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Industrial Value Chain through use of emerging industry 4.0 technologies

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Abstract

Emerging technologies are now springing up in evolution. The pandemic was really a boon for digital growth across the world. Every communication or share of data across the internet found to be archived somewhere in the digital space. The data hives thus captured are minuscule in use, with abundant data still to find its latent application. The data use applications depend on the understanding capability of the data architect, who would position their use appropriately, depending on the specific process that is unique to the industry. Modeling and analysis of big data systems with enterprise's function, their associated market, and the people capability proliferates an abundant conversation among nodes of interactions of machines, materials, men, methods, market and money. The sensor generated and captured data from these nodes are very relevant and real time in nature leading to cognizable applications of business decisions, improving to innovate smart actions that can create competitive advantage to the organization. Automation of data gathering and piping its flow along the process offers objective scenarios to the organization, which can be intelligently processed by machine learning, for enlightening various options that can be chosen for intelligent decision making. Otherwise, this data could have been missed by the organization due to its inability to comprehend landing into a disadvantageous positioning of the value chain. The common novel hardware applications of Robotics and drones have captured more acceleration in their acceptance and development. Following the race of acceptance and development Additive manufacturing and Augmented Reality are also pushing for their position. While the more software and intelligence networked applications such as Simulations, Big data are still lagging behind. The middle wares of applications such as Systems Integration, cloud computing, cyber security, and IoT are now comfortably placed with the arrival of 5G mobile Networks to offer affordability, speed and low latency in connection. This paper aims to identify the organization intelligence that can be automated through the use of emerging technologies, suitably applying them for achieving the strategic intent on a case of Bio life Industries.

Keywords: Internet of Things, Artificial Intelligence, Big Data, Value Chain of emerging technologies.

المستخلص

بدأت تقنيات التكنلوجيا في الظهور والتطور الان. حيث كان الوباء حقًا نعمة للنمو الرقمي في جميع أنحاء العالم. مما ادى الى العثور على كل اتصال أو مشاركة بيانات عبر الإنترنت مؤرشفة في مكان ما في الفضاء الرقمي. وان خلايا البيانات التي تم التقاطها بهذه الطريقة صغيرة قيد الاستخدام مع وجود بيانات وفيرة يمكن العثور على التطبيق الكامن لها. وتعتمد تطبيقات استخدام البيانات على قدرة فهم مهندس البيانات ، الذي سيضع استخدامها بشكل مناسب ، اعتمادًا على العملية المحددة الفريدة للصناعة.وتعمل نمذجة لتحليل أنظمة البيانات الضخمة مع وظيفة المؤسسة والسوق المرتبط بها وقدرة الأفراد على نشر محادثة وفيرة بين عقد تفاعلات الآلات والمواد والايدي العاملة والأساليب

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والأسواق والمال. يعد المستشعر الذي تم إنشاؤه والتقاطه من هذه العقد وثيق الصلة للغاية وذات طبيعة في الوقت الحقيقي مما يؤدي إلى تطبيقات يمكن التعرف عليها لقرارات العمل ، وتحسين الإجراءات الذكية التي يمكن أن تخلق ميزة تنافسية للمؤسسة. توفر أتمتة جمع البيانات وتدفقها على طول العملية سيناريوهات موضوعية للمؤسسة ، والتي يمكن معالجتها بذكاء عن طريق التعلم الآلي ، لتنوير الخيارات المختلفة التي يمكن اختيارها لاتخاذ القرارات الذكية. خلاف ذلك ، قد تكون هذه البيانات قد فاتتها المنظمة بسبب عدم قدرتها على فهم الهبوط في وضع غير ملائم لسلسلة القيمة. حققت تطبيقات الأجهزة الجديدة الشائعة للروبوتات والطائرات بدون طيار مزيدًا من التسارع في قبولها وتطويرها. بعد سباق القبول والتطوير ، يدفع التصنيع الإضافي والواقع المعزز أيضًا من أجل موقعهما. في حين أن المزيد من البرامج والتطبيقات الذكية المتصلة بالشبكات مثل الحوار بين الاشخاص ، لا تزال البيانات الضخمة متخلفة عن الركب. يتم الآن وضع الأدوات المتوسطة للتطبيقات مثل تكامل الأنظمة والحوسبة السحابية والأمن السيبراني وإنترنت الأشياء بشكل مريح مع وصول شبكات الهاتف المحمول لتوفير القدرة على تحمل التكاليف والسرعة والكمون المنخفض في الاتصال. تهدف هذه الدراسة إلى التعرف على الذكاء الاصطناعي الذي يمكن أتمتة من خلال استخدام تقنيات التكنلوجيا الحديثة ، وتطبيقها بشكل مناسب لتحقيق الهدف الاستراتيجي في ازدهار تكنلوجيا الحياة الحيوية.

الكلمات الرئيسية: إنترنت الأشياء ، الذكاء الاصطناعي ، البيانات الضخمة ، سلسلة القيمة لنشؤ التكنلوجيا الحديثة

Introduction

Technology is changing swiftly transversely across all of the industries, getting new products, services and operational methods, with accelerated understanding of the advances which benefit and ensure protection from harm. Medicinal plants are the richest bio resource of drugs, to obtain sustainable industrial exploitation of medicinal extractions the agricultural practices, should have scientific and discriminate practices from the wild, postharvest and post-gathering practices of quality raw material, research support for the development of high-yielding varieties and propagation methods, efficient processing techniques, facilities, local fabrication, and access to the latest technologies along with market information (Sukhdev et al., 2008). Digital transformation takes an urgent priority for several businesses and service providers, implementing processes and extending the economic indicators to cling on to the digital revolution depending on the infrastructure and digital readiness among the providers and customers (Nachit et al., 2020). Squeezing the renovation aggressively and progressively turns the technology as a strategic turner of the earlier lost opportunities into a realizable asset in reality. The linkages among the various elements lines up the considerations for fostering content improvement, escalating connectivity and competitively stimulating Internet admittance (OCED, 2011). In the big data repositories, It is crucial to discover relationships among datasets, as there are frequently no schemas, as well as correlations among attributes. Big Data Analytics (BDA) is progressively an attractive practice that various establishments are implementing to assembling appreciated evidence from BD. The analytics with the positioning and procedure of BDA tools, advances operational efficiency for strategic potential determinations that original revenue streams can advantage with competitiveness above professional rivals (Uthayasankar et al., 2017). Data architect then decides to select attributes or features for their machine learning tasks such as classification or anomaly detection, which are connected to hypothesis that sheds light in identifying a real opportunity. Machine learning (ML) models are dignified to make a transformative influence on chemical sciences by intensely accelerating computational algorithms and magnifying comprehensions accessible from computational approaches to realize a convergence and coaction of proficiency in computing and physical sciences (John et al., 2021). Artificial intelligence (AI) understands and responds suitably to the specific activities running in the industry. AI technique exploits information as signified knowledge gathered to simplification that stake assets as assembled and organized, relatively permitted for distinct depiction

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(Kumar 2020). Continuous spikes of data from the sensor-based nodal devices or equipment spur the data-driven industrial intelligence thereby enhancing and empowering the good manufacturing practice of gathering and analyzing the use of data into informed decisions. Conclusions are completed by people, therefore they need to have the obligation to be driven by understandings, not only statistics, evidences and knowledge. Hence the decision is informed with the ability to regain the applicable data at the pertinent time, in the appropriate format, manageable to the significant people (Tata, 2016). Integrating various performance metrics architectures an edifice of data which has to be identified, deciphered, latent or missed in normal functions of everyday routines.

Latent Cognizance and Applied Knowledge

These big data management gets constructed on real-time and confirmed enterprise oriented action with a lot of scope of being reused, repurposed, reoriented for scaled-up or miniature executions, inter or intra firm as per the arising requirements. Fundamental to investigative grind on electronic market requires the ability to measure accurately all data sources that connect with the business-to-business (B2B) e-commerce in the market, aiming on the business-to-consumer (B2C) segment (OECD, 1999). The workflows in organizations are in heterogeneous environments, more so when linked with geographically spread plants, suppliers, vendors, processing partners and customers, leading to connections that are across different time zones, requiring a dynamic orchestration. The construction of workflow along with the units with which the main interactions take place guarantees resource management, significantly developing responsibilities and facilities across the platform, orchestrating virtualized lifecycle (EU (2021). Therefore streaming real time makes the chain with multiple partners to share, operate and use data simultaneously. Approach to suppleness needs to importance on trade, investment, conglomerates and employments prospects to share values of human dignity, worker rights, environmental defense, and democracy (White House, 2021). The operational effectiveness through Industry 4.0 technologies significantly influences the real physical and digital ecosystems with radical changes, fetching real-time activity plans synchronized to add value to the chain. The swift expansion of technical and human competences can permit organizations to obtain assistances from emerging technologies. However, there are many encounters linked to skill gaps, technological concerns, business morals, and beliefs that is necessarily to be dazed to earn a return from this innovative industrial advancement (Mohiuddin et al., 2022). The delivery chain is sequenced with the materials, methods and operational modules with dynamic self-optimization.

Right from simulation, logistics, inventory, transport, warehousing, and servicing positively influence the Intelligence which is self-optimized by the communicating platforms, software's, hardware's, analytics, and security devices connected through the process. The Internet is the lifeline connector signifying Industrial solutions. There is an increasing requirement for operational logistics control that involves the total business succors towards cost declines and augments service delivery (IIMM, 2020). As a driver for managing the horizontal and vertical value chains, the industrial internet and IoTs require an extensive plan with large allocations that can extend investments, innovatively position and facilitate the change for the future. Challenged with the overbearing of engaging in alterations and retorting to thorough, fast-paced changes in global technical knowhow, consumption and inhabitant configurations, prove that sustainable development is the only way. Industrial Internet of Things (IIoT) provides access to the cyber physical systems and processes, thereby efficient and sustainable throughput gets enabled. Internet of Things emerges to promise with abundant assembly to the Internet, turning common objects into connected devices, shifting the way people interact with things all over the place bringing pervasively associated infrastructures to support

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innovative services and possibilities to better the flexibility and efficiency. These are attractive benefits to consumer applications and industries (Sisinni et al., 2018). Applications of IIoT require throughput per node, connected with information communicating devices through the Internet with miniature electrical power sources such as batteries. IoT systems are available in various architectures, but include components such as sensor to communicate locally, with a protocol, gateway, server, cloud application, and user interface. Numerous non-conventional energy resources can also find use connecting hardware capabilities, thus making more returns on desired features such as latency, cost, energy efficiency, reliability, and security.

Digital manufacturing is structured around IIoT as the basic pillar. Linking all machines and control systems or any assets, with the systems and processes that support information in the business process, where big data is collected and fed into analytics, for solutions that lead to optimal operations. The big data analytics cover all the procedures of warehousing, computing, engineering and mining. The rapid and vibrant retort to demands brings various combinations and permutations to the cases developed on the real time situations and facilitate alterations that can materialize smart manufacturing. Intricate capture of vivid data ensures the product or service development and nurtures product and service life-cycles. Vicissitudes of scenarios affect the value chain through communication gadgets across innumerable sections, covering to handle monitoring of legacy data and bring innovative opportunities in self-organizing or autonomic firms, thereby reducing the interventions of humans to a bare essential. Time consuming process such as tracking, locating of materials, components and finished goods in the supply chain or delivery chain gets easily fulfilled with the use of IIoT devices installed at specific data locations, trusted as safe and confidential data also can be screened as required and shared as operational block chains, based on the needs of the collaborating parties, not limited to but can extend to include suppliers, distributors, wholesalers, and customers.

New Technologies

Autonomous robots are programmed to manage tasks swiftly, precisely, and perform composite repetitive activities, intelligently saving the manual intervention and time. These however require intermittent and prognostic maintenance. Integrating the systems horizontally and vertically brings assured and discernible credibility to the organization both from outside and inside among the partners in the value chain. IoT sensors connect physical and operational assets though sensors deployed to assemble and observe data in real-time and compute the development of interconnectedness. These huge data sets called as Big Data from processing machines and servicing entities constantly communicate requiring deeper analysis which could lead to opportunities, greater transparency, and increased efficiency.

These massive amounts of raw data, statistical analysis with specialist teams would require spending greater time and even could probably run processing for year if it were to be done manually and quiet belligerent to attain an actual value. Data sources therefore are all-encompassing from IoT sensors, systems, in-house data extending from raw materials, processing, sub-assemblies, inventory of finished goods and also retrievable rejects as part sales, supply chain, performance, quality. Predictions which affect due to natural causes, political incidence and social reasons can also be preempted with big data analytics transformed into precise, actionable acumens for dynamic decision-making.

Additive manufacturing produces layer by layer of joining of materials or composites fairly with very minimal or no elimination or material removal through machining process. These process are cloud enabled to be controlled, monitored and facilitated for obtaining the manufacturing value chain. The dissemination of Additive Manufacturing (AM) knowledge and the concept of Could Manufacturing (CM) embed, connect

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and utilize existing manufacturing resources, and other machines. Next for the end-users the use AM/3D printing resources over the Internet reduces the need for owning the machine, rather than using on demand instead of acquiring one for their own (Felix et al., 2017).

Cloud Computing

The Cloud is a free form of associated systems on the internet ranging from software, servers, data and analytics that is kept safely in a tenuously located server. This offers a lot of benefits as it grips vast volumes of sensor data steadily with redundancies already in place. It can safely hold customer data. It can intensively carry out computation feasibilities with tasks taking care of risk with reduced cost of investments on resources. There is susceptibility to the technology calling for protections from hackers and supplementary nefarious proxies out thus defending digital systems from attackers. Cyber security involves wrapping all the possible exposed data and updating from being pilfered, fraud and stolen or more.

Artificial intelligence besides machine learning employ algorithms to develop data conclusions for auto programmed machines learning, thus generating increasingly accurate predictions. Therefore AI-ML is widely applied in manufacturing for productive or predictive maintenance and demand forecasting. These features are better positioned over cloud, fog and edge computing. Digital twin coordinates digital 3D representation to all the physical, operational systems and interoperable structures for an authentic technology linked to the entire facility through simulation and operation of their interconnectedness.

Case study of Bio life Industries

Bio-life sciences industries are such that comprise a wide list of companies which operate in the research, development and manufacturing of products that are for improving the nutrition, Nutraceuticals, herbal, Ayurveda, pharmaceuticals, customized food and medicines, medical devices, nutraceuticals, that improve the lives of living beings and herbal cosmetics & personal care product. In such biological processes where data attains its prime importance, has an alternative to seek community-wide consensus in smaller sub communities associated with specific areas such as sequence analysis, gene expression, and protein pathways etc., Annotation is associated as auxiliary information with primary information contained in a database. In the genome database, the primary database has a sequence of approximately billions of nucleotides, containing genes, regulatory elements, and other material with unknown function. The enormous sequence, identifies significant patterns, gets identified, annotated as translation, transcription, variation, structural, which has similarity, repeated, or even experimented.

The data use applications depend on the understanding capability of the data architect. A data model, be it conceptual, logical and physical, are abstract and represent the real-world entities which interoperate within an environment that links data entities, their attributes and relation among each other. These are developed and refined by data modelers. They use the data with sufficient clarifications on the requirements which is necessary and can be iterated with sufficient refinement along with application developers to evolve the development of the application to determine the best data representation for yielding appreciative information suitable for decision making. The architecture specifies the described state, with data requirements, and guides integration of data assets as envisaged in the plan. Starting with the focus of the data sets existing inside or from outside, the evaluation of the infrastructure selects the data platforms and the associated information tools and services, for systemic construction of centers that can be configured in the

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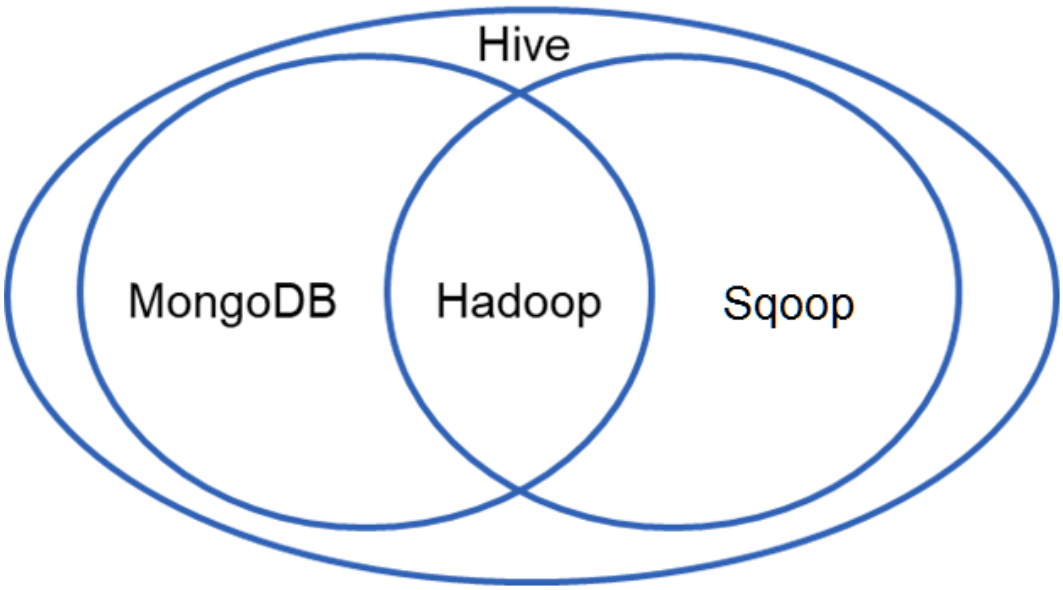
cloud. Next the data feed and ingestion happen after validating the external data sources, with data quality parameters, transform into customizable formats suited. Then the structured big data is then stored in relational database management systems while the unstructured data managed in NoSQL databases and cloud object storage services.

Hive is a software application that is used to analyze big data (refer Fig 1.) through the batch processing technique by a structured query language used for interaction with databases. The analyzed data is then sent to Hadoop, to derive the schemas, while the stereotypes remain with Hive itself. Hive is fault-tolerant in Hadoop and operates on the basis of replica creation, preventing loss of data or schemas just in case a particular machine fails to work or stops in between. From an organizational perspective that looks out for cheaper options to achieve same goals on a cost-effective mode, Hive offers to stand as best software to use and operate. Hadoop is an open source software on Java based framework for storing and processing big data, competitive in cost using commodity servers that runs on clusters. The RDBMS enables concurrent processing and fault tolerance. These Java programs are used by Google, Facebook, LinkedIn, Yahoo, and Twitter etc., Mongo DB has a document-based structure, a natural way to store unstructured data, while its flexible schema accepts data in any form and volume, it is quite comfortable to handle increasing storage of data. Mongo DB is highly scalable, for advanced big data analytics and insights; it also allows users to query for data in any format on the cloud. Sqoop is a connector that is used to transfer data from RDBMS such as MySQL or Oracle to Hadoop Distributed File System (HDFS).

Figure 1 – HIVE in Big Data



Source - K Umachandran (2014), Data Science Analytic Tools, DOI: 10.13140/2.1.1913.9365

In the Hive has the data indexed (refer Fig. 2) in the Stores and as Stored in Algorithms. To query the data transaction happens, user defined functions tools are used in data mining finally meta data gets embedded. Compiling the compressed data accelerate the process. Hive table is the big data tables which depend on structural data, by default, the data storage happen in the warehouse. Hive follows the same SQL concepts like row, columns, and schema. The storage to a specific location is carried through location tag. The data is written in Hadoop clusters using spark or Nifi streaming or any ingestion application.

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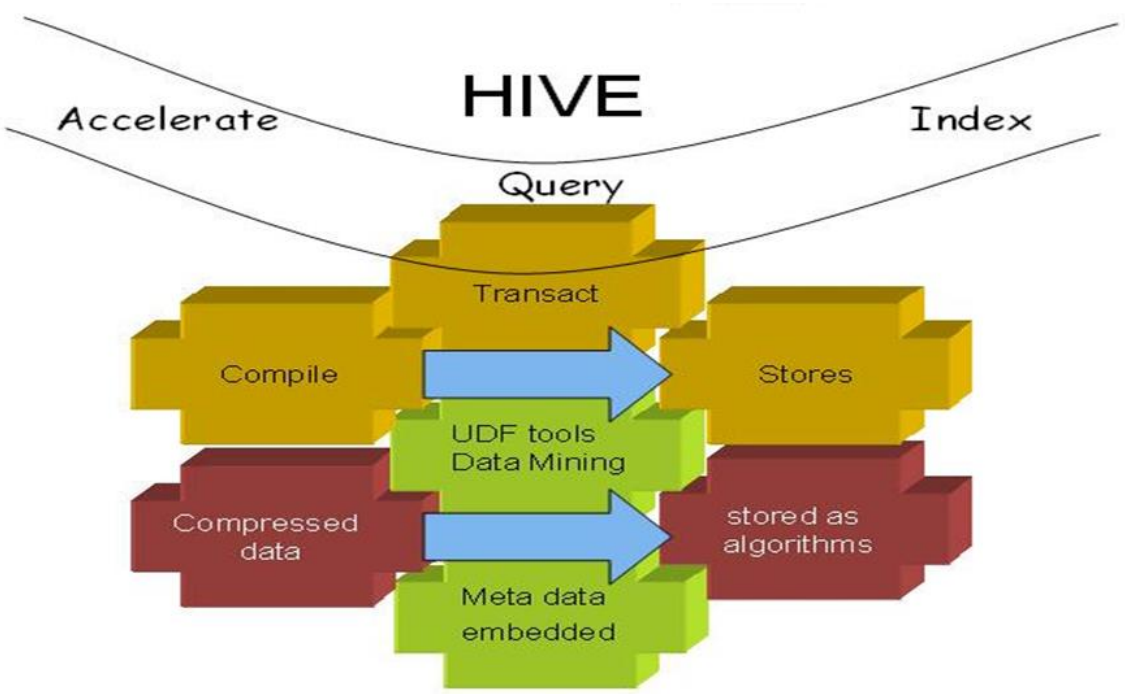

Figure 2. The Hive Composition

Source - K Umachandran (2014), Data Science Analytic Tools, DOI: 10.13140/2.1.1913.9365

Interoperable Sensing devices

New computing technologies such as machine learning have evolved a lot from that in the past. Starting from pattern recognition, computers today learn automatically without being specifically programmed to tasks with iterative aspect of models being subjected to new data, and also learn from various computations to produce repeatable and reliable decisions. The emerging technologies enhance the data collection, information processing and communication enabled through sensors, and devices that are logically located throughout to measure, monitor congestion. Pinpoint the exact locations and report conditions through connectivity anywhere to everywhere, including individuals and every of their interoperable devices. Augmented reality overlays data and information to line-of-sight onto the real world. Manufacturing uses AR technologies for operators training and process and maintenance tasks. New employees learn on machine safety, virtualized even before they enter the shop floor for the first time. AR support in facilitating the maintenance tasks through tooltips, operating and maintenance manuals, and other inputs in the environment readily available and visible on the site. Using AR Maintenance technicians can see the inside of any complicated or even dangerous machinery before opening to know accurately the real problem before attempting to start the activity.

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Conclusion

Artificial intelligence and cloud computing with centralized database of all records of the networks, customer connectivity and data traffic, enables fully cloud based correlation of AI representing industries, to deliver a cutting-edge digital experience. Digital transformation is moving mobile access network from silo site structure to cloud haul connectivity to the last mile and provide better features to customer, optimizes network and enables intelligent service provision through better bandwidth, traffic streaming and mobility connectivity. AI offers comprehensive verification of network, including checking value stream industrial network to do best of traffic flow and allocate required resources along with CRM, thus precisely identifying the velocity of demand in any area or resources that needs to be enriched or updated.

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