

Leveraging virtual technology, artificial intelligence, and data analytics: Basis for skills development framework for car manufacturers in the Philippines

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Abstract

The automotive sector is going through a transformative stage that is powered by virtual technology, artificial intelligence (AI), and data analytics. Such a paradigm shift required a skilled work force to support competitiveness. The objective of the research was to create a practical framework of skills development through virtual technology, artificial intelligence (AI), and data analytics to assist in enhancing the ability of the big car companies in the Philippines, without omission of ethical issues during the research phase. It analyzed the possibility of developing skills with the help of virtual technology, AI-based techniques of personalized learning creation, and data analytics as an evaluation metric. This study attempted to establish a complete skills development model that would be applicable in major car manufacturers in the Philippines. The model combined the latest technologies to supplement operational effectiveness and competitiveness. Using a thorough descriptive research design, the research explored the capabilities of trainees and measured the efficacy of training intervention programs using strict performance evaluation methods and artificial intelligence-based analysis. The research design used was descriptive so that trainees and their competencies could be described and interpreted in the most appropriate way by applying performance assessment and AI-based analysis. The respondents selected were the employees representing different departments of the work as well as chosen clients, which were a wide-range of people of different opinions. The survey questionnaire was able to collect quantitative and qualitative data giving a holistic picture on the subject matter. The analysis of data was conducted through descriptive statistics, which allowed determining trends and patterns in the data and maintaining a sense of ethics concerning data confidentiality and permission. The research established that the adoption of virtual technology in car manufacture in the Philippines improved efficiency and cost-effectiveness, but there are still uncertainties on soft skills development. AI methods hold potential in customized learning even though data analysis and scaling are difficult. Another finding the researcher made was that, data analytics could be instrumental in the performance evaluation and the determination of skills gaps. As a gist, to achieve a sustainable growth, and a lifelong learning, the

incorporation of virtual technology, AI, and data analytics in the car manufacturing sector is essential.

Keywords: skills development, virtual technology, Artificial Intelligence (AI), data analytics, competency enhancement

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1. Introduction

Virtual technology, artificial intelligence, and data analytics have been game-changers across industries, including the automotive sector. With the global competitive landscape becoming more intense and the rise of smart mobility, there is a need for car manufacturers to address the skill gap among their work forces. The integration of these technologies in the industry requires a skills development framework that can improve overall competency and increase efficiency (Huang et al., 2019). Virtual technology, such as virtual reality (VR) and augmented reality (AR), allows car manufacturers to create immersive and interactive experiences for both employees and customers. VR can be utilized for virtual design, prototyping, and simulation, enabling manufacturers to visualize and test new car models before production (Grieco et al., 2019). AR may deliver on-the-fly data and guidelines, which will increase the productivity of assembly line employees and minimize mistakes (Huang et al., 2019). Through these virtual technologies, automobile companies may improve their designing processes, time-to-market and the general quality of their cars.

The automobile industry needs AI and data analysis technologies that are useful in predictive maintenance, self-driving, and smart manufacturing. The AI algorithms have the ability to process volumes of data that are gathered by sensors in vehicles, which provides predictive maintenance when the algorithms can anticipate possible failures in the vehicles before they happen (Huang et al., 2019). Autonomous driving technology is based on AI to interpret the surrounding world and make decisions and control the car (Grieco et al., 2019). Intelligent manufacturing may be used to streamline production processes, allocate resources to a greater extent, and increase energy efficiency with the help of AI (Huang et al., 2019). By incorporating AI and data analytics, car manufacturers can increase productivity, reduce costs, and enhance the overall efficiency of their operations.

To effectively leverage virtual technology, AI, and data analytics, a comprehensive skills development framework is essential. Car manufacturers need to invest in upskilling and reskilling programs to ensure that their workforce is equipped with the necessary knowledge and competencies. This framework should include training on virtual design, VR and AR technologies, AI algorithms, data analysis, and machine learning techniques (Marston et al., 2016). Training can be delivered through a combination of online courses, seminars, workshops, and hands-on experience. The industry associations and the government will be very instrumental in helping to implement this skills development framework. Associations in the industry can liaise with learning institutions to come up with specialized training programs that suited the automotive industry. By fostering partnerships between academia, car manufacturers, and the government, a sustainable ecosystem for skills development can be established.

In the Philippines, the growth of the automotive industry has been significant over the past years. The industry still faces challenges in terms of skilled talent, particularly those who are knowledgeable about virtual technology, artificial intelligence, and data analytics. Investing in upskilling and reskilling programs will have significant impacts on the industry's productivity and competitiveness. Virtual technology, such as virtual reality (VR) and augmented reality (AR), has gained traction in the Philippines' automotive industry. Local vehicles are employing the use of VR and AR in designing their vehicles virtually, prototyping, and training. The ability of manufacturers to develop virtual models and prototypes allows visualizing and evaluating alternative design choices and eliminates the necessity in physical prototypes and reduces the product development cycle (Santos, 2021). Moreover, AR may also be applied to offer real-time solutions and directions to the employees working in the assembly line, reducing the number of mistakes and enhancing efficiency in the production process (DTI, n.d).

AI and data analytics have also become important tools in the Philippine automotive industry. Car manufacturers are utilizing AI algorithms and machine learning techniques to analyze large volumes of data collected from various sources, such as sensors in vehicles and customer feedback. This data analysis can provide valuable insights for improving product quality, enhancing customer experiences, and optimizing manufacturing processes (DTI, n.d.). Moreover, AI-powered predictive maintenance systems can help car manufacturers identify potential vehicle failures in advance, leading to improved reliability and reduced downtime (PNA, 2021). To develop the necessary competencies, a skills development framework needs to be implemented. Training programs should focus on virtual technology, AI, and data analytics. Car manufacturers can collaborate with educational institutions and industry associations to design and deliver these training programs. Providing workshops, seminars and online programs will help employees acquire the knowledge and skills necessary to use these technologies to their advantage (DTI, n.d.).

The government is also very essential in favoring the skills development structure. Research and development activities should also be supported and collaboration between the players in the industry and the academic institutions facilitated to enhance the overall competency in the automotive industry (DTI, n.d.). By leveraging virtual technology, AI, and data analytics, Philippine car manufacturers can enhance their competitiveness and meet the challenges of the ever-evolving automotive market. Increased efficiency, cost reduction, and enhanced product quality are some of the benefits that can be achieved through the adoption of these technologies. Furthermore, a skilled workforce will be better prepared to adapt to technological advancements, resulting in a more sustainable and innovative automotive industry in the Philippines.

To develop a skills development framework, car manufacturers can first conduct a skills gap analysis to identify the specific needs of their workforce. Once the skill gap has been determined, a training program can be designed catered to those needs. Virtual technology, artificial intelligence, and data analytics training can be delivered through a variety of methods, such as online courses, seminars, and workshops. Hands-on training and experiential learning can be included to maximize the effectiveness of the program (Marston et al., 2016). The advantages of adopting a skills development framework are the improvement in productivity, development of problem-solving skills, and the innovation of workforce. Moreover, more flexible employees will be better suited to changes in new technologies which results to a more stable workforce. Moreover, the number of skilled workers means that the car manufacturers will be able to create more advanced products that are safer, smarter, and more efficient (Grieco et al., 2019).

While there has been significant research on the integration of virtual technology, artificial intelligence (AI), and data analytics in the automotive industry and its potential benefits, there is a limited amount of research on the skills development framework needed to effectively adopt and leverage these technologies in the Philippine context. Although some local articles have touched on the importance of skills development and training in the automotive industry, there is a gap in the literature in terms of a comprehensive analysis of the skills and competencies needed for the adoption of these technologies. Moreover, there is a need for research on the challenges that Philippine car manufacturers might face in implementing a skills development framework related to these technologies. Factors such as funding, access to technology, and lack of awareness of the benefits of these technologies may present barriers to implementing a successful skills development framework. A comprehensive analysis of these challenges can help organizations design effective strategies to overcome these obstacles and promote the adoption of these technologies.

The role of the government and industry associations in facilitating the skills development framework implementation is also interesting to investigate. Although there are local articles that have briefly mentioned this topic, more research should be conducted to establish the most effective ways of supporting government and collaboration between the industry players and the academic institutions. In embarking upon the development of this comprehensive skills development framework, it is evident that its impact extends far beyond the enhancement of employee capabilities. Rather, it holds the power to empower individuals to navigate the ever-evolving landscape of the automotive industry with dexterity and adaptability. By meticulously identifying

the specific skills and competencies necessitated by virtual technology, AI, and data analytics, this framework ensures that the workforce is not only equipped but fortified with the indispensable knowledge and expertise demanded by these transformative technologies. Furthermore, the integration of virtual technology, AI, and data analytics possesses the potential to usher in a new era of unparalleled progress within the Philippine automotive industry. Through this integration, we can anticipate heightened levels of efficiency, productivity, and competitiveness, propelling car manufacturers to the forefront of innovation and success. It is in this framework that a proposal to develop a comprehensive skill development framework takes its least relevance.

It is through this work and publication of a carefully designed framework that we hope to make a difference towards the success and development of car manufacturers in the Philippines. However, the impact of this endeavor extends far beyond the confines of the automotive industry. It reverberates throughout the broader economy and society, fostering an environment of progress and prosperity. Through the cultivation of a highly skilled and adaptable workforce, we lay the foundation for a future characterized by innovation, economic growth, and societal advancement. In essence, this study represents a pivotal step towards harnessing the transformative potential of virtual technology, AI, and data analytics. It is an endeavor driven by the belief that through the cultivation of skills and competencies, we can shape a future that transcends the boundaries of what was once deemed possible. As we embark upon this journey, let us embrace the profound impact that this comprehensive skills development framework can have, not only on the automotive industry but on the very fabric of our society.

Objectives of the Study - The general objective of the study was to propose a comprehensive skills development framework that would have elevated the overall competency of leading car manufacturers in the Philippines. Moreover, specifically, the study aimed to analyze the role of virtual technology in skills development in terms of Current Usage and Adoption, enhancing practical skills, soft skills development, Utilization of Artificial Intelligence Techniques in terms of Identification of AI Techniques, analysis of personal learning, Scalability and Resource Requirement Assessment, and the Use of Data Analytics in terms of Performance Assessments, Skill Gap Identification, Collecting and Analyzing Skills Development. It tested the relationship between the role of Virtual Technology and Utilization of Artificial Intelligence Techniques and the use of data analytics. The relationship between Utilization of Artificial Intelligence Techniques and Use of Data Analytics. Finally, the researcher proposed the skills development framework for Car Manufacturers in the Philippines.

2. Methods

Research Design - The study used descriptive research design to develop a framework, which utilized virtual technology, artificial intelligence, and data analytics to enhance the overall competency of leading car manufacturers in the Philippines. The purpose of employing descriptive research was to accurately describe, explain, and interpret the phenomenon or situation at hand (Creswell et. al.,2017). In this particular case, the phenomenon under investigation was the competencies of trainees, and the skills development framework sought to have provided an accurate description, explanation, and interpretation of these competencies.

Participants of the Study - The research involved 385 respondents who were employed in different departments of the major automobile companies within the Philippines. These respondents consisted of finance, IT, and learning and development, supply chain and logistics, and people services employees. The inclusion of employees from different departments ensured representation from various functional areas within the organization, which provided a more comprehensive understanding of the overall competency improvement efforts. The selection of participants was carried out through a pre-chosen process. In this process, specific criteria were used to identify employees who were suitable for inclusion in the study. Participants who met the criteria were duly informed about the study and invited to participate. This approach ensured that the participants had a vested interest in the skills development framework and could provide valuable insights and feedback on their competencies and the effectiveness of the interventions. Additionally, the study aimed to include both

internal employees and selected clients as participants. The sample size comprised of chosen clients, which offered a chance to receive views of external stakeholders that engaged the workforce of the organization. This inclusion offered to see the overall competency improvement efforts more holistically and to make sure that the skills development framework was in line with the needs and expectations of the internal and external stakeholders.

Instruments of the Study - The questionnaire survey has been formulated by the researcher to correspond to the research objectives and collect the appropriate data concerning the competencies and effectiveness of the skills development framework. The questionnaire contained both closed and open ended questions. Closed-ended questions offered pre-set responses in which it was possible to analyze and compare the responses of the participants effectively. Open-ended questions allowed participants to provide more detailed and nuanced responses, enabling a deeper understanding of their experiences and insights. The distribution of the survey questionnaire was done online or in-person, depending on the preference and convenience of the participants. Distribution online was made easy with the use of email or online survey tools and faster responses were made possible. Face to face distribution was a more personalized approach with the chance of clarifying any questions or concerns that the participants may have had.

Data Gathering Procedures - The process of collecting data of the skills development model that deployed a virtual technology, artificial intelligence, and data analytics to educate the general competency levels in major car manufacturing companies in the Philippines consisted of various stages. The data was gathered effectively, precisely, and without violating the privacy and confidentiality of the respondents. The researcher designed a survey questionnaire that aligned with the research objectives and gathered relevant data on competencies and effectiveness of the skills development framework. Questionnaire included a combination of closed-ended and open-ended questions to gather both quantitative and qualitative data. Before distributing the survey questionnaire to the participants, a pre-testing phase was conducted. A small sample of participants, representative of the target population, was invited to complete the questionnaire. This pre-testing phase helped in identifying any issues with the questionnaire's clarity, relevance, or length. Feedback from the participants was collected and incorporated into the final version of the questionnaire.

Survey questionnaire was distributed to the selected participants through online platforms or in-person. Online distribution was facilitated through email or online survey tools, providing ease of access for participants. Personal distribution provided the chance to communicate more personally and ask any questions or concerns. The survey questionnaire was to be filled out by the participants within a given time frame. The researcher may have chosen to provide reminders to ensure a satisfactory response rate. The data collected was stored securely to protect the privacy and confidentiality of the participants. After data collection was completed, it was analyzed using appropriate statistical techniques and qualitative analysis methods, depending on the nature of the data.

Data Analysis - Descriptive statistics were used to summarize and describe the main characteristics of the data collected in the study. The first step in analyzing the data was to calculate measures of central tendency such as the mean into the average or typical values of the variables of interest. The mean was used on the agreement of the Role of Virtual Technology in Skills Development in terms of Current Usage and Adoption, enhancing practical skills, soft skills development, Utilization of Artificial Intelligence Techniques in terms of Identification of AI Techniques, analysis of personal learning, Scalability and Resource Requirement Assessment, and the Use of Data Analytics in terms of Performance Assessments, Skill Gap Identification, Collecting and Analyzing Skills Development. The Spearman correlation test was used to examine whether two variables are correlated with one another or not. The Spearman's tested relationships It also tested relationship between the role of Virtual Technology and Utilization of Artificial Intelligence Techniques and the use of data analytics. Also, the relationship between Utilization of Artificial Intelligence Techniques and Use of Data Analytics.

Ethical Considerations - Ethical considerations were of utmost importance when conducting research on a skills development framework that leveraged virtual technology, artificial intelligence, and data analytics for overall competency improvement in leading car manufacturers in the Philippines. Firstly, obtaining informed consent was crucial. Participants had to be fully informed about the purpose of the study, their involvement, potential risks and benefits, and their rights as participants. It was essential to ensure that participants had the right to withdraw from the study at any time without facing any negative consequences. Secondly, privacy of the participants was important; thus, the researcher maintained confidentiality and anonymity. Researchers never revealed any personal identifiable information without the express consent of the participants. Unique identifiers or codes were employed in data analysis and reporting as opposed to real names. Moreover, there was an urgent necessity to archive all the gathered information and make sure that it was available to authorized people only.

Thirdly, data protection laws and regulations had to be strictly adhered to. Compliance with applicable laws, such as the General Data Protection Regulation (GDPR) or the Data Privacy Act in the Philippines, was essential. The necessary permissions or approvals were required for collecting, storing, and analyzing personal data. Implementing appropriate security measures to protect the data from unauthorized access, loss, or misuse was equally important. Fourthly, it was vital to ensure voluntary participation in the study. Participants should not have faced any form of coercion or undue influence. They were made aware that their participation was entirely voluntary, and declining participation or withdrawing from the study did not result in any negative consequences. Respecting participants' decisions and ensuring their autonomy was crucial throughout the research process.

Lastly, debriefing sessions and feedback mechanisms were established. The participants were then given the chance after taking part in the study to ask questions, give any feedback or request additional information. The overall findings of the study were communicated to the respondents clearly and succinctly, with any possible advantages or lessons learned. This debriefing session served to address the issue of ensuring that the experience of the participants was heard and that the role that they play in the research is taken into consideration. Adhering to these ethical considerations contributed to conducting the research in an ethical and responsible manner. It fostered trust between researchers and participants and ensured that participants' privacy, autonomy, and rights were respected throughout the research process.

3. Results and discussions

The high composite mean of 2.47, which is below the Disagree level of the Verbal Interpretation (VI) level, means that the participants tend to be skeptical on the nature and the possibility of the virtual technology in an overall skills development in the car manufacturing sector in the Philippines.

Table 1

Summary Table on Role of Virtual Technology in Skills Development

Key Result Areas	Composite Mean	VI	Rank
Current Usage and Adoption	2.59	Agree	1
Enhancing Practical Skills	2.46	Disagree	2
Soft Skills Development	2.37	Disagree	3
Grand Composite Mean	2.47	Disagree	

Legend: 3.50-4.00=Strongly Agree; 2.50-3.49=Agree; 1.50-2.49=Disagree; 1.00-1.49=Strongly Disagree

In that context, the KRA that is the most resonant with the use of virtual technology is its present usage and adoption (Rank 1; M=2.59, Agree). The mean score in this KRA shifted to agreement only so there is an indication that the participants recognize that it is in use in the industry. In contrast, areas where improvements could be made are evident by mean scores of Enhancing Practical Skills (Rank 2; M=2.46, Disagree) and Soft Skills Development (Rank 3; M=2.37, Disagree). Participants were skeptical about the potential of virtual technology to enhance both technical and soft skills. It is interesting to note that skepticism is stronger for the development of soft skills. These insights imply that despite the advances in the field, the perceived effectiveness

of virtual technology in skills development is still limited. The overall responses indicate that more advocacy and awareness campaigns are needed, along with greater emphasis on integrating virtual technology in the sector to showcase its advantages gaining buy-in from stakeholders in effectively enhancing skill sets.

Table 2

Summary Table on Utilization of Artificial Intelligence Techniques

Key Result Areas	Composite Mean	VI	Rank
Identification of AI Techniques	2.45	Disagree	2
Analysis of Personal Learning	2.41	Disagree	3
Scalability and Resource Requirement Assessment	2.46	Disagree	1
Grand Composite Mean	2.44	Disagree	

Legend: 3.50-4.00=Strongly Agree; 2.50-3.49=Agree; 1.50-2.49=Disagree; 1.00-1.49=Strongly Disagree

In Table 2, the summary of the answers provided by the participants regarding the use of AI methods in different spheres is presented. The overall composite mean of 2.44 translates to deeming the general sentiment of the participants regarding the overall use of AI as disagree. 'Scalability and Resource Requirement Assessment' scored the highest composite mean (Rank 1; M=2.46), though it falls under the category of "Disagree". 'Identification of AI Techniques' came second (Rank 2; M=2.45, Disagree), reflecting participants' hesitation toward AI's impact upon identifying suitable learning strategies. 'Analysis of Personal Learning' holds the lowest composite mean (Rank 3; M=2.41, Disagree), indicating a lack of agreement on AI's role in evaluating and enhancing personal learning. The overall average of disagree implies that there was a relatively cynical view of AI methods among the respondents in these main categories, and this may not understand or be aware of the advantages of AI. These impressions emphasize the need to create publicity campaigns that specify the way AI can be used to improve the learning process. The need for practical demonstrations highlighting AI's strengths might also be inferred from these statistics.

Table 3

Summary Table on Use of Data Analytics

Key Result Areas	Composite Mean	VI	Rank
Performance Assessments	2.64	Agree	1
Skill Gap Identification	2.61	Agree	3
Collecting and Analyzing Skills Development	2.63	Agree	2
Grand Composite Mean	2.63	Agree	

Legend: 3.50-4.00=Strongly Agree; 2.50-3.49=Agree; 1.50-2.49=Disagree; 1.00-1.49=Strongly Disagree

Table 3 consolidates findings on the use of data analytics spanning three key result areas: Performance Assessments, Skill Gap Identification, and Collecting and Analyzing Skills Development. The composite mean (2.63) is less than the agree category and it proves that there is an overall agreement on the importance of data analytics in these fields. The subjects were most in agreement as far as the issues concerning the area of the 'Performance Assessments' (Rank 1; M=2.64, Agree). The second rating in the context of Collecting and Analyzing Skills Development was rated second by the participants (Rank 2; M=2.63, Agree), which means that they saw the opportunity of using data analytics to extract valuable patterns and trends of skills data, and thus optimize learning content and methods. The third one ranked in the third rank (Rank 3; M=2.61, Agree), participants said that data analytics play a significant role in identifying, targeting, and addressing the skill gaps. Despite the unanimous agreement in the significant role of data analytics, going by the composite means, there is room for enhanced understanding, especially in the domains of Skill Gap Identification and Collecting and Analyzing Skills Development. It raises the need to further educate and build consensus on the applications and potential benefits of data analytics, as evident in the latest literature.

Table 4*Relationship Between Role of Virtual Technology and Utilization of Artificial Intelligence Techniques*

Variables	Rho	p-value	Interpretation
Current Usage and Adoption			
Identification of AI Techniques	0.688**	<.001	Highly Significant
Analysis of Personal Learning	0.819**	<.001	Highly Significant
Scalability and Resource Requirement Assessment	0.637**	<.001	Highly Significant
Enhancing Practical Skills			
Identification of AI Techniques	0.855**	<.001	Highly Significant
Analysis of Personal Learning	0.688**	<.001	Highly Significant
Scalability and Resource Requirement Assessment	0.827**	<.001	Highly Significant
Soft Skills Development			
Identification of AI Techniques	0.740**	<.001	Highly Significant
Analysis of Personal Learning	0.798**	<.001	Highly Significant
Scalability and Resource Requirement Assessment	0.812**	<.001	Highly Significant

***. Correlation is significant at the 0.01 level*

Table 4 summarizes the correlation between the role of virtual technology and the utilization of artificial intelligence (AI) techniques under three distinct domains: Current Usage and Adoption, Enhancing Practical Skills, and Soft Skills Development. For Current Usage and Adoption, identification of AI Techniques ($\rho=0.688$, $p<.001$), Analysis of Personal Learning ($\rho=0.819$, $p<.001$), and Scalability and Resource Requirement Assessment ($\rho=0.637$, $p<.001$) are all highly significant. This implies that there is a strong correlation between the mentioned AI techniques and the current use and adoption of virtual technology. In the domain of Enhancing Practical Skills, Identification of AI Techniques ($\rho=0.855$, $p<.001$), Analysis of Personal Learning ($\rho=0.688$, $p<.001$), and Scalability and Resource Requirement Assessment ($\rho=0.827$, $p<.001$) also exhibit strong and highly significant correlations. Soft Skills Development demonstrates a similar pattern: Identification of AI Techniques ($\rho=0.740$, $p<.001$), Analysis of Personal Learning ($\rho=0.798$, $p<.001$), and Scalability and Resource Requirement Assessment ($\rho=0.812$, $p<.001$) are likewise highly significant and highly correlated. AI's potential to influence and drive soft skills training. However, it is important to note that while these correlations are strong and highly significant, correlations do not infer causation. Additionally, while AI and virtual technologies have shown beneficial impacts, their successful implementation necessitates careful consideration regarding technical requirements, accessibility, and individual disparities.

Table 5 presents the relationship between the role of virtual technology and the use of data analytics in various aspects. The variables examined include performance assessments, skill gap identification, collecting and analyzing skills development, and enhancing practical skills, as well as soft skills development.

Table 5*Relationship Between Role of Virtual Technology and Use of Data Analytics*

Variables	Rho	p-value	Interpretation
Current Usage and Adoption			
Performance Assessments	0.781**	<.001	Highly Significant
Skill Gap Identification	0.687**	<.001	Highly Significant
Collecting and Analyzing Skills Development	0.770**	<.001	Highly Significant
Enhancing Practical Skills			
Performance Assessments	0.813**	<.001	Highly Significant
Skill Gap Identification	0.767**	<.001	Highly Significant
Collecting and Analyzing Skills Development	0.751**	<.001	Highly Significant

Soft Skills Development			
Performance Assessments	0.758**	<.001	Highly Significant
Skill Gap Identification	0.624**	<.001	Highly Significant
Collecting and Analyzing Skills Development	0.636**	<.001	Highly Significant

***. Correlation is significant at the 0.01 level*

The correlation coefficients (rho) indicate the strength of the relationship, while the p-values determine the statistical significance. All correlations in the table are highly significant at the 0.01 level, indicating a strong association between the role of virtual technology and the use of data analytics in the examined variables. For instance, in terms of current usage and adoption, performance assessments (rho = 0.781, p < .001), skill gap identification (rho = 0.687, p < .001), and collecting and analyzing skills development (rho = 0.770, p < .001) all show highly significant correlations. Similarly, when focusing on enhancing practical skills, performance assessments (rho = 0.813, p < .001), skill gap identification (rho = 0.767, p < .001), and collecting and analyzing skills development (rho = 0.751, p < .001) exhibit highly significant correlations. Furthermore, in the context of soft skills development, performance assessments (rho = 0.758, p < .001), skill gap identification (rho = 0.624, p < .001), and collecting and analyzing skills development (rho = 0.636, p < .001) also demonstrate highly significant correlations. These findings highlight the significant relationship between the role of virtual technology and the use of data analytics in various aspects of performance assessments, skill gap identification, collecting and analyzing skills development, and soft skills development. The strong correlations observed emphasize the importance of virtual technology and data analytics in these areas.

Table 6

Relationship Between Utilization of Artificial Intelligence Techniques and Use of Data Analytics

Variables	Rho	p-value	Interpretation
Identification of AI Techniques			
Performance Assessments	0.818**	<.001	Highly Significant
Skill Gap Identification	0.672**	<.001	Highly Significant
Collecting and Analyzing Skills Development	0.709**	<.001	Highly Significant
Analysis of Personal Learning			
Performance Assessments	0.761**	<.001	Highly Significant
Skill Gap Identification	0.620**	<.001	Highly Significant
Collecting and Analyzing Skills Development	0.659**	<.001	Highly Significant
Scalability and Resource Requirement Assessment			
Performance Assessments	0.798**	<.001	Highly Significant
Skill Gap Identification	0.767**	<.001	Highly Significant
Collecting and Analyzing Skills Development	0.724**	<.001	Highly Significant

***. Correlation is significant at the 0.01 level*

Table 6 illustrates the correlation of the application of artificial intelligence (AI) techniques and data analytics to three variables, which are Identification of AI Techniques, Analysis of Personal Learning and Scalability and Resource Requirement Assessment. The 'Identification of AI Techniques' variable exhibits the strongest correlation with Performance Assessments (rho=0.818, p<.001), which is the highest mean. This suggests that performance assessment methods that apply data analytics tend to have a higher likelihood of utilizing AI techniques. The lowest mean correlation appears between Analysis of Personal Learning and Skill Gap Identification (rho=0.620, p<.001), although this correlation remains significant. This lower correlation suggests that the intersection between these two domains is less intense.

In the variable of Scalability and Resource Requirement Assessment, all the correlations were very significant, Performance Assessments (rho=0.798, p<.001), Skill Gap Identification (rho=0.767, p<.001) and Collecting and Analyzing Skills Development (rho=0.724, p<.001). This implies that data analytics would offer useful information about the scalability and resource demands of AI methods.

Proposed Framework For Manufacturing of Car Industries

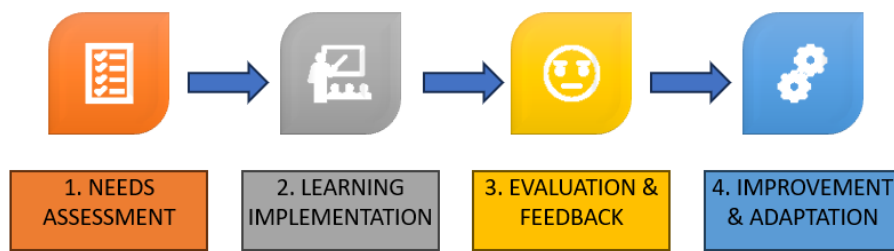


Figure 1: Implementation Model in the Adoption of AI

The suggested model, based on Virtual Technology, Artificial Intelligence, Data Analytics, Improved Competence as a Whole, and Management Awareness and Support, is a holistic development of skills in the Philippine car manufacturing sector. This begins with assessment of the level of skills possessed by workers, existing skills gaps as well as training needs. The use of virtual technology to conduct this stage enables the comparison of current skills with those required in the workplace in an efficient way by use of remote and interactive tests. The learning implementation phase (2nd phase) uses virtual technologies to deliver tailored material after the needs assessment. Customizing learning routes to fit the pace, preferences, and style of each individual learner is made possible in large part by AI. Using technologies like mixed reality (MR), augmented reality (AR), and virtual reality (VR) improves education by offering an engaging and immersive environment.

In the third step, which is evaluation and feedback, learners' performance is continuously monitored through the use of data analytics and artificial intelligence. Predictive analytics is used to generate individualized, real-time feedback, providing insights that optimize and inform the learning process. This dynamic feedback loop makes sure that skill development is done in a responsive and adaptable manner. The final step, the improvement and adaptation, is based on the knowledge gained through AI and data analytics. The learning resources, strategies and strategies are periodically assessed to ensure that the curriculum is in tandem with the evolving skill demands. To measure its success, it is proposed that a number of key measures are considered.

A pre-test and post-test design can be used to evaluate the Skill Acquisition through comparing the skill level before and after the implementation of the frameworks. The evaluation of skill acquisition is crucial in determining the rate and quality at which new skills are learned. To measure this, a pre-test and post-test design can be implemented. Participants would undergo assessments before the introduction of the framework and after its utilization. The comparison of skill levels pre and post-implementation provides insights into the effectiveness of the framework in facilitating skill acquisition.

Skill Retention can be gauged through post-tests conducted at intervals, such as 3 or 6 months post-training. Assessing the ability of individuals to retain acquired skills over time is vital for long-term competency improvement. Post-tests conducted at intervals, such as 3 or 6 months post-training, can effectively measure skill retention. This evaluation measure ensures that the skills acquired through the framework are not only learned but also retained, contributing to sustained competency development.

Skill Application can be evaluated through observation, feedback, or self-assessment, coupled with measures of work performance and productivity. The effects of the framework on the real performance of the obtained skills in the selected field of work or study are assessed with the help of observations, feedback, or self-assessment. Besides, work performance and productivity actions also give concrete results of the ability of people to utilize gained skills. This aspect of the framework is guaranteed to make the competencies developed into practical effectiveness in the car manufacturing industry.

Efficiency can be measured by calculating the cost, time, and resources invested in the skill enhancement process. Efficiency is a critical aspect of any skills development framework. It involves measuring the cost, time,

and resources used in the skill enhancement process. Calculating the cost per unit of skills improvement and tracking the time taken to move from initial to desired proficiency levels provides insights into the economic and temporal efficiency of the framework.

User Satisfaction can be assessed through surveys or interviews, utilizing the Net Promoter Score (NPS) methodology. User satisfaction is a subjective yet essential dimension to evaluate. This measure assesses the overall satisfaction of individuals with the developed skills development framework. Utilizing user satisfaction surveys or interviews and employing the Net Promoter Score (NPS) methodology helps capture participants' perceptions, ensuring that the framework aligns with user expectations and needs.

Lastly, Scalability can be tested by measuring system usage metrics as the number of users is developed and introduced to a controlled environment. This solid evaluation method will provide comprehensive information on the influence of this framework on development of skills, user satisfaction and scalability within the car manufacturing business. One of the evaluations is scalability, which measures how well the system can be able to support more and more learners without performance reduction. This is more so when it is broadly applied in the industry. Monitoring the metrics of usage of a tracking system as the number of users is sequentially increased in a restricted setting offers information on the scalability of the framework.

The utilization of virtual technology (VT) is contingent upon its designated roles, which subsequently dictate its application across various domains. VT assumes diverse functions, including but not limited to training, collaboration, and design, each exerting distinctive influences on its implementation.

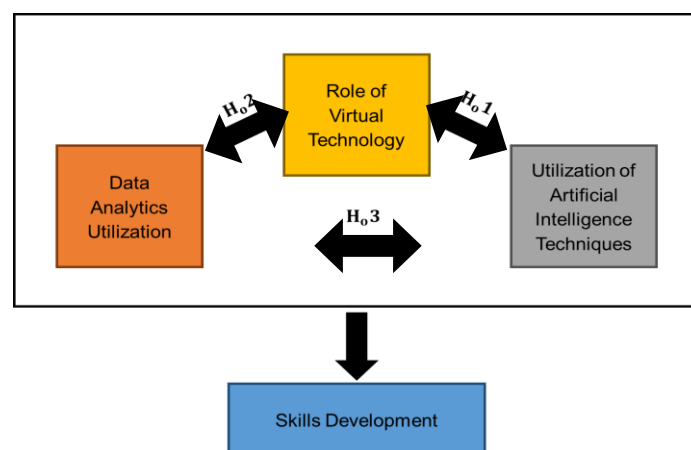


Figure 2: AI Adoption Framework

For instance, VT may serve as a potent tool for professional training, providing immersive simulations tailored to specific fields such as medicine. Conversely, in collaborative environments, VT facilitates seamless remote interactions, transcending geographical constraints and fostering effective communication. Furthermore, within design contexts, VT enables intricate 3D modeling, thereby catalyzing innovation and creative endeavors.

The pivotal role of VT also significantly shapes the landscape of data analytics within these domains. Data collection strategies are inherently intertwined with the specific objectives of VT applications. For example, in training scenarios, meticulous data on user performance is collected and analyzed to assess the efficacy of learning outcomes. Moreover, the utilization of VT inherently generates extensive datasets ripe for analysis, offering valuable insights into user behavior. These insights not only inform iterative enhancements to VT applications but also guide improvements in design and functionality. For instance, through the scrutiny of user interactions within virtual environments, designers can refine user experiences, ultimately augmenting learning outcomes.

Included in this conceptual framework is the AI techniques and Skills Development, which also enhances

the effectiveness of VT application. The AI approaches are also essential to the creation and the improvement of VT applications, which can help to create more realistic and immersive experiences. At the same time, VT is a channel of skills growth in the form of avenues to not only acquire new skills but also to enhance the already obtained skills. This symbiotic relationship between VT and skills development fosters professional growth and adaptability, empowering individuals to navigate evolving landscapes effectively.

Thus, this framework elucidates the intricate interplay between VT's role, utilization, and data analytics. The designated role of VT determines its operational parameters, which, in turn, generate data crucial for informed decision-making and iterative improvements. These insights not only refine VT applications but also inform skills development initiatives, ultimately unlocking VT's transformative potential across diverse domains.

4. Conclusions and recommendations

Based on the results of the study, the following conclusions were drawn: The use of virtual technology in skills development was only agreed on the existing usage and adjustment and not on the improvement of practical skills development and soft skills development. The respondents did not agree that AI needs to be utilized in auto manufacturing firms like Scalability and Resource Requirement Assessment, Identification of AI Techniques and Analysis of Personal Learning. The use of data analytics was found to be useful as agreed upon by the respondents on areas as Performance Assessments, Collecting and Analyzing Skills Development and Skill Gap Identification. There is a significant relationship between the role of virtual technology and the utilization of artificial intelligence (AI) techniques under three distinct domains: Current Usage and Adoption, Enhancing Practical Skills, and Soft Skills Development. The Role of Virtual Technology and Use of Data Analytics are all highly significant variables. There is a significant relationship between the use of artificial intelligence (AI) techniques and data analytics across three variables: Identification of AI Techniques, Analysis of Personal Learning, and Scalability and Resource Requirement Assessment. A framework was proposed for Car Manufacturing industries in the Philippines based on relationship variables for virtual technology, use of data analytics and use of artificial intelligence.

Based on the conclusions of the study, the following recommendations were drawn: Car manufacturers' IT managers may implement virtual technology enhancements to improve practical skills development, including more realistic simulations and the integration of VR and AR technologies. The Learning and development department of manufacturing companies may enhance soft skills development strategies through interactive exercises in virtual training environments, focusing on teamwork, communication, and problem-solving. Supply chain logistics departments may leverage AI for personalized learning by employing algorithms to tailor learning pathways, integrating adaptive learning systems, and utilizing AI-powered virtual assistants for real-time support. The management team of Car manufacturing may optimize data analytics for continuous improvement by tracking performance metrics, identifying skill gaps, implementing continuous monitoring, and leveraging predictive analytics for future training needs. Future research should focus on conducting longitudinal studies to assess long-term impacts, exploring cross-industry applications, conducting cost-benefit analyses, and investigating ethical implications associated with virtual technology, AI, and data analytics in skills development.

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