

Implementation Of Information Technology In The Us Chemical Industrial Sector

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Abstract:

Information technology in chemical industry is the application of digital tools and technologies to support the improvement of operations, processes and values chains of businesses in the chemical industry. This paper examine the implementation of information technology in the US chemical industrial sector. Data was collected through qualitative and quantitative methods. Questionnaires were distributed to 20 companies to complete the survey which were then subjected to analysis. The result of the study shows that the rate of information technology use in US chemical industry is frequently used which was strongly agreed (90%) to by the majority of respondents compared to 10% who disagreed it was rarely used. Efficiency improvement is agreed (50%) to as the major benefits of information technology adoption in US chemical Industry. High costs (30%) which was strongly agreed to, was however regraded as the major challenge facing the implementation of Information technology in chemical sector in US. For the Information Technology implementation factors in chemical industries, Cost savings (50%) was strongly agreed to as the major factor. In conclusion, implementation of Information Technology has led to improve efficiency and productivity enhancement in the US chemical industrial sector.

Date of Submission: 03-06-2024

Date of Acceptance: 13-06-2024

I. Introduction

The chemical industry are manufacturing processes that deals with products which occurred as a result of chemical reactions between organic or inorganic materials, extraction , separation or purification of a natural product, with or without the aid of chemical reactions; the preparation of specially formulated mixtures of materials, either natural or synthetic (Mesubi, 2008). Most of the products obtained from chemical industry includes dyes, plastics, resins detergents, cosmetics etc. Mesubi (2008) pointed out that the global chemical industry is estimated to be valued at one and half trillion US dollars today with more than 70,000 commercial products while the total world trade in chemicals is placed at US\$ 400 billion which is about 10% of the value of the global trade.

Petrochemicals, (30%), pharmaceuticals (16.5%) and performance chemicals, (16%) has been regarded as the three largest sectors in the world chemical industry (Mesubi, 2008). The European Union (EU), the U.S.A and Germany has also been regarded as the three major countries globally with the largest manufacturers of chemicals. Other countries after the likes of the EU, USA and Germany in chemical manufacturing are Japan, France and United Kingdom, Italy and other Asian countries (Mesubi, 2008).

Rahman and Dewantara (2017) defined information technology as a technology that can exists in hardware or software to extract, obtain, transom, process, store and use data in a significant way to achieve quality information. Information technology in chemical industry according to Chemical Industries Association (CIA), (31) is the application of digital tools and technologies to the value chains of businesses in order to make an operation asset intensive. The use of this technologies creates rooms for the physical and digital worlds to be combined in order to bring about significant enhancements to performance and productivity (CIA, 2021). With information technology, modern and emerging digital technologies can be used to streamline workflows, improve operational efficiency, and sustainable, explore new business models and revenue streams, save time and costs, and meet customer expectations. Dewett and Jones (2001) posited the need for organizations to continuously adopt new information technologies (IT) if they want to sustain competitiveness, stay relevant and improve their productivity in current markets. However, many attempts at implementing information technologies have been an issue in US chemical industries as it has resulted in failures basically due to behavioral problems involving users, organizational characteristics and technological features of a particular technology (Edmondson *et al.*, 2001). The implementation of Information technology in the chemical industry is a great source of concern due to the benefits that could be easily derived from it. This tenets leads to the premise implementation of information technology in the US chemical industrial sector.

II. Information Technology Applications In Chemical Industry

The role of information technology cannot be disputed in the chemical industry. One of the application of IT in chemical industry has to deal with Enterprise Resource Planning (ERP) systems which are used for the management of inventory, track orders and also to optimize production planning (Alrubaishi *et al.*, 2017). The use of advanced analytics and simulation tools are also not left out as they are being put into use in terms of the deployment of production processes optimization, reduction in waste and increment in efficiency (Kougioumtzoglou *et al.*, 2019). Information technology is an essential component of the chemicals industry operations. Some information technology used in chemical industries also include business Intelligence and Analytics which is mainly use to analyze production data and to provide insights in order to help in proper decision-making (Morales *et al.*, 2019); the use of digital twins models through information technology are also in place to optimize production processes in real-time reduction in downtime and efficiency increment (Venancio *et al.*, 2021). The proper implementation of IT in chemical industries will help in the achievement of attaining greater efficiency and productivity.

III. Research Methodology

In this study, a mixed-methods approach was used combining qualitative and quantitative methods. The period for time horizon in this study is cross-sectional. In this study, the author used raw data in the form of questionnaires on chemical companies in USA. The sampling technique uses an intentional sampling method. The author distributes questionnaires 20 companies to complete the survey. For this study, surveys and questionnaires were used to gather data on Information technology infrastructure usage, and benefits of IT implementation. Descriptive statistics such as frequency distribution and percentage tables were used to analyze the objectives of the study.

IV. Results And Discussion

Table 1. Information Technology adoption and Usage in US chemical industry

| S/N | Variables | A | SA | D | SD |
|-----|---------------------------------------|------------------------------------|--------------------------------------|--------------------------------|--|
| 1. | Which IT system does your company use | Enterprise resource planning (60%) | Manufacturing execution system (20%) | Supply chain management (10%) | Customer relationship management (10%) |
| 2. | Level of IT adoption | Limited (10%) | Extensive (40%) | Neutral (30%) | None (20) |
| 3. | Departments that uses IT the most | Production (30%) | Quality control (30%) | Research and development (30%) | Sales and marketing (10%) |
| 4. | IT rate of use in the company | Rarely (10%) | Frequently (90%) | | |
| 5. | Purpose of IT usage in the company | Automation of processes (10%) | Data analysis and reporting (30%) | Communication (10%) | Customer management (50%) |

Source: Field Survey (2022)

Based on the results of the analysis, the profiles of respondents obtained were: based on the sexes of 16 men and 4 women; by age, the respondents were between 35 and 55 years old. The result obtained in this study in terms of the adoption of information technology and usage shows that 60% of the respondents agreed to the use of enterprise resource planning system in their various companies while 20% strongly agreed to manufacturing execution system followed by supply chain management (10%), and customer relationship managements (10%) which were disagreed and strongly disagreed to. The main reason why ERP is preferred could be as result of better decision making and improved efficiency in their various work compared to other IT system. Study by McKinsey Global Institute (2017) revealed that companies that invest in advanced technologies including ERP systems have higher productivity growth and also, they are more likely to achieve above average points. In relating this to this present study which centered on chemical industry, Gartner (2017) agreed with this present study where it was also reported that chemical industries that successfully implemented ERP will have significant improvements in supply chain management and regulation compliance. In addition to this, in the study carried by SAP (2016), the result of their findings shows that major chemical industry tends to reduce their inventory level by 20% and also improve its compliance with safety regulations by implementing an ERP system. Thus, this justifies the reason why most of the chemical industries respondents in this study tick ERP as the major IT systems used in their company's. Furthermore to the result obtained in this study, the result shows that 40% of the respondents strongly agreed that their chemical industries companies are extensively involved in IT adoption in the company while 10% believed it is limited in their various company's and 30% are neutral to this. In the result obtained from this study also, the result shows that the production (30%), quality control (30%) and research development (30%) departments are the three departments that are more involved in the use of IT in the chemical

industry. The result shows that sales and marketing department recorded the least (10%). The reason why these departments (Production, quality control and research and development) are more involved in the use of IT adoption in the chemical industries is due to the fact that IT system helps these departments to monitor some variables, improve quality and also, the chemical industry with the research department will help to constantly help to keep the company's abreast of constantly innovating and developing new products and process. The result obtained from this study tandem with that of Brabham and Suarez (2000) in their study on the role of IT in the chemical industry. The result of their study shows that IT was extensively used in the production quality and the research and developments departments for process monitoring and research data management compared to other departments. The last result obtained in table 1 shows the result obtained for Purpose of IT usage in the company. The result shows that data analysis and reporting (30%) recorded the highest while others also recorded 30% while communication recorded 20%. Automation of processes and communication recorded the least (10%).

Table 2. Benefits and Challenges of information Technology Adoption in US chemical Industry

| S/N | Variables | A | SA | D | SD |
|----------------------------------|--|------------------------------|--------------------------------|-----------------------------|----------------------------|
| 1. | Benefits of IT adoption | Efficiency improvement (50%) | Productivity enhancement (20%) | Cost savings (20%) | Others (10%) |
| 2. | IT adoption impacts on company's competitiveness | Negatively (10%) | Positively (70%) | Indifferent (20%) | |
| 3. | IT has impacts on company's operations | Yes (70%) | Don't know (20%) | No (10%) | |
| 4. | IT effect on employees roles | No change (20%) | Some changes (30%) | Significant changes (50%) | |
| Challenges of IT adoption | | | | | |
| | | A | SA | D | SD |
| 1. | Challenges | Technical difficulties (30%) | High costs (30%) | Insufficient training (20%) | Resistance to change (20%) |
| 2. | My company's strategies in solving these challenges | Trainings and seminars (50%) | Published materials (20%) | Nothing has been done (20%) | Personal meeting (10%) |
| 3. | Obstacle to successful IT adoption | Lack of resources (30%) | High Costs (50%) | Employee resistance (10%) | Limited IT expertise (20%) |

Source: Field Survey (2022)

Benefits and Challenges of IT Adoption result is shown in table 2. The result shows that efficiency improvement in chemical industries is the major benefits of IT adoption in this present study, while productivity enhancement (20%), cost savings (20%) and others (10%) followed by IT adoption in chemical industry has led to significant improvement when it comes to efficiency. Kotha *et al.* (2002) findings revealed that the use of IT in chemical industry significantly increased organizational productivity and efficiency. In addition to this, Donovan *et al.* (2001) also deduced in their findings that IT adoptions in the chemical industry lead to increased profitability with a significant impact on efficiency and productivity. From the result obtained in Table 2, the result also shows that IT adoption impacts on company's competitiveness is strongly agreed to (70%). This could be due to changes that has been felt and impacted in the course of the introduction and implementation of IT in chemical industry. The result on table 2 also present the challenges faced in the adoption of IT implementation in chemical industry. The result shows that technical difficulties and high cost (30%) respectively are the challenges affecting chemical industry in the implementation of IT in US. This result correlates with that of Kaya *et al.* (2004) findings where it was also gotten that high cost of implementation and maintenance of some IT systems is the major reason for refusal to implement IT in chemical industries. Kaya *et al.* (2004) further made it known that this costs are in millions. Thus, the reason for the slow adoption of Information technologies in chemical industries in US. Furthermore to the result obtained on table 2, the result for company's strategies in solving these challenges shows that 50% of the respondents agreed to the fact that in order to solve some of the challenges faced by their chemical industries, trainings and seminars (50%) has been the major measure put in place to solve this followed by published materials which was strongly agreed to by (20%) of the respondents of these chemical industries while 20% of the respondents disagreed to this that nothing has been done to solve the challenges attached to IT adoption in their chemical industries while 10% strongly disagreed to other options available going for personal meetings as the solution that has been put in place to stop this challenges.

Table 3. Information Technology implementation factors in chemical industries

| S/N | Variables | A | SA | D | SD |
|-----|--|---------------------------------------|------------------------------|--------------------------|----------------------------|
| 1. | Factor s influencing my companies adoption of IT | Trends in the chemical industry (25%) | Costs savings (50%) | Customers' demands (20%) | Government regulation (5%) |
| 2. | IT adoption relevance in my company | Relevant (20%) | Very relevant (40%) | Not relevant (10%) | Extremely relevant (20%) |
| 3. | IT primary driver in my company | IT department (60%) | Senior management (10%) | CEO (10%) | Operations Teams (10%) |
| 4. | My company's investment on IT | Increase investment (50%) | Maintain current level (40%) | Decrease investment (0%) | Undecided (10%) |

Source: Field Survey (2022)

Table 3 presents the result obtained for IT implementation factors to be considered in chemical industry in the United States., The result of the study shows that 50% of the respondents picked on cost savings as they strongly agreed to it as the major factors influencing the decision of their chemical industries to adopt IT in their industry while 20% disagreed to customers satisfaction and trends in the chemical industry respectively. The result also shows that the adoption of IT in their chemical industry work place is due to the relevance of IT with 40% strongly agreed that IT is very relevant in their chemical industry compared to 10% who disagreed that it is not. Also in table 3, the result shows that the primary driver of IT adoption in the chemical industry is the IT department (60%) followed by the senior management, CEO and operations team (10%) respectively. The last result on Table 3 shows that most (50%) of the chemical industry workers the questionnaire were shared to agreed that their companies are planning to increase investment in IT adoption while 40% strongly agreed that the chemical industry they worked for are only planning to maintain the current level of IT adoption in the workplace.

V. Conclusion

The paper objective was to identify the implementation of information technology in the US chemical industrial sector. From the study, the result obtained shows that information technology has a positive impact on IT adoption. The study also deduced that the implementation of Information Technology has led to improve efficiency and productivity enhancement. The study however also revealed that technical issues and high cost has been the major issue why the implementation of IT in chemical industry has not been fully achieved.

VI. Recommendations

Considering the enormous potential of information technologies and the challenges ahead, the following recommendations have been formulated for the chemical industry to ensure beneficial implementation of information technologies in the chemical sector in the United States.

- Drive in targeted investment is needed in information technologies with the aim to achieve circularity and sustainability targets
- There is need to demonstrate best practices and also communicate the benefits of applying information technologies for sustainability in the chemical sector through best practices
- Further study is also needed to examine the need to encourage broader adoption of Information technology in the chemical industry.

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