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The possibility of employing Intelligence Poka Yoke technology to reduce marketing risks: A study of the Iraqi oil refineries company

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Abstract
Business organizations today are working hard to detect and prevent errors in all their operations to ensure the provision of a product that meets the ambitions of customers on the one hand, and faces all types of risks that the organization may be exposed to, including marketing risks. From this standpoint, the primary goal of the study is the possibility of employing Intelligence Poka Yoke technology to reduce marketing risks through a study in the Iraqi North Refineries Company. In order to achieve this goal and address the problem of the study, the company was visited and based on the results of the field visits, a questionnaire form was designed to collect data and information, and the results of the questionnaire were analyzed using the statistical program SPSS and based on the results of the analysis. The study reached conclusions and recommendations that are appropriate for the current study.

Keywords: Intelligence Poka Yoke, marketing risks

Introduction
Poka-Yoke Intelligence technology is one of the means of detecting and predicting errors and defects in digital physical production systems. Poka-Yokes also play an essential role in achieving (nearly) zero defects or errors in complex production systems. This technology contributes to reducing Risks of all kinds, as the Poka-Yoke technology is of particular importance in this context, as it is concerned with focusing on preventing errors and improving quality in all stages of manufacturing and service. This technology is also based on the philosophy of prevention and continuous improvement, and focuses on analyzing processes and identifying potential weak points with the use of methods Innovative to avoid and correct errors.

Successful marketing requires achieving a careful balance between meeting customers' needs and reducing risks that may involve brand reputation and achieving profits. In this context, Poka-Yoke technology comes as an effective means of reducing marketing risks by improving the quality of products and services, which leads to improving customer experience and enhancing loyalty. For the brand and achieving competitive superiority in the market, therefore, the Poka-Yoke Intelligence technology has an effective role in understanding and addressing marketing risks. From this standpoint, the study consists of five axes. The first axis includes the study methodology, the second includes the Intelligence Poka Yoke technology, while the third contains On marketing risks, while the fourth deals with the field aspect, and the fifth section is devoted to conclusions and proposals.

Study methodology
Problem study: Most Iraqi organizations suffer from marketing risks as a result of the economic, social, political and societal conditions and weak infrastructure. This made these organizations think about finding a solution to this problem, and at the forefront of the solutions was the Intelligence Poka Yoke technology because of its importance in confronting risks and mistakes. Marketing, production, and other activities. The company sample of the study suffers from the problem of applying the Intelligence Poka Yoke technology due to weak financial allocation, lack of experience, and lack of sufficient

infrastructure. This is what makes all the mistakes and risks in that company exacerbate in all its formations, including the Baiji Refinery. To solve this problem, The aim of the study must be achieved, in addition to raising the following question: How can Intelligence Poka Yoke technology contribute to reducing marketing risks in the company sample of the study?

Objective study: The primary objective of the study is to address the problem of the study by analyzing how to employ the Intelligence Poka Yoke technology in order to reduce risks related to marketing, and from this objective we indicate the following sub-objectives:

1. Examining all the obstacles and problems facing the application of the Intelligence Poka Yoke technology requirements in the Northern Oil Refineries Company in Iraq, and addressing them by relying on both the theoretical and practical aspects of the study in a way that ensures the reduction of errors and risks in all administrative, production and service activities.
2. Assess marketing risks to indicate the most important reasons behind the occurrence of these risks and address them based on the Intelligence Poka Yoke technology.

Importance study: The importance of the study lies in several aspects related to providing an effective contribution to understanding how this technology affects marketing risks:

1. Determine the ways in which Intelligence Poka Yoke technology can be used to reduce marketing risks, enabling the company to effectively use technology to maximize its benefits in the field of risk management.
2. Helping the company improve the quality of products and services by applying Intelligence Poka Yoke technology, which reduces risks associated with quality and increases customer satisfaction.
3. Determine the cost associated with applying the Intelligence Poka Yoke technology and the benefits achieved as a result of its application, represented by reducing the marketing risks facing the company.
4. Helping the company achieve competitive superiority by improving operational efficiency and providing high-quality products or services by enhancing the spirit of innovation and development to explore new and creative uses of Intelligence Poka Yoke technology in the field of risk management and marketing.

Methodology and hypothesis study: The study adopted the descriptive analytical method because it is the approach closest to the content of the theoretical and field study. The study also relied on one hypothesis, the content of which is (there is a relationship with a significant effect of the Intelligence Poka Yoke technique in reducing marketing risks).

Intelligent Poka Yoke technology

The term "Poka-Yoke" has its origin in the Japanese language from the word "poka" (which means an unintentional mistake). The term Poka Yoke was invented in 1963 by engineer Shigeo Shingo, who works at Toyota, and the main idea behind the term is Poka Yoke is the design of the process in such a way that the possibility of errors occurring is almost impossible and at least they can be easily detected and corrected. In light of this, this topic is divided into several paragraphs:

Definition of Intelligent Poka Yoke: Both (Dudek & Szewieczek, 2009, 97) [5] define the traditional Poka Yoke technology as a technology to avoid human error at work by detecting a defect before it occurs or is about to occur, by relying on three basic functions: stopping And controlling, warning, and dealing with the matter according to the characteristics of the causes in a process, and (Joshi & Shinde, 2013, 46) [10] believe that it is a way to prevent errors by setting limits on how the process is carried out in order to force its completion correctly, and (Silva, *et al.*, 2018, 28) [4] shows A system is a tool or device that aims to prevent defects from occurring by checking all steps 100%, ensuring that the product moves to the next step without any possibility of failure.

As for the Intelligent Poka Yoke, he defined it (Romero, *et al.*, 2022, 597) [15] as a device that works with smart sensors, real-time data, and immediate feedback mechanisms to predict whether a human or automated error will occur based on task tracking and methods of predicting intent or Controls during the process to prevent error. Table (1) shows the difference between smart and traditional Poka Yoke.

Table 1: The difference between Intelligent and traditional Poka Yoke

Function	Traditional poka-yoke	Intelligent Poka-Yuke
Collection or group	Collect data manually Limited data collection Collect historical data	Automatic data collection (using smart sensors) Collect big data Real-time data collection
Participation	Delayed data sharing	Instant data sharing (IoT enabled)
Analysis	Basic data analysis tools Monitoring statistical processes Root cause analysis Correlation analysis	Big data analysis tools Machine learning Data extraction Predictive analysis
Optimization	Post improvement	Real-time optimization
Feedback	Real time feedback	Real-time feedback (IoT enabled) Rich feedback (with augmented reality enabled)

Source: Romero, *et al.*, 2022 [15], Intelligent Poka-Yokes: Error-Proofing and Continuous Improvement in the Digital Lean Manufacturing World. In IFIP International Conference on Advances in Production Management Systems.

Benefits of Intelligent Poka-Yuke: The application of the Intelligent Poka-Yuke technology achieves a number of benefits, the most important of which are (Bovo, *et al.*, 2020, 540) [3]:

1. **Information inspection:** In order to support and improve production processes, it is carried out using

smart sensors and computer vision systems, to detect all errors and defects (data and information), analyze them in a timely manner, and use them to discover possibilities for error prevention and improvement.

2. **Inspection at the source:** This is done by tracking tasks and predicting error in human-restricted procedural tasks (such as maintenance and assembly tasks) to provide them in real time and provide quick reactions if necessary to the technician or operator, as this inspection process relies on reality-based evidence systems. Enhanced, and in accordance with standard operating procedures so that errors can be prevented the first time or allow a human to fix the error as soon as it occurs. There are four ways to prepare and support the inspection process at the source:
   - **Virtual methods:** These are the methods represented by electromagnetic induction, laser imaging, the optical method, the electrical method, the ultrasound method, etc., which measure the workpiece without causing any deformation in it due to contact with it (Junaid, *et al.*, 2019, 109) [11].
   - **Assembly methods:** This method is based on computer vision to highlight specific parts or products to be easily assembled, to provide updated information about the product as well as the order status and delivery date in real time (Belu, *et al.*, 2015, 2) [2].
   - **Sequencing methods:** Such as picking by sequence and performing verification operations based on guidance systems based on augmented reality or based on smart sensors so that operators can assemble and distribute parts in the correct order (Mohamad, *et al.*, 2019, 3) [12].
   - **Ways to improve information:** Digital information systems based on mobile computing and smart technologies allow the correct information to be notified and delivered to the right person at the right time to solve problems or troubleshoot (Mohamad, *et al.*, 2019, 3) [12].

Steps to apply Intelligent Poka-Yuke technology: This technology collects error data in real time, analyzes it, and addresses its root cause by providing insights from simulations based on real data, which makes operations continuously improved (Joshi & Shinde, 2013, 46) [10]. From this standpoint, applying this technology requires several steps:

1. **Choosing sensor technology:** Documenting reality with the help of automatic data collection systems, such as smart sensors and computer vision systems, will lead to the availability of more reliable data compared to manual data, making it easier to detect and address errors (Romero, *et al.*, 2022, 599) [15].
2. **Error analysis:** Identifying and analyzing errors with the support of advanced analysis and forecasting tools capable of anticipating problems. The cause of these problems can be a system error or human error, as a system error is an error that usually occurs because of the system that controls the process, and if it is fixed, it will not The error appears again, but human error results from a lack of awareness of the situation. These errors must be analyzed using advanced error prediction techniques and their consequences explained. These consequences can affect humans, machines, equipment, and the environment, and even affect the general work system in the event of a human error. (Sembiring, *et al.*, 2019, 4) [17].
3. **Fault diagnosis:** It is the activity of troubleshooting and repairing faults by diagnosing faults resulting from the manufacturing process or errors that occur due to a defect in some production elements, based on two distinct categories: monitoring the condition of machine tools using sensory data and deducing machine tool faults through examination and analysis. Manufacturing data for components produced by a number of processes, diagnosing this requires the implementation of short- and long-term countermeasures with the help of advanced modeling and simulation techniques, to determine the root cause of faults (Bagshaw & Newman, 2002, 1066) [1].
4. **Eliminating losses:** This paragraph relates to eliminating steps that do not add value with the help of advanced technologies in real time, through redesigning and implementing tools to avoid error or repeating the defect with the support of advanced modeling and simulation tools (Romero, *et al.*, 2022, 599) [15].
5. **Verifying the change:** Verifying the validity of the change process is usually performed upon completion of product development or process development, to produce a product free of technical and human errors and before marketing the final product, as well as conducting the process of verifying the new change by monitoring the production process based on Automated controls for tracking tasks based on the Internet (European, 2016, 5) [7].
6. **Measuring results (improvement):** The goal of process improvement is to implement changes to eliminate defects by preparing a work breakdown structure, developing and testing possible solutions, and designing an implementation plan, as well as obtaining the necessary information to create and develop an action plan in order to improve the organization's performance and aspects Financial and customer relationship issues. Possible solutions should be presented to the business plan and implemented, and these solutions should be implemented in an experimental manner that confirms the validity and accuracy of the analytical work, allowing any corrections to be made before implementing the solutions on a large scale. This is done with the help of performance measurement systems based on the Internet of Things (Smętkowska & Mrugalska, 2018, 592) [18].

Marketing Risks

Concept of marketing risk: Marketing risk is defined as "devoting the organization's resources to high-return projects with a risk that may result in a high possibility of failure" (Yacoub and Haddoun, 2023, 108) [20], and (Tkachenko, *et al.*, 2019, 235) [19] believes that it The system that provides conditions and opportunities to avoid or prevent negative consequences related to the changing marketing environment, to reduce losses associated with the high level of regulatory, purchasing, pricing, marketing and innovative risks, and will create prerequisites to make marketing decisions reasonable, and (Hussein, 2021, 16) [8] indicates that it is a state of not Certainty and doubt that lead to price fluctuations and the inability to predict them, as the

state of price fluctuation arises due to changes that occur in supply and demand, and this matter cannot be controlled, and (Ostapchuk, *et al.*, 2023, 2) [13] explains it as the threat of loss or loss. Lack of income as a result of implementing decisions or specific types of production and sales activities, based on marketing recommendations, which leads to the occurrence of consequences that make it impossible to achieve goals at certain stages of marketing activities or in the field of marketing as a whole.

Main measures for managing marketing risks: There are many necessary measures that enable the company to avoid risks, which are (Tkachenko, *et al.*, 2019, 236) [19]:

1. Risk avoidance: means complete refusal to perform an action that could lead to a risky event.
2. Improving the level of risk: Reducing the probability of a risk event occurring by: creating reserves and stocks, external insurance or distributing risks.
3. Risk perception: means that the organization leaves a certain amount of risk and fulfills its obligations according to the risk event.

Types of marketing risks: The marketing process is exposed to many risks, the most important of which are:

1. **The risk of low demand:** Which relates to the demand for the product that the organization may fail to provide and supply to the market within a certain period of time, as well as with regard to changing customer tastes, needs, and desires (Yacoub and Haddoun, 2023, 109) [20].
2. **The risk of price policy:** It is represented by a sharp, unexpected drop in product prices, which causes financial losses to the organization, and a price war that the organization cannot face against competitors, and this causes many variables, including a change in the customer's taste towards the product, and these risks lead to difficulty adapting to Market prices (Hussein, 2021, 17) [8].
3. **Production risk:** It includes the risks of providing advanced products that are different from existing products in the market, and making them superior to competitors during the product's life cycle (Yacoub and Haddoun, 2023, 109) [20], as well as the risks of poor use of inputs due to the inability to purchase them, as well as poor transportation. The organization's modern technology.
4. **Brand reputation risk:** Most organizations have come to consider reputation to be the asset most at risk. However, this may stem from overestimating the true costs and perhaps the benefits associated with it. The determinants of reputation risk, the first is whether its reputation exceeds its true personality. The second is the extent to which external beliefs and expectations change, which can serve to widen or (less likely) narrow this gap. The third factor is the quality of internal coordination (Jadoua and Abdullah, 2023, 159) [9], so effective reputation risk management must begin with the recognition that reputation is a matter of perception among various stakeholders (investors, customers, suppliers, employees, regulators, politicians, non-governmental organizations, and the communities in which the company operates). (Eccles, *et al.*, 2007, 3) [6].
5. **Promotion risk:** Related to presenting an unreasonable marketing mix, repeated promotion, and potential risks resulting from promotion (Rutkauskas & Ginevičius, 2011. 7) [16].
6. **Distribution risk:** These risks result from the conflict of interests of intermediaries in distribution channels, the loss of suppliers and customers, as well as the lack of product inventory and the organization's inability to meet the market need, as well as the risks of shipping, transportation, and storage (Yacoub and Haddoun, 2023, 109) [20].
7. **Operations risk:** It takes the form of errors or problems before, during and after production. Also, a problem may appear in packaging, as well as in the nature of the product and its physical and chemical components (Yacoub and Haddoun, 2023, 109) [20].
8. **Competition risks:** Intense competition between local retail companies, and the entry of retail groups across national borders, which negatively affects marketing activity (Rutkauskas & Ginevičius, 2011. 7) [16].

The theoretical relationship between Poka Yoke technology and marketing risks: Intelligence Poka Yoke technology works to detect errors before they occur and treat them without human intervention. It is applied in various fields of healthy life, productivity, service, etc., including marketing activity, as this technology relies on Analyzing large amounts of data in order to help companies understand customer behavior and better identify market trends, which helps direct marketing efforts more effectively, as well as its role in reducing the risk of losing customers by building better relationships with them, which leads to better business continuity. In addition, this technology allows companies to analyze potential marketing risks and identify marketing activities that may be exposed to risks, which helps guide marketing strategies better.

Field aspect

The study sample company: North Refineries Company is one of the companies affiliated with the Iraqi Ministry of Oil. It is headquartered in Tikrit. It was founded in 1976. This company produces various types of products such as unleaded gasoline, jet fuel, white oil, gas oil, black oil prepared for export, and various types of oils. Such as motor oil for gasoline, motor oil for diesel, oils for sewing machines, transformers, asphalt products, sulfur, fuel gas, liquid gas, etc. This company includes many of the following refineries: 1- Baiji Refinery, production capacity 310,000 barrels/day, 2- Kirkuk Refinery, production capacity 30,000 barrels/day, 3- Al-Kasak Refinery, production capacity is 10,000 barrels/day, 4- Al-Siniya Refinery, production capacity is 30,000 barrels/day, 5- Modern Refinery, production capacity is 16,000 barrels/day, 5- Al-Qayyarah Refinery, production capacity is 16,000 barrels/day, so the field of this study will be in the refinery. Baiji is the largest oil refinery and manufacturing complex in Iraq. It was established in July 1978. It produces a third of the output of Iraqi refineries. The refinery is located in Salah al-Din Governorate, about 130 kilometers north of Baghdad, in the middle of the road leading from Baghdad to Mosul. Its production capacity is 15 million tons annually of petroleum derivatives, and the refining capacity is 310,000 barrels per day, and the products of this refinery are marketed to various sectors in the country.

Description and diagnosis of the results of Poka Yoke: The results presented in Table (2) show that the answers of

individuals in the company sample of the study to the paragraphs of the variable Poka Yoke, where the answers tended towards agreement at a rate of (51.1%), and this percentage is very modest, while the percentage of answers was neutral. (21.7%), while the negative answers (disagreement) were (26.7%), and thus the value of the arithmetic mean was (2.2), and this value is appropriate because it is higher than the estimated hypothetical mean (2), while the value of the standard deviation constituted (0.918), in addition to The response rate was (74.6%) and the coefficient of variation (43.4%). The response rate indicates the high level of employees' awareness about the importance of using the Poka Yoke technique, while the coefficient of variation indicates the dispersion of answers or the difference of opinion on the topic, and from here we can say that the company She does not have this technology, and after learning about the mechanisms of how this important technology works, she decided that she would try to apply it in all of her activities in the near future.

Table 2: Response scale, arithmetic mean, standard deviation, percentage of agreement, and difference for the Poka Yoke variable

Poka Yoke techniques	Response scale			Arithmetic mean	Standard deviation	Response rate	Coefficient of variation
	Agree	Neutral	Not agree				
Intelligent sensing	44.2	22.5	32.9	1.697	1.099	0.565	0.647
Error diagnosis	52.3	20.6	26.7	2.225	0.871	0.741	0.391
Error analysis	56.7	19.6	23.4	2.637	0.837	0.879	0.317
Eliminate losses	40.3	24.1	35.6	1.673	1.006	0.557	0.601
Verify the change	55.7	18.5	25.4	2.537	0.809	0.845	0.318
Measure results	57.9	25.0	16.7	2.676	0.886	0.892	0.331
Average	51.1	21.7	26.7	2.2	0.918	0.746	0.434

Describing and diagnosing the results of marketing risks: The results presented in Table (3) indicate the answers of the individuals in the study sample to the variables of marketing risks, as it was found that most of the answers tended towards agreement (57.5%), while the percentage of neutral answers was (17%). While the percentage of disagreement was (25.3%), with a mean (2.307) and standard deviation (0.970), the response rate (matching) between the answers was (76.9%), and the coefficient of variation was (47.2%), and from the above results it is clear that the management of the refinery Biggie seeks to reduce marketing risks by forming a team to confront those risks by planning how to deal with all the risks and crises that the company may face in the future.

Table 3: Response scale, arithmetic mean, standard deviation, percentage of agreement, and difference for the marketing risk variable

Marketing risk variable	Response scale			Arithmetic mean	Standard deviation	Response rate	Coefficient of variation
	Agree	Neutral	Not agree				
Risk of falling demand	0.331	0.224	0.445	1.338	1.131	0.446	0.845
Price policy risk	0.453	0.189	0.358	1.543	1.022	0.514	0.662
Production risk	0.704	0.121	0.175	2.891	0.897	0.963	0.3102
Brand reputation risk	0.663	0.154	0.183	2.657	0.992	0.885	0.373
Promotion risk	0.504	0.234	0.262	2.011	0.999	0.670	0.496
Distribution risk	0.697	0.123	0.18	2.876	0.923	0.958	0.320
Operational risk	0.751	0.115	0.134	3.021	0.794	1.007	0.262
Competition risk	0.502	0.206	0.292	2.121	1.002	0.707	0.472
average	0.575	0.170	0.253	2.307	0.97	0.769	0.468

The relationship of influence of Poka Yoke technology in reducing marketing risks: Through the results of Table (4), it is clear that the dynamic equation for the relationship between Poka Yoke technology and reducing marketing risks is:

$Y = \alpha + \beta X_1$ ….. $MR = \alpha + YBX_1$
$MR = 6.830 + 0.40X_1$

It is clear from this equation that the Poka Yoke coefficient x1 affects marketing risks by (0.40) and this indicates the significance of the effect. In terms of the value of the calculated T-test (7.115), this effect is significant, and this means that changing x1 by one unit will lead to an increase in the ability The company was able to reduce marketing risks by (49.2%) with the rest of the variables held constant, and this leads to accepting the study's main hypothesis, which states (there is a significant impact relationship for the Poka Yoke technology in reducing marketing risks). The validity of the model may also be proven through the value of R^2, which It is 0.491, which is a significant value according to the calculated F value of 12.23, which is a significant value. This means that 49.1% of the change occurring in the dependent variable (marketing risks) is the result of the independent variables[1].

Table 4: The impact relationship of the Poka Yoke technology in reducing marketing risks (overall)

Dependent variable	marketing risks	
Independent variable	Coeff	Significance test
Poka Yoke X1	0.40	$p \leq 0.05$
T test	7.115	$p \leq 0.05$
α	6.830	$p \leq 0.05$
R^2	0.491	
F test	12.23	

Conclusions and Recommendations

First: Conclusions: The study reached a number of conclusions, the best of which was:

[1] - MR (Marketing risks) (dependent variable)
- β (PY) (Poka Yoke) (independent variable)
- α = alpha, which is the fixed term

1. The study revealed that most of the individuals in the study sample agreed to manage their company, which is working on developing future plans and financial allocations in order to apply Poka Yoke technology in all its activities, through their high awareness of the importance of this technology, as the percentage of awareness and response to the topic reached approximately 75%.
2. The study found that the answers of individuals working in the company sample of the study agreed with an acceptable percentage about confronting marketing risks through the application of the smart Poka Yoke technology, and this indicates their high response in bearing risks and adapting to them or confronting them in various circumstances, as the response rate for this variable reached 77% almost.
3. The regression model revealed that there is a significant, statistically significant impact relationship for the Poka Yoke technology in reducing marketing risks, which indicates the accuracy of choosing the topic. The model shows that increasing work with the Poka Yoke technology for one unit will contribute to reducing marketing risks to approximately 50%.

Second: Recommendations: Based on the conclusions, we suggest the following:

1. It is necessary to apply the Poka Yoke technique in all the company's activities, because of its major role in detecting and preventing errors before, during and after work, as well as its role in improving operational and technical activities.
2. Holding practical workshops to educate workers on the necessity of applying this technology because of its great importance in improving the quality of production and service, as well as its role in reducing marketing risks.

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