TECHNOLOGY INTEGRATION FOR DIGITAL TRANSFORMATIONS AND MULTI-ENABLER APPLICATIONS

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Introduction

Since the dawn of human civilisation mankind embarked on the ever-continuing journey of learning, innovating, and inventing followed by unlearning, relearning and 'innoventing'. The resultant impacts are value creation with speed, quality, and scalability of operations. If any person is now given the task of lighting fire on dried leaves by scratching two stones, perhaps that would be an impossible task for her/him to do. Because man has unlearned that process. Navigating through the path of three industrial revolutions mankind is presently in Industry 4.0 era of digital technologies imbibing the pervasive culture of digital transformation (DT), which by itself is a journey and not a destination. Emerging perception of technology commentators is that some of the digital technologies would redefine and recreate societal and economic foundations of every sovereign nation.

While traversing through the earlier revolutions, mankind has witnessed shifting of sources for energy, strength, power and speed from human beings, animals, and wind to steam and water during the first industrial revolution. This was followed by inventions of electricity in the second to electronics, computers, information, and communication technologies of the third industrial revolution. During this prolonged journey of about three and a half centuries, since the first industrial revolution of 1780, certain qualities, capabilities, and habit of human beings continued to remain common and constant. And those are critical thinking, experimentation, innovation, and infusion of one technology with the other simultaneously with improved man-machine collaboration. This accentuated the process and accelerated the pace of technological advancements across centuries for benefits of mankind till the next ground-breaking invention revolutionised the entire civilisation and industrial ecosystem.

Objective

One single objective of this article is to bring out various

Image Source:
https://www.actian.com/blog/data-integration/digital-transformation-begins-with-integration/

aspects of integrating digital technologies with the objective of designing solutions of problems, service delivery through digital mode and creating new physical products. It will also briefly bring out various dimensions of integrating digital technologies with ICT and other operating technological systems, viz., mechanical, electronic, control systems, etc. Readers will also get ideas about multi-enabler applications of digital technologies.

Innovention and Technology Integration

Technology integration in common parlance signifies innovative, exploratory, and research-oriented approach and process of work for combining and infusing one technology with the other irrespective of being homogeneous and/or heterogeneous. The very definition of digital transformation of the contemporary industry 4.0 era expands scope of the task of integrations. It demands integration of digital technologies into all functional areas of business entities, and service deliveries by government agencies and NGOs. This in turn calls for challenging legacy systems and status quo, experimentation going beyond the fear psychosis of failure. In one of its documents[1] Deloitte mentioned that, *"An effective systems integration allows IT solutions to address business needs and mitigate transitions risk ..... systems integration is about consolidating and customizing technology solutions to support the successful delivery of most complex business challenges .... integrate systems and technologies with a business-centric, value-driven approach."*

This habit of exploration, experimentation and infusion of technologies have many a times lead to inventions of absolutely new technologies and products which completely redefined the hitherto unknown products and technologies. One of the recent examples of this is invention of blue 'Light Emitting Diodes' (LED) by the three cerebral research scholars, viz., Prof. Isamu Akasaki, Hiroshi Amano, and Shuji Nakamura in early1990s.

Source: https://www.bbc.com/news/science-environment-29518521#:~:text=The%202014%20Nobel%20Prize%20for,LEDs%20in%20the%20early%201990s.

Blue LEDs also helped replacing conventional electric bulbs and tube-lights with brighter illumination and substantially save electricity. This technology is being used for various display applications like for televisions, computer screens, etc. with much clear and sharper display of contents. Such further developments of this invention brought for those three cerebral researchers Nobel Prize for physics in 2014. Invention of blue LEDs is a unique example of 'Innovention' which is a combination of three terms, viz., innovation, invention, and creation of value by minimising value destruction and maximising value creation.

The Approach and Process

The approach and process for technology integration, refines and upgrades the resultant impacts with multifaceted outcomes which could have not been achieved without integration. Another key objective of such a combination is to reduce human interventions and thus reduce probability of error to improve quality and speed. One commonly known technology in good old era for moving primitive mechanical machines was windmills. After electricity was invented in 1870 another path breaking integration was done for providing electrical power and speed to mechanically engineered technologies by propelling motors to rotate wheels of mechanical machines.

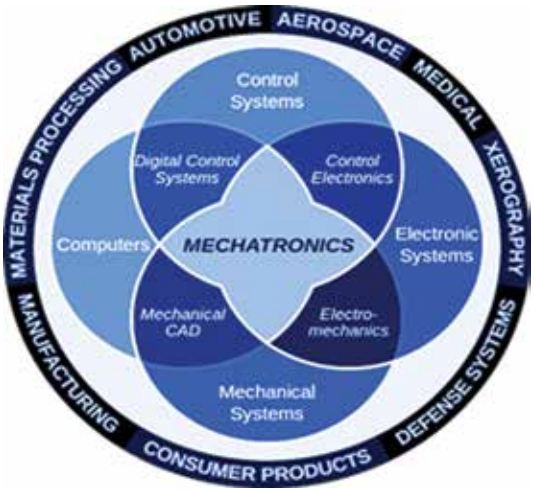
Two of the most popular and commonly known knowledge about technology integration thereafter was for miniaturisations and revolutionization of controls mainly by Japanese and Korean scientists. They applied electricity related technology innovatively with continuous improvements from valves to transistors to chips for electronic circuits which were also ultimately used for creating computing hardware and other devices. This process of technology integration continued to meet latent demands of society and create values by minimisation of value destruction and maximisation of value creation.

The phrases used for such integration, e. g., electro-mechanical, electro-magnetic, mechatronic, etc. are in common domain of applications by designers and product creators in general. This would have not been possible if mankind would have not continued with the habit of critical thinking, experimentation, research, and development adopting innovative approaches for integrating different technologies. History has time and again testified that outcomes from great research works have been converted into a great product. Blue LED is a scintillating example of that.

Examples of Technology Integration

Mechatronics is a unique example of an entirely new technology created by integration/infusion of several technologies into one combined creation. This illustrates evolution from mechanical engineering to

information-based industrial automation. Robots are unique examples of mechatronics which enables a flexible physical device to perform many tasks right from cooking, dancing, performing medical surgery to manufacturing of goods and assembly of cars.



Source: Mechatronics Engineering Clayton Club https://meccmonash.weebly.com/

Readers will observe from the above graphics that mechatronics is born by integration of four technological systems in the following manner:

- Mechanical Systems + Computer Systems = Mechanical design automation (MCAD)
- Computers + Control Systems = Digital Control Systems
- Control Systems + Electronic Systems = Control Electronics
- Electronic Systems + Mechanical Systems = Electro-mechanics

The unique final output from these combinations of four systems is Mechatronics which in turn gives birth to new age digital system driven machines like a robot. A robot can even perform surgery on a human body like a medical surgeon. While constructing such robotic surgeons, the knowledge and art of medical science have also been instilled into control systems for the robot. Objective is to provide instructions from the computer console, being physically operated by the medical surgeon, for controlling the robotic surgeon's activities in physical operation on the body of a patient. This has been demonstrated in the first picture provided below. Readers may know more about Robots and robotic process automation (RPA) from the author's article[2] published under this column in September 2021

Another pathbreaking application of mechatronics is one step ahead because it is combined with one more unique technology for aero-dynamics or aviation enabling a machine to fly with precision of moving over pre-specified location(s). Such geography-specific location-wise movement is possible due to integration of another digital technology called Global Positioning System (GPS). "*GPS works through a technique called trilateration. Used to calculate location, velocity and elevation, trilateration collects signals from satellites to output location information.*"[3] If allowed, a drone can fly independently and use remote sensing devices which enables it to locate a target as asked for by the flier pilot of the drone through ICT systems from ground. It can also be integrated with edge computing systems so that while flying, snapping pictures, and performing actions can also perform data processing before transmitting information to a central computing system for initiating the next course of actions. The author has ideated this application in his article on Kishan Blockchain Platform[4].

Sources:

Robotic Surgeon: https://www.wired.co.uk/article/robotic-surgery-coronavirus

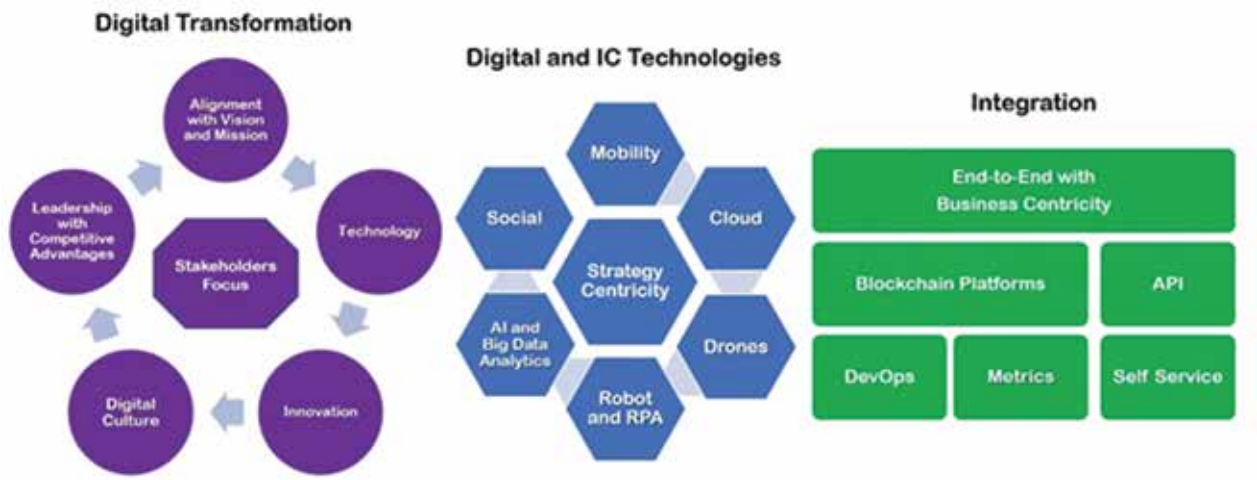
Drone: https://lawtrend.in/what-is-the-law-on-flying-drone-in-india/

Readers by now must have guessed what is being talked about. Yes, such a capable unmanned arial vehicle (UAV) is nothing but a Drone created by excellent integrations of several technologies including digital technology of the present Industry 4.0 era. Asa Weiss, of X, the moonshot factory, Stanford, USA, in an article of Simplexity[5] defined a drone by stating *"The definition of drone has come to encompass most small, unmanned vehicles, including remote-controlled aircraft. Technically, drone also implies a level of autonomy, anything from simple self-balancing to more complex functions like hands-off GPS-waypoint navigation missions or swarm logic. It's the culmination of several recent technological breakthroughs in each of the fundamental mechatronic fields (electrical, computer, mechanical, and controls engineering) that has led to the recent ubiquity of drones."*

The present author has written a separate article[6] in October 2021 on drones under this column. Readers would be able to know more about the genesis and evolution of UAVs tracing its genesis since the days of gas balloon. Drones are now being used for achieving unique objectives of defence and strategic actions of a sovereign country, agriculture, healthcare, cinematography logistics management and many other industrial applications

Integration of Digital Technologies

More narratives about creations of various applications, popularly known as 'Apps' by combination of various digital technologies like Blockchain, AI and ML, RPA, Drones, IoTs, handheld ICT devices and so on are being avoided due to shortage of space. Moreover, readers are aware of several such Apps because they experience some of those while living daily life. It is to be agreed that the fundamental task of present-day CTOs, CDOs, CIOs and CSOs is to make various disparate Apps and systems function in orchestration. The pressure of attaining leadership position with sustainable competitive advantages on the face of sever competitions and continuous disruptions has forced them to innovate with multiple digital technologies and marry those with other operating technologies as have been explained above.



Source: Graphic recreated by author from ideas derived from
https://www.dataversity.net/integrations-key-technology-enablers-digital-transformation/

The entire process of digital transformation and integration of digital technologies must start with alignment of strategic objectives of digital transformation with the vision and mission of the business entity, government, or NGO. If need be, those are also to be revisited and redefined with long term perspective and new aspirations befitting the emerging business ecosystem of Industry 4.0 era, At the centre of the project should be the stakeholders whose interests and objectives are to be served in compliance with ethical and regulatory obligations for the causes of environment, society, and governance (ESG). Success would also depend on migration from the hitherto organisational ecosystem of legacy policies, systems, and processes with the overarching attributes of digital culture. The axiom that must be kept in mind is, *"What has brought us up to here, will not take us there, and right to make mistakes is a key enabler of innovation."* Users must adopt digital culture and change with vibrating ethos of innovation for value creation. All these have been captured in the purple-coloured part of the above graphic.

Integration of digital technologies are accomplished with the specific objective of creating new-age multi-enablers for value creation. Therefore, purposeful digital transformation depends on the critical task of successfully identifying the technologies to be integrated to serve long term strategic purposes. Prasanna Kumar Illa[7], an eminent

integration architect at Sun Power is of the view that, *"The four technology areas: Social, Mobile, Analytics and Cloud were the foundation for digital innovation in most organizations till recently. Today IoT, Big Data, Virtual Reality and Artificial Intelligence are further accelerating the digital transformation. The convergence of all these technology areas give raise to next generation applications and new business opportunities. Integrating these diverse technology areas is paramount for the convergence to happen and the traditional integration approaches are not feasible in the new digital disruption era where changes occur very fast".* Therefore, in the middle of the process lies the blue-coloured basket of options for technologies.

The core task of integration must also ensure pervasive risk enabled performance management while creating values to be shared with all stakeholders. The of newly designed solutions and digital applications must be multi-enablers for risk mitigation and withstanding cyber-terrorism, establishing one version of truth with pervasive ESG compliance. End to end business centricity must be at the core for identifying technologies which are to be used for creating a multi-enabler platform and convergence/ infusion of technologies into one integrated solution. The essence of this has been captured in the third green block. Last but not the least are introduction of a culture of continuous tracking, monitoring, and upgrading of solutions with pre-defined KRAs and KPIs as technologies keep evolving with higher versions for designing multi-enabler solutions.

Conclusion

The chosen theme for this article is a vast one. Much more should have been written to do justice. Again, there are many seeds in the womb of time which digital scientists are working with. However, the author would consider this article to have met success if readers get brief overarching ideas about technology integration with a specific purpose of creating multiple enablers that help moving ahead with sustainable shared value creation in compliance with ethical and humane obligations while conducting business and delivery of services. MA

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All these websites have been accessed during April and May 2022.

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