17	10	2	0.334
<b>Downstream Risk Factors</b>						<b>Average Probability = 0.419</b>					

Key: F = Frequency, p = Probability value



**Table 3. Downstream, Internal and Upstream Risk Factor Impacts (N = 287)**

	Risk Factors	Impact(W) and Frequency(F)					Impact Value	Rating	Criticality (P x I)
		NC	LC	CC	SC	VSC			
Upstream Risk Factors	Suppliers failure to have or deliver product	10	24	154	56	43	3.342	CC	1.355
	Untimely delivery of products by suppliers	5	17	194	41	30	3.258	CC	1.78
	Increase in product prices by suppliers	4	10	62	188	23	3.753	SC	2.163
	Supplier products' quality problems	7	9	27	60	184	4.411	SC	1.826
<b>Upstream Risk Factors</b>		<b>Average Impact = 3.691</b>							
Internal Risk Factors	Product expiration on shelves	9	7	31	161	79	4.024	SC	2.318
	Inventory mismanagement	14	24	188	46	15	3.084	CC	1.47
	Poor product knowledge by branch staff	15	15	51	174	32	3.673	SC	1.54
	Excess stocking	18	120	32	83	34	2.983	CC	1.74
	Low stocking	12	26	149	76	24	3.258	CC	1.553
	Inventory shortage of new items	11	19	168	48	40	3.293	CC	1.863
	Poor merchandising (product arrangement)	6	16	35	106	124	4.136	SC	1.636
	Poor customer service by branch staff	9	13	36	99	130	4.143	SC	2.024
	IT/Computer related problems	15	18	54	178	22	3.606	SC	1.653
	Accidental product damage	15	35	178	42	17	3.038	CC	1.484
<b>Internal Risk Factors</b>		<b>Average Impact = 3.5234</b>							
Downstream Risk Factors	Unexpected consumer demand fluctuations	22	55	20	83	107	3.690	SC	1.811
	Decline in market prices (after purchasing from suppliers)	10	16	37	88	136	4.129	SC	1.981
	Untimely delivery of products to customers	10	22	24	83	148	4.174	SC	1.946
	Failure to deliver product to customers	9	8	35	27	208	4.453	SC	1.488
<b>Downstream Risk Factors</b>		<b>Average Impact = 4.112</b>							

Key: NC = No Consequence; LC = Little Consequence; CC = Considerable Consequence; SC = Serious Consequence; VSC = Very Serious Consequence  
Code: NC = 1; LC = 2; CC = 3; SC = 4; VSC = 5

**Table 4. SCRF Probability, Impact and Criticality Values**

	Risk Factors	Probability(p)	Impact(I)	Criticality (=)
Upstream Risk Factor	Suppliers failure to have or deliver product	0.406	3.342	1.355
	Untimely delivery of products by suppliers	0.546	3.258	1.780
	Increase in product prices by suppliers	0.576	3.753	2.163
	Supplier products' quality problems	0.414	4.411	1.826
Internal Risk Factors	Product expiration on shelves	0.576	4.024	2.318
	Inventory mismanagement	0.477	3.084	1.470
	Poor product knowledge by branch staff	0.409	3.673	1.504
	Excess stocking	0.583	2.983	1.740
	Low stocking	0.477	3.258	1.553
	Inventory shortage of new items	0.566	3.293	1.863
	Poor merchandising (product arrangement)	0.396	4.136	1.636
	Poor customer service by branch staff	0.489	4.143	2.024
	IT/Computer related problems	0.459	3.606	1.653
Accidental product damage	0.489	3.038	1.484	
Downstream Risk Factor	Unexpected consumer demand fluctuations	0.491	3.690	1.811
	Decline in market prices (after purchasing	0.480	4.129	1.981
	Untimely delivery of products to customers	0.373	4.174	1.946
	Failure to deliver product to customers	0.334	4.453	1.488
	Average Values	0.474	3.750	1.755

Criticality = Probability (p) x Impact (I)