Building AI Driven Marketing Capabilities

Understand Customer Needs and Deliver Value Through AI

Edited by
Neha Zaidi · Mohit Maurya
Simon Grima · Pallavi Tyagi

Apress®

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CHAPTER

1

Using Social Media for Improving Customer Engagement

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Customer engagement is an essential aspect of corporate success, as engaged customers are more likely to purchase products and services, refer friends and family, and provide valuable feedback. Social media has not only become a powerful platform for corporate houses and marketers, but at the same time, it's helping them to connect with customers on a personal level, which was difficult through traditional marketing channels. Recent technological developments have also made it possible to personalize the information. Another important development is the use of artificial intelligence for the purpose of understanding customers' issues and engaging them for better

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relationships. The integration of AI with different social media platforms is helping the marketers to be more connected with their customer base. Therefore, this chapter is going to give us an insight about social media and its use for better customer engagement.

Introduction

Social media has changed the way we used to communicate. It has also paved the way for better engagement with customers. Boyd and Ellison (2008) defined social media in this way: "a networked communication platform in which participants create, share, and/or exchange information and content (including user-generated content) and engage in social networking." Social media has transformed the way business communication used to take place with their customers. Social media platforms, such as Facebook, Twitter, Instagram, and LinkedIn, offer businesses the ability to engage with customers in real time. Social media is becoming very important because according to the latest statistics, as of January 2022, there were approximately 4.87 billion social media users worldwide, representing around 62.4% of the total global population. In India, as per the data of January 2022, the number of social media users reached 517 million, making India the second-largest social media market in the world after China. This represents around 37.5% of the country's total population.

In this way, its global presence is encouraging different multinational companies to also use social media platforms for better communication and engagement with customers. Let us understand the concept of customer based on the following definitions given by renowned scholars:

According to Marketing Guru Philip Kotler, "a customer is a person who buys goods or services for personal use or consumption and not for resale or manufacturing" (Kotler, 2003, p. 6).

In the field of customer relationship management, Peppers and Rogers define a customer as "someone who has interacted with your company in any way" (Peppers & Rogers, 2016, p. 21). This includes not only purchasers but also prospects, influencers, and even dissatisfied customers who have made complaints.

In relation to social media, a customer may be defined as "an individual or group who engages with a company or brand on social media platforms, by interacting with their content, posting comments, asking questions, or providing feedback" (Kietzmann et al., 2011, p. 243).

Therefore, we can say that customers are very precious for us, and in recent marketing communications, they are being treated as king. As we discussed earlier about social media, let us learn about the different types of social media platforms which are frequently being used by different companies and corporate houses.

Important Social Media Platforms

Social media is becoming an integral part of marketing communication which is being used for the purpose of better customer engagement. Some of the important social media platforms that are widely used for customer engagement and marketing are as follows:

- **Instagram**: Instagram provides a platform where users can share photos and videos. We can witness its popularity with the fact that it has more than one billion monthly active users. It helps marketers in sending appropriate audio and visual content reels for creating better engagement which helps in a strong visual identity. As we know, Instagram stories also do the job of creating better engagements with their customers and showcasing their products or services.
- **YouTube**: YouTube is an important platform for sharing audio and video content. It's also very important because it has over two billion monthly active users. It is an ideal platform for corporate houses that want to showcase their products or services through interactive video content. With different advanced tools like creating channels, playlists, and other tools, marketing activities can become more engaging and could result in motivating and convincing customers to drive traffic to their website.
- **Facebook**: Actually, Facebook is also a very popular social media platform for customer engagement. It's very important because it has a monthly active user base of more than 2.7 billion. It offers a range of features such as pages, groups, messenger, and formulation of social groups based on their liking, interest area, and profession.

- **Twitter**: Twitter is one of the microblogging platforms that is being used frequently by corporate houses and marketers. It also comes with different features like the blue tick facility and sharing information through text and audio/visual elements. Twitter has more than 330 million monthly active users. Twitter is also being used for the purpose of updating new information and announcement.
- **LinkedIn**: LinkedIn is also a social networking platform which is being used by professionals. It also offers a range of services, such as company pages and showcase pages, and at the same time is used for the purpose of workshops, sessions, and seminars which might be related with customer engagement.
- **TikTok**: TikTok was once one of the most popular social media platform in India. Still, it has a monthly user base of more than one billion. TikTok has different tools like duets and challenges that are also being used by marketers for the purpose of customer engagement and awareness.
- **WhatsApp**: WhatsApp is a messaging app that is widely used for personal communication. However, businesses can also use WhatsApp to engage with their customers through features such as WhatsApp Business and WhatsApp API. These features allow businesses to provide customer support, send transactional messages, and engage in conversations with their customers.
- **Pinterest**: Pinterest is used for visual discovery and for the purpose of bookmarking. It has more than 400 million monthly users. It is an ideal platform for businesses that have a strong visual identity and want to showcase their products or services through images. Different tools such as boards and pins are encouraging customers and being used to increase the traffic of different websites.
- **Snapchat**: Snapchat is a multimedia messaging app that is widely used by younger audiences. With the help of tools like filters and lenses, different marketers used to engage with their customers and build brand awareness.
- **Reddit**: It is used for news aggregation and discussion. More than 52 million active users are using it daily. It is being used to engage with niche communities and drive traffic to their website.

Important Studies on Social Media and Customer Engagement

Chen and Chen (2017) conducted a study to investigate the impact of social media engagement on customer loyalty. Their findings showed that social media engagement had a positive effect on customer loyalty and that social media was an effective tool for building customer relationships.

Sharma and Joshi (2018) conducted an empirical study on Indian brands and their use of social media for customer engagement. The study revealed that Indian brands are increasingly using social media to engage with their customers by building brand awareness, creating user-generated content, and providing customer support.

Singh and Srivastava (2018) conducted a study on the Indian FMCG sector and analyzed the impact of social media marketing on customer engagement. The study found that social media marketing has a significant positive impact on customer engagement, and companies should focus on creating relevant and engaging content.

Chauhan et al. (2019) conducted an exploratory study on Indian consumers and their engagement with social media platforms. The study identified that Indian consumers are highly engaged with social media platforms, with a focus on entertainment, socialization, and information seeking. The study also revealed key factors that influence customer engagement, such as trust, social influence, and interactivity.

Singh and Saini (2017) conducted a study on the Indian fashion industry and examined the impact of social media on customer engagement. The study found that social media has a significant positive impact on customer engagement, and companies in the fashion industry should focus on creating visually appealing and informative content.

Singh and Saini (2018) conducted a study on the Indian hospitality industry and examined the impact of social media on customer engagement. The study found that social media has a significant positive impact on customer engagement, and companies in the hospitality industry should focus on creating personalized and engaging content.

Leung et al. (2013) explored the effects of different types of social media engagement on customer loyalty. Their findings suggested that proactive engagement, such as responding to customer queries and complaints, was more effective in building customer loyalty than reactive engagement, such as promotional posts.

Hajli (2014) investigated the impact of social media on customer engagement and found that social media was a useful tool for businesses to engage with their customers, improve customer satisfaction, and enhance brand image.

Verhoef et al. (2010) studied the relationship between customer engagement and loyalty. They found that customer engagement had a significant positive effect on loyalty and that social media was an effective platform for engaging with customers.

Finally, Kaplan and Haenlein (2010) proposed a framework for businesses to engage with their customers through social media. The 4Cs framework emphasizes the importance of providing relevant and engaging content, creating a community of engaged customers, and customizing content to meet customer needs and preferences.

Conclusion: The literature highlights that social media engagement is an effective tool for businesses to build customer loyalty, enhance customer experience, and improve brand image. By engaging with customers through social media, businesses can build strong relationships and create a loyal customer base.

Impact of Social Media on Customer Engagement

Different social media platforms are being used for the purpose of marketing communication and for better engagement of customers. Therefore, we can have a lot of examples through which we can say that it's having a great impact on customer engagement:

- **Provide customer support**: Social media provides businesses with a platform to provide customer support in real time. Customers can reach out to businesses through social media, and businesses can respond promptly, providing solutions to their queries or complaints, leading to improved customer satisfaction and loyalty.
- **Strengthening relationship with customers**: Social media is helpful for corporate houses to build and strengthen relationships with their customers. Through social media, better engagement is possible; it can create a sense of belongingness and leads to the formulation of better relationship with customers. Generally, satisfied customers are more loyal, and sometimes they are also doing the job of advocacy.

- **Create brand awareness**: Social media provides businesses with a platform to create brand awareness. The way people used to share the content on different social media platforms is helpful in reaching toward a wider audience, increasing brand visibility and awareness which is helpful in increasing profit.

Advantage of Social Media Strategies for Customer Engagement

The following are strategies for leveraging social media to improve customer engagement:

- **Engage with customers**: Engage with customers on social media by responding to their comments, queries, and complaints promptly. This can help build relationships and create a sense of community.
- **Share valuable content**: Share valuable content that is relevant and engaging to customers, such as blog posts, infographics, and videos. Valuable content is very helpful in building trust with customers, and on the basis of it, credibility can be ensured.
- **Provide exclusive offers**: Provide exclusive offers to customers on social media. This can incentivize customers to engage with your brand on social media, leading to increased engagement and loyalty.
- **Personalize communications**: Personalize communications with customers by addressing them by their first name. This can help create a more personal connection and foster a deeper relationship with customers.

Disadvantages of Social Media Strategies for Customer Engagement

Despite the benefits, social media and customer engagement present several challenges; these are as follows:

- **Negative feedback**: Social media allows customers to provide negative feedback publicly, which can damage a brand's reputation and lead to decreased customer engagement and loyalty.

- **Privacy concerns**: Privacy concerns are a significant challenge associated with social media and customer engagement. Customers may be hesitant to engage with businesses on social media if they feel their personal information is not secure.
- **Competition**: Competition is another challenge associated with social media and customer engagement. With so many businesses competing for customer attention on social media, it can be challenging to stand out and engage customers effectively.

Hence, social media platforms helps in different aspects of marketing communication, for instance: to build relationships, provide customer support, and create brand awareness. To improve customer engagement, businesses should engage with customers, share valuable content, personalize communications, and provide exclusive offers. While there are challenges associated with social media and customer engagement, corporate houses can overcome these challenges with the right strategies and approaches.

Social Media Engagement vs. Mainstream Media Engagement

As we discussed about social media use for better engagement with customers, we must be familiar with why it's different from mainstream media in relation with customer engagement. The following are the elements which make it different:

- **Interaction**: Social media engagement is interactive, and it's very helpful in ensuring a two-way communication. Customers can ask questions, provide feedback, and engage with companies in real time, while mainstream media is typically a one-way communication.
- **Cost**: Social media engagement is generally more cost-effective than mainstream media engagement. Creating and posting content on social media platforms are typically free, while advertising in mainstream media can be expensive.
- **Speed**: Social media engagement is faster than mainstream media. Customers can contact companies through social media platforms and receive an immediate response, while mainstream media engagement may take longer due to the need for approval.

- **Reach**: Social media engagement can reach a larger audience compared to mainstream media, as it allows companies to engage with customers from all around the world.

Based on the preceding elements, we can say that customer engagement through social media offers a faster, more interactive, wider-reaching, and cost-effective option for companies to engage with their customers compared to mainstream media.

Innovative Technologies and AI in Social Media

Artificial intelligence is becoming an integral part of marketing communication. The following are the important AI-based tools and cases which are related with the application of artificial intelligence:

- **Chatbots**: One of the most common uses of AI for customer engagement is through chatbots. Chatbots can be used to provide 24/7 customer support, answer frequently asked questions, and help customers with their purchasing decisions. Chatbots use natural language processing (NLP) to understand customer queries and respond in a conversational manner, making it a seamless experience for customers. Chatbots have become a popular tool for customer engagement on social media platforms. Many Indian companies are leveraging chatbots to provide 24/7 customer support, answer frequently asked questions, and provide personalized recommendations. Some examples of Indian companies using chatbots for customer engagement include
    - **HDFC Bank**: HDFC Bank uses Eva, a chatbot that provides instant responses to customer queries related to banking products and services.
    - **ICICI Lombard**: ICICI Lombard, a leading insurance provider, has developed a chatbot that helps customers buy insurance policies, renew policies, and get claims settled.
    - **OYO Rooms**: OYO Rooms, a hotel booking platform, uses a chatbot to assist customers with booking inquiries, room availability, and other questions.

- **Kotak Mahindra Bank**: Kotak Mahindra Bank uses Keya, an AI-powered chatbot that provides customer support, helps customers find the nearest bank branch, and offers personalized product recommendations.
- **Flipkart**: Flipkart is one of India's ecommerce platforms that uses a chatbot to help customers track their orders, get information on products, and resolve complaints.

Personalization

Artificial intelligence is also used to personalize customer experiences. In this regard, customer data such as browsing behavior, purchase history, and preferences are recorded. AI algorithms can use this data to provide personalized product recommendations, targeted marketing messages, and customized offers, leading to increased customer engagement and loyalty.

Personalization has become an essential aspect for Indian companies in meeting the individual needs and preferences of their customers. Here are some examples of personalization approaches that Indian companies use:

Customized products and services: Companies in India offer customized products and services that cater to their customers' unique needs and preferences. For example, Lenskart, an Indian eyewear company, provides its customers with a virtual try-on feature to choose frames that fit their face size and shape.

Targeted advertising: Indian companies use targeted advertising to personalize their marketing messages and promotions based on the customers' interests. Myntra, an online retailer, uses machine learning algorithms to suggest personalized recommendations to customers based on their purchase and browsing history.

Personalized customer service: Indian companies provide personalized customer service to enhance customer satisfaction. For instance, ICICI Bank uses AI-powered chatbots to deliver personalized support to its customers and respond to their queries instantly.

Personalized loyalty programs: Indian companies offer personalized loyalty programs that provide customers with personalized offers and discounts based on their purchase history. Tata CLiQ, a loyalty program by the Tata Group, is an example of such a program. Swiggy, a food delivery platform, sends personalized messages to customers with recommendations based on their order history.

Another type of content is the video content which exhibits product demos and showcases a product's features and benefits in action. Testimonial videos can also be used to feature satisfied customers sharing their positive experiences with a product or service. In addition, brand story videos can be created to highlight a brand's history, values, and mission. Finally, live videos can be streamed in real time, allowing viewers to engage with the content in real time. By creating engaging and informative video content, businesses can enhance their brand awareness and connect with their audience on a deeper level.

BYJU'S, an edtech company, uses video content as the centerpiece of their learning platform. BYJU'S offers a vast library of video lessons and lectures, covering a wide range of subjects and topics, presented by India's best educators. These videos are not only informative but also engaging, with animation, graphics, and interactive elements, making learning a fun experience for students.

Myntra, an online fashion retailer, has also been leveraging video content to showcase their products and engage with their customers. They created a series of short, fashion-focused videos, featuring their models in different outfits, styled for different occasions. These videos not only showcase the latest fashion trends but also demonstrate how their products can be styled to create different looks.

Finally, Tata Sky, a direct-to-home television provider, uses video content to promote their services and entertain their customers. They created a series of short, humorous videos, featuring popular Bollywood actors, showcasing the different features and benefits of their service. These videos are widely shared on social media, generating buzz and engagement among their customers.

Frequently Used Online Tools for Customer Engagement

- **Predictive analytics**: Artificial intelligence helps strategists to anticipate customer needs and provide proactive support. Predictive analytics can be used to identify potential issues before they occur and take proactive steps to prevent them. This can help businesses improve customer satisfaction and loyalty.
- **Sentiment analysis**: AI can be used for sentiment analysis, which can help businesses understand customer feedback and sentiments. Sentiment analysis helps in understanding and identifying customer sentiments and related issues, allowing businesses to take immediate action to resolve them. Sentiment analysis can also be used to identify customer trends and priorities, allowing corporate houses to provide more personalized experiences. Sentiment analysis is a versatile tool that can be applied in different ways to analyze customer feedback and gauge the overall sentiment toward a particular product, service, or brand. The following are some examples of how sentiment analysis can be utilized:
    - **Product reviews**: Companies can utilize sentiment analysis to assess customer reviews of their products and services to determine customer sentiment. This can aid in identifying areas for improvement and enhancing customer satisfaction.
    - **Social media monitoring**: Sentiment analysis is used by various social media platforms for identifying brand, product, or service mentions. This can help companies track customer feedback and sentiment in real time and respond to customer inquiries or complaints proactively.
    - **Brand reputation management**: Sentiment analysis can be used to monitor and manage a company's brand reputation. Companies can track mentions of their brand on various social media platforms, news websites, and blogs and use sentiment analysis to determine the overall sentiment toward their brand.

- **Customer surveys**: Sentiment analysis can be utilized to analyze customer survey responses and determine customer sentiment toward a particular product or service. This can aid companies in making data-driven decisions to enhance customer satisfaction.

- **Customer feedback tools**: Customer feedback tools such as surveys and feedback forms are used in India to collect feedback from customers. For instance, hospitality brand OYO uses customer feedback tools to collect feedback and improve customer experiences in its hotels.
- **Live chat**: Live chat is another tool used in India for customer engagement. For example, online education platform BYJU'S uses live chat to provide instant support to students and resolve their queries.
- **Mobile apps**: Mobile apps are increasingly being used in India for customer engagement. For example, food delivery app Swiggy uses its mobile app to offer personalized recommendations to customers and provide 24/7 customer support.

Overall, these effectively provide better customer support and ultimately drive business growth.

Indian Companies Using Social Media Platforms for Better Customer Engagement

Social media has become a vital tool for customer engagement in India, and several Indian companies have successfully leveraged it to engage with their customers. Here are some examples of Indian companies that have used social media for customer engagement:

- **Zomato**: Zomato, a food delivery and restaurant discovery platform, has built a strong reputation for customer service by the support of different social media platforms. In this regard, Zomato is using Twitter and Facebook to engage with its customers. The company has a dedicated Twitter handle called @ZomatoCare that addresses customer complaints and issues in real time, demonstrating its proactive approach to customer service.

- **Ola**: Ola, a popular ride-hailing platform in India, has used social media to provide real-time customer support and address customer issues. The company has a dedicated Twitter handle called @OlacabsSupport that addresses customer complaints and issues. Ola has also used social media to run promotional campaigns and offer discounts to its customers, further increasing customer engagement.
- **Flipkart**: Flipkart, one of the leading ecommerce platforms in India, has used social media to build a loyal customer base and drive sales growth. The company engages with its customers on platforms like Twitter and Facebook, providing updates about its products and services and running promotional campaigns. Flipkart's social media strategy has helped it build strong customer relationships and increase customer engagement.
- **HDFC Bank**: HDFC Bank, one of the leading banks in India, has leveraged social media to provide 24/7 customer support and offer exclusive discounts and promotions to its customers. The bank engages with its customers on platforms like Twitter and Facebook, resolving customer issues and building strong customer relationships.
- **Lenskart**: Lenskart, a popular eyewear brand in India, has successfully used social media to build brand awareness and drive sales growth. The company engages with its customers on platforms like Facebook and Instagram, providing updates about its products and services and running promotional campaigns.
- **Amul**: Amul is an Indian dairy brand that has successfully used social media to engage with its current and prosperous customers. The brand has a strong social media presence and is known for its witty and humorous posts that connect with its customers. Amul has launched various campaigns, like the "Amul Topical" campaign through social media.
- **BigBasket**: BigBasket is an Indian online grocery delivery platform that is also using various social media platforms for connecting with customers. The brand has a dedicated customer service team that addresses customer queries and grievances on social media. BigBasket also uses social media to promote its offerings, launch campaigns, and engage with its audience through interactive posts and contests.

- **Swiggy**: Swiggy, a popular food delivery platform in India, has a strong social media presence and engages with its customers through various social media channels. The brand uses social media to address customer queries, complaints, and feedback, as well as to promote its offerings and launch campaigns.
- **MakeMyTrip**: MakeMyTrip is an Indian online travel company. This company is having a presence on various social media platforms in order to engage with the customers. The brand has a dedicated customer service team that addresses customer queries and solves the problem on social media. MakeMyTrip also uses social media to promote its offerings, launch campaigns, and engage with its audience through interactive posts and contests.
- **Mahindra Group**: This multinational conglomerate uses tools like Brand watch to monitor its brand reputation and gain insights into customer sentiments and preferences by tracking mentions of its brand on social media platforms.

These examples demonstrate how Indian companies are leveraging social media to engage and strengthen relationship with customers, address their concerns and feedback, and to promote their offerings and campaigns. By using social media effectively, companies can build a strong relationship with their customers and drive customer loyalty.

Conclusion

Engaging with customers through social media has become an essential strategy for businesses to stay relevant and competitive in today's digital age. Companies are using various tools and techniques to enhance customer engagement through social media, such as personalized messaging, social listening, sentiment analysis, chatbots, and more.

For example, Indian companies like Tata Sky, Vodafone, and HDFC Bank are using chatbots to engage with their customers and provide them with personalized recommendations based on their preferences. The chatbots are available 24/7, and they can handle many queries simultaneously, reducing the response time and improving the overall customer experience.

Similarly, many Indian companies are using social listening tools to monitor online conversations and gather customer feedback, which helps them to understand their customers' needs and preferences better. For instance, Amul, a leading dairy brand in India, uses social listening to track online conversations related to its brand and products. This information is used to develop new products and marketing campaigns that are tailored to meet out the needs and expectations of its customers.

Apart from the preceding things, social media has transformed the way marketing companies used to engage with their customers, and it has become an essential tool for customer engagement and marketing. Indian companies are leveraging various social media tools and techniques to enhance customer engagement and improve their overall business performance. As social media continues to evolve and become more sophisticated, it is expected that more innovative and effective strategies will emerge, leading to better customer engagement and increased business growth.

In summary, we can say that social media has provided us with different features and tools, and especially in India, it is being used by various companies for better and continuous customer engagement. Companies are also using it to provide 24/7 customer support and to resolve issues in real time.

CHAPTER

2

Applying AI for Product Life Cycle Management

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AI has been getting a lot of attention lately in the manufacturing industry. Considering it is the foundation of Industry 4.0, so smart manufacturing strategies are really interested in it. PLM (Product Life Cycle Management) covers all the engineering, enterprise, and administrative tasks related to a product throughout its life cycle, from the creation of an idea to the recycling of finished goods. In this chapter, we look at a few AI theories, methods, and technologies related to the key PLM stages of intelligent manufacturing (e.g., product design, manufacturing, and service). We also provide a road map to help guide future research and use cases for AI in PLM. We also look at the potential and challenges of AI for PLM.

Introduction

Product life cycle management encompasses engineering, commercial, and managerial tasks related to a product throughout its entire life cycle: from the ideation of an abstract concept to the disposal of a final product.

Modern production is changing rapidly due to the rapid development of information-related technologies such as the IoT, cloud computing, AI, and big data which impact every aspect of product life cycle management.

International production strategies and innovations, such as the Industrial Internet strategy in the United States, Industry 04 strategy in Germany, Manufacturing Innovation 03 strategy in South Korea, Industry 2050 strategy in the UK, and Made in China 2025 strategy in China.

Artificial intelligence (AI) refers to a variety of theories, approaches, technologies, and tools that are designed to mimic and augment human intellect. Artificial intelligence (AI) applications have recently become widely used in a wide range of industries, contemporaneous with the fast growth of big data, machine learning (ML), and computer chips. In order to do complex jobs demanding noticeably improved dependability, precision, and efficiency, human operators must be supported, helped, and sometimes even replaced by AI. A few examples of well-known AI applications are Google's DeepMind AlphaGo in board games, security systems for all transportations, facial recognition systems for payments, speech recognition systems for smart devices, and carriage security systems.

In the context of advanced manufacturing, there aren't as many AI applications for product life cycle management as there are in other disciplines. On the one hand, manufacturers are naturally apprehensive to embrace AI in product life cycle management owing to the extremely high requirement for quality, dependability, precision, and cost-effectiveness in manufacturing. This particularly stands for small- to mid-sized organizations (SMM). The benefits of AI to product life cycle management, however, are too many to mention. The first benefit is that a complicated production process may be optimized for a less

labor-intensive phase since AI can easily replace people in repetitive and risky activities. Second, a costly manufacturing process may be made more affordable given that verified AI solutions can last a very extended period. Third, because countless AI algorithms are becoming more compatible with industrial-scale big data, production decision-making is moving more in the direction of data-driven approaches. Manufacturers are better prepared to respond to a changing industrial environment because of their improved capacity for handling massive volumes of data. Finally, many advanced AI programs may be easily modified for use in industrial settings. Computer vision has been used, for instance, to automate quality control, visual localization, dimension measuring, object sorting, bar code identification, and other processes.

Recent Trends in Product Life Cycle Management

Product life cycle management (PLCM) was originally designed to capture the three phases of a product's life cycle in the open market: promotion, maturation, and depreciation. With the advent of concurrent engineering in the 1980s, PLCM gradually gained traction in manufacturing engineering. This led to a new division of product life cycle management operations: market research, product development, process design, production, distribution, utilization, after-sales service, and recycling. Different academics understood product life cycle management differently in view of the constant changes in the production pattern. The product design phase, the product production phase, and the product service phase are the three distinct phases that AI technology is categorized into to classify their techniques and goals in various stages. Substages are further separated into each stage: the planning phase, manifestation layout, design specification, and trial manufacturing are all parts of the product design stage. Substages of the product manufacturing stage include material procurement, production scheduling, manufacturing, and warehousing/logistics. The service stage encompasses a variety of value-added services, including recycling, sales, use, and after-sales support.

A comprehensive information structure that integrates diverse data, information, and technologies is crucial for product life cycle management deployment in practice. Information integration for product life cycle management calls for general theories and methodologies, as well as specialized technologies for data analysis, information and semantic integration, information interaction, and web service connectivity, among other things. The requirements and components of the product life cycle management extension are continually improved by the new manufacturing processes. However, given the wide range of product life cycle management, the majority of the current frameworks are particularly designed for a single application situation, which hinders their general applicability.

Various optimizing and assessment strategies have been introduced inside the product life cycle management framework. Common evaluation criteria for the design phase include aesthetics, functionality, development time, and environmental friendliness. Typical evaluation techniques include the Analytic Hierarchy Method, the Method for Orders of Preferences based on Resemblance to the Perfect Solution, the Impact Matrix, the Kano Model, etc. Prevalent assessment pointers for the production cycle include production span, cost, resource usage, and energy consumption; common optimization techniques are embodied by theme and subtheme algorithms. For the registration phase, the service quality is a crucial metrical system for assessing service performance since it shows how much personalization is provided to clients.

The data of product life cycle management has experienced marvelous growth as a consequence of the extensive usage of implanted technology such as RFID tags and of course cutting-edge sensors in the manufacturing and service stages. Newly formed approaches to product life cycle management data modeling, synchronization, connection, transformation, and removal are being actively developed as of now. The measure and diversity of product life cycle management data will keep on increasing as new age technologies such as the Industrial-grade Internet and the digital counterpart expansion traction. When it comes to analyzing great quantities of data with several dimensions, numerous AI algorithms are bigger than orthodox practices. One of product life cycle management's most striking potentials across their design, production, and service stages is the interface among product life cycle management and data science.

AI: What Is It?

Depending on their research specialities, disciplinary backgrounds, and domains, researchers describe and interpret artificial intelligence (AI) differently. Personification and intelligence are two terms that appear in several definitions of artificial intelligence.

Symbolisms, which proposed that cognition, knowledge representation, application, and reasoning were at the core of AI, are credited with first introducing the concept of AI. The creation of several expert systems was one of symbolism's greatest contributions. According to connectionism, AI is developed from bionics (or engineering that is inspired by biology), particularly concerning our knowledge of animal and human brains. The development of artificial neural networks, which were motivated by the biological neural networks that make up the core of animal brains, was a significant contribution to connectionism.

Actionism, a relatively recent school, specializes in the study of cybernetic model of systems about auto-organization, auto-learning, auto-adaptation, auto-stabilization, and auto-optimization. Based on the pre-existing characterizations, the authors define artificial intelligence (AI) as the applications, theories, tools, and methodologies designed for simulating intelligent behavior, create artificial intelligence in computer systems, empower artifacts to perform intellectual tasks, and understand human intelligence.

"Artificial narrow intelligence" (ANI), "artificial general intelligence" (AGI), and "artificial superintelligence" (ASI) are the three subcategories of AI. A single domain-specific job may be carried out by artificial systems thanks to ANI. Three other subcategories of ANI include perception, cognition, and learning, in addition to behavior. A further developed stage of AI is represented by AGI, where AI is viewed as being roughly similar to human intelligence when compared to their capacity to carry out general intellectual-based activities. The present state of our knowledge of AI, however, is further away from sufficient to create a fully operational ASI system. It is a potential AI state in which AI has higher intelligence levels than human intellect. As a result, it can do jobs that are too difficult for the human intellect to handle. Authors of this chapter primarily discuss the use of ANI in product life cycle management.

AI systems must possess the cognitive and learning intelligence to learn, analyze, evaluate, and make decisions based on observed information. Logic, planning, knowledge representation, reasoning, machine learning, and other important technologies are included. Before the development of AI, logic was a well-developed academic field. Logic refers to the general principles of the reasoning used in various problem-solving scenarios. It facilitates analysis, characterization, and programming while describing and simulating intelligence and resolving challenges with intelligent thinking. Propositional logic and first-order logic are both parts of the common logic branch.

In order to control the behaviors of artificial systems, behavior scientists integrate computer-based systems, sensory systems, feedback-generating systems, and communication tracker systems (such as automation software, robot process, and intelligent robots). Complex tasks can be accomplished by intelligent robots through manual instruction or auto-learning. It can communicate with human handlers using everyday language, and they can even work along with human handlers using more sophisticated sensory abilities. Human operators can be replaced by intelligent robots that are more productive, less expensive, and more reliable. Prescription dispensing, medical material handling, direct material handling, patient care, inventory replenishment, product packaging and picking, order fulfillment, help with shopping, package delivery, security, customer service, etc., are a few examples of potential applications. Interface recognition and workflow execution technologies are combined by robot process automation software. Screens

and keyboards are used to control programs and carry out system activities automatically, simulating human actions. Software for robot app automation is a "bridge" technology which combines several systems to carry out more sophisticated tasks than automation.

Product Life Cycle Management

Product life cycle management had their beginning in the automobile and aviation business and then spread to other related and unrelated sectors including electronics, packaged products, fashion, and healthcare. Product life cycle management was industrialized as a result of technology development in product data and their management, computer-aided design (CAD), and computer-aided engineering (CAE) (PDM). These expansions made it possible for manufacturers to integrate design and production, reducing the lead times and production cycles. Because of the complexities and the sheer number of processes involved within the production, it was likely possible to boost the competition by restructuring the methods and centralizing all information involved. Product life cycle management is more than concerned with integrating these available technologies with the procedures, humans, and theories as a product moves through their life cycle, though.

Product life cycle management is the process of not only managing a product when it passes through their several lifetime phases but also including the introduction of the product and implementation of the production, further development, managed timescale, and ultimately the collapse.

The production of goods and then their marketing are both an integral part of their management. While making business-related decisions, from factors like pricing and advertising to their growth or necessary cost-cutting, the idea behind the PLC can be helpful.

The definitive goal of effective PLM is to generate an item that outclasses their rivals, is incredibly lucrative, and lasts for as much as the consumer prefers and future technologies allow. This is accomplished by getting together the multiple corporations, departments, and relevant personnel in the product's production to modernize their operations. The process involves more than just generating Bills of Material (BOM).

Product life cycle management solutions help businesses in overpowering the engineering problems and growing complexities of the product development process. They can be assumed as one of the four standards of a production company's information-based systems structure, among which are the management of infrastructures with clients ("customer relationship management," CRM), relations with suppliers, resources held by the company, and supply chain management such as ERP.

The marketing strategies for a product are decided by the stage of their life cycle. For example, a newly made model (that is still in the beginning phase) is in need of explanation, but in the case of a matured product, it requires differentiation methods. Product life cycle management has a huge influence on a product's most basic elements as well. A product can still continue to be developing even after it reaches the maturity phase, principally if it is being upgraded or improved in some other way.

Effective product life cycle management offers various advantages, including accelerating product launch, releasing a product of higher quality, enhancing product safety, boosting revenue prospects, and minimizing mistakes and waste. Product life cycle management can be supported by specialized computer-based software programs that perform activities like documentation, design integration methods, and procedure administration. Product life cycle management lowers the total cost involved and reduce lead time for "new product development" (NPD). In case the newly made products consist of increasing or imitative changes to the already made old products, ground-breaking new items, and the next-gen of the platform, there needs to be a method for each department to manage them. This new "product development process" (PDP) uses the product life cycle to determine what the basic shape and arrangement of the method will look like. A good product life cycle management is all-inclusive, secures and manages the product info, and ensures that business procedures use and are built upon the information generated.

The three key essentials of product life cycle management are as follows:

- Information and Communication Technology (ICT): The essential integrated platform and processes, including the architecture, resources, and standards, are at the center of this.
- The Processes: These cover all the parties, faculties, and organizations concerned.
- The Methods: These are the protocols, laws, and customs.

Product life cycle management is increasing in scale as a result of the globalization of the world economy. Giving rise to shorter production run window, new supply chain processes, and outsourcing all necessitate the need for businesses to have accurate and current manufacturing information. Moreover, the Internet allows us to communicate swiftly with partners who happen to be located far away. The modification of production requirements may now be done during the production period because of the product life cycle management. With segregated engineering and production divisions, this procedure would commonly take days and even weeks, particularly if the production plant was located abroad. Product life cycle management upsurges the speed to market in numerous different ways: