ISSN: 2456-9348
Vol (03) _Issue (10) Impact Factor: 4.520

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International Journal of Engineering Technology Research & Management

FINDING A DIAMOND NEEDLE IN A HUGE HAYSTACK

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ABSTRACT
Drug discovery is a complex, and lengthy daunting process resembling to find a diamond needle in a huge haystack. The symbiotic integration of quantum computing, 6G wireless communications, artificial intelligence, and blockchain have emerged to constitute *quantum communication intelligence chain (QCIC)* to disrupt drug discovery process cutting down efficacy failure boosting a success rate significantly while minimizing investment. Pharmaceutical companies have not yet adopted to think holistically to apply QCIC through the unique strength of quantum systems thinking to empower drug discovery exaltation. The aim of this research is to investigate the influences of quantum systems thinking from the perspective of QCIC applications in the drug discovery process disrupting pharmaceutical industry to create quantum opportunities to attain quantum value co-creation. The research methodology utilizes an exhaustive literature review on the historical perspective of drug discovery process,quantum systems thinking, QCIC, and the quantum value co-creation. The application of *KLAS (Kanban, Lean, Agile, Scrum)* methods with *perpetual product, process, service innovation(P^3SI)* is confabulated to focus on the best possible evidence-based research for drug discovery quintessence. The contribution of this research provides quantum systems thinking approach for the QCIC applications to the drug discovery process to attain *quantum value co-creation (QVCC)* transcendence and stakeholder satisfaction.

Keywords: Drug Discovery, Quantum Systems Thinking, QCIC, Quantum Value Co-Creation.

INTRODUCTION

The quantum revolution is poised to emerge with prominent and eye-catching disruptive technologies to fundamentally transform the economy from digital to quantum. The symbiotic integration of quantum computing (QC), 6G wireless communication (6G), artificial intelligence (AI) and blockchain (BC) are emanating to form the *quantum communication intelligence chain* [1] disrupting drug discovery process.

The author has coined the term quantum communication intelligence chain (QCIC) which signifies the symbiotic integration power of the four technologies - QC, 6G, AI and BC - that can sort through massive volume of data to answer a single question in a highly complex process of drug discovery.

Developing new drug involves the identification of candidates, synthesis, characterization, screening, assays for therapeutic efficacy and development of the drug prior to clinical trials. It starts with the identification of the molecule that can activate or block the target or receptor involved in a disease. A chemical compound identification and validation is one of the most important steps in the drug discovery process. Scientists have already developed quantum processor capabilities with quantum bits (qubits) that can complete a task in 200 seconds (3 minutes 20 seconds) which would take 10,000 years for the state of the art classical (super) computer. Such quantum supremacy of power can be applied for drug discovery and development work where researchers can find a molecule from thousands of molecular compounds to confirm in few minutes for the molecule involved with the disease in question. It is like searching huge haystacks to find a diamond needle in minutes.https://fortune.com/2019/09/20/google-claims-quantum-supremacy/

When one think about drug discovery, one must approach it as a quantum systems thinker. The first is to look for components of the problem that characterizes as a system. Meaning where are the inputs, outputs (overall objective), throughput, boundaries, feedback and control mechanisms, interactions with other systems. To build systems kinetics models that capture a system, one should explore how cycles and delays affect the overall behavior of the system. Also, one always looks out for emergent properties that arise as a result of interactions across a system. As shown in figure 1, the author has introduced quantum systems thinking approach with a novel orientation to QCIC applications to achieve simplicity for the drug discovery process.

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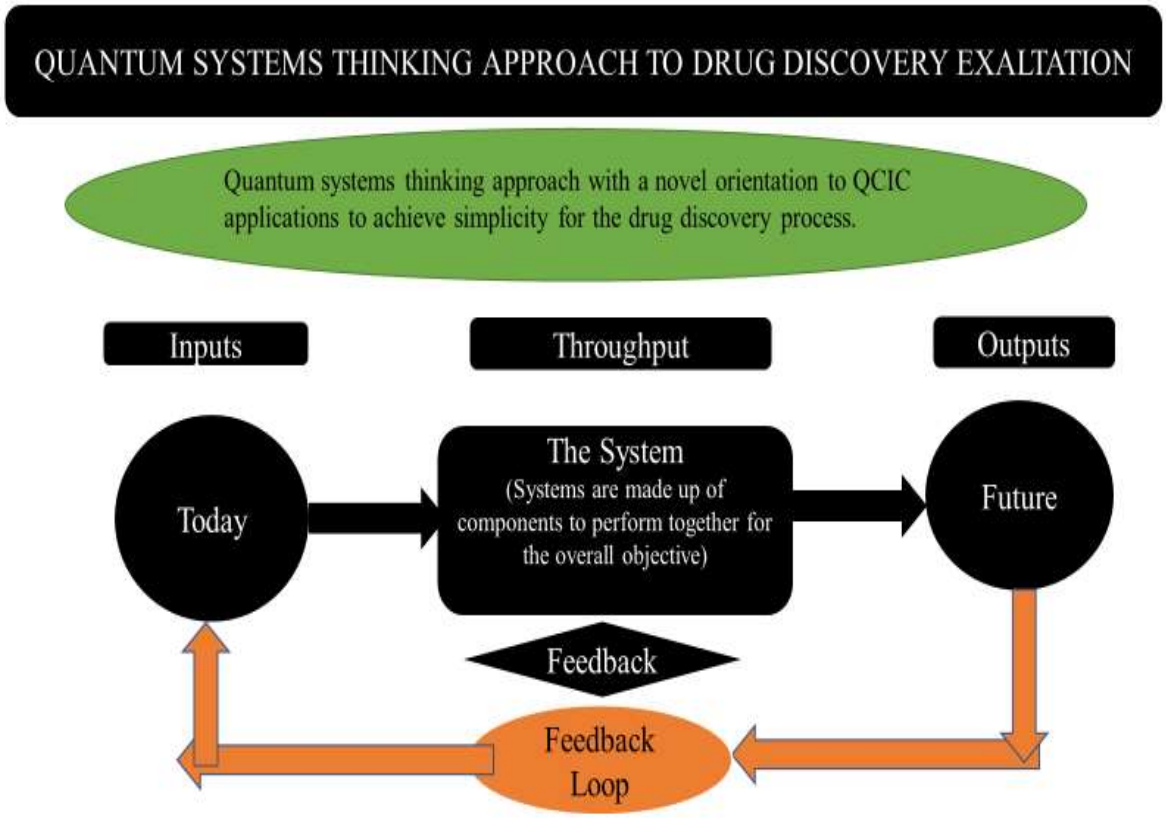

Fig.1 Quantum systems thinking approach to drug discovery process

PURPOSE OF THE STUDY

The aim of this research is to investigate the influence of quantum systems thinking (QST) from the perspective of QCIC applications in the drug discovery process to create quantum value co-creation (QVCC).

JUSTIFICATION OF THE STUDY

Pharmaceutical companies have not yet adopted to think holistically to apply the unique strength of quantum systems thinking to achieve drug discovery eminence. The QCIC integrated concept as a system is still largely undiscovered areas in the drug discovery process. The convergence and application of QCIC has not received its fair share of scholarly attention yet in the drug discovery literature. There is a knowledge vacuum in the literature with respect to quantum systems thinking approach in the applications of QCIC to drug discovery process. Projects in practice devoted to this groundbreaking symbiotic integration of QCIC applications and QST is not pursued by the pharmaceutical companies yet. Hence, the author has ventured to investigate the influence of QST approach in the QCIC applications to demonstrate its enormous benefits to accelerate drug discovery process boosting success rate significantly while minimizing investment.

RESEARCH BACKGROUND

Drug discovery – A historical perspective

Drug discovery history dates to the early days of human civilization and drugs were used for physical remedies and associated with religious and spiritual healing. Drug discovery history in the pharmaceutical industry and academic labs over the past 50 years shows a progression of discovery paradigms that began shortly after “miracle drugs” such as the penicillin’s and saw the rise of synthetic organic chemistry which had influenced the large scale preparation of drug candidates was economically feasible.

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3500 BC – Traditional Chinese medicine originated during legendary emperor Sheng Nong.
3000 BC – Egyptian medicine (Ebers papyrus provided 877 prescriptions and recipes for internal medicine, eye, skin and gynecology.
3000 to 5000 years – Ayurvedic medicine in India.
400 BC – Greek Medicine - Hippocrates, the father of medicine is credited with laying down the ethics for Physicians. The Greeks established that diseases result from natural causes.
400 to 1500 AD – Roman medicine – Romans instituted hospitals.
900 to 1000 AD – Arabian medicine.
1800s to 1900s – Beginnings of modern pharmaceutical industry.
Pre 1919 – Herbal drugs and serendipitous discoveries.
1920s & 30s – Vitamins and Vaccines (such as Penicillin).
1940s – Antibiotic era. Research and development boost due to World War II.
1950s – New Technology and discovery of DNA.
1960s – Breakthrough in Etiology
1970s – Rise of Biotechnology and use of Information Communication Technology (ICT).
1980s – Commercialization of drug discovery and combinatorial Chemistry
1990s – Robotics and Automation for the manufacturing of drugs.
2000s – Breakthrough in the Cancer Treatment - Gleevec, also known as Imatinib, is considered a miracle drug given an approval in 2001 by the US Food and Drug Administration to cure Chronic Myelogenous Leukemia (CML).
2010s – 435 human genome products were identified as therapeutic drugs targets of FDA approved drugs.
www.scalettar.physics.ucdavis.edu/frs/historyofdrugdiscovery1.pdf, www.chemdiv.com/top-10-scientific-drug-discovery-breakthroughs-deadly-diseases/

There are more than 100,000 known diseases in the world out of which 7,000 of them are considered rare. The treatments are available only for 500 diseases approximately. Scientific breakthroughs and technological advances have been made greater understanding of the drug discovery process. The current approach to creating new molecule therapeutics remains fundamentally inefficient consuming 10 to 14 (approximately) years and billions of US$ searching for new drugs. In 2018, fifty-nine (59) drugs (a new record) were approved by the Food & Drug Administration (FDA – USA). The fundamental question is whether such numbers are artifacts, random noise, or part of a real trend? The chances of success for a compound entering phase 1 clinical trials have not increased. It's still less than 10%, same as last couple of decades. 10% success rate is the single most important figure in the pharmaceutical industry. The number of drugs in early-stage development has been dropping steadily since the 2009-2011 period. No other industry or business operates under such a high failure rate. Greater than 90% failure in the central, crucial process of the drug discovery business is "distinctive" creating infuriating experience. Between 2002 and 2012, the *failure rate* for new *drugs* targeting Alzheimer's disease was 99.6%. Therefore, in my opinion, fix that failure rate and everything changes.https://www.quora.com/How-many-diseases-are-known-on-this-world, https://www.google.com/search?client=firefox-b-1-d&q=how+many+rare+diseases, https://www.washingtonpost.com/news/fact-checker/wp/2016/11/17/are-there-really-10000-diseases-and-500-cures/

The drug discovery process:
The process is somewhat murky, and a vast majority of population as well as healthcare investors don't quite understand the ins and outs of this opaque process. To that end, nine steps process are discussed below, as shown in figure 2, for most drugs go through from concept to medicine cabinet. The author contends that most pharmaceutical companies have not yet devoted to the integration and application of QCIC and its enormous benefits to impact the game changing acceleration of drug discovery process boosting success rate significantly while minimizing investment substantially.

Step 1: Drug discovery and target validation
Typically, researchers discover new drugs through new insights into a disease process. The first step involves discovery work where researchers choose a molecule from thousands of compounds, such as a gene or protein, and confirm that the molecule is indeed involved with the disease in question.

Step 2: Preclinical testing
The preclinical testing, which is divided into two subcomponents: in vitro and in vivo testing. In vitro examines the drug molecules' interactions in test tubes and within the lab setting. In vivo involves testing the drug molecules on

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animal models and in other living cell cultures. Efficacy is starting to be established at this stage. Safety is still paramount as the FDA will not let preclinical studies move into human trials without extensive data on safety.

This is the stage where researchers whittle thousands of drug molecule down to one and five. Generally, many years have often passed in this phase.

Step 3: Investigational New Drug (IND) application filing
This step involves submitting an investigational new drug (IND) application to the FDA prior to beginning human clinical trials. FDA will scrutinize the results from the preclinical testing, look at side effects and other safety features of an experimental drug. If the FDA approves a drug developer, then it can move onto human trials. This approval by FDA is called IND approval at which a patented drugs' 20-year exclusivity period begins.

Step 4: Phase 1 clinical studies
This phase involves with a relatively small group of healthy people, and the focus entirely on safety involving how a drug is absorbed and eliminated from the body, as well as what side effects. This is the stage where maximum tolerated doses are established and drug developers to tout early signs of efficacy.

Step 5: Phase 2 clinical studies
At this stage the patient pool widens from a few dozen to perhaps 100 or more patients, and the patients are afflicted by the disease in question. Safety remains a big focus with short-term side effects being closely monitored and establish which dose performed most optimally.

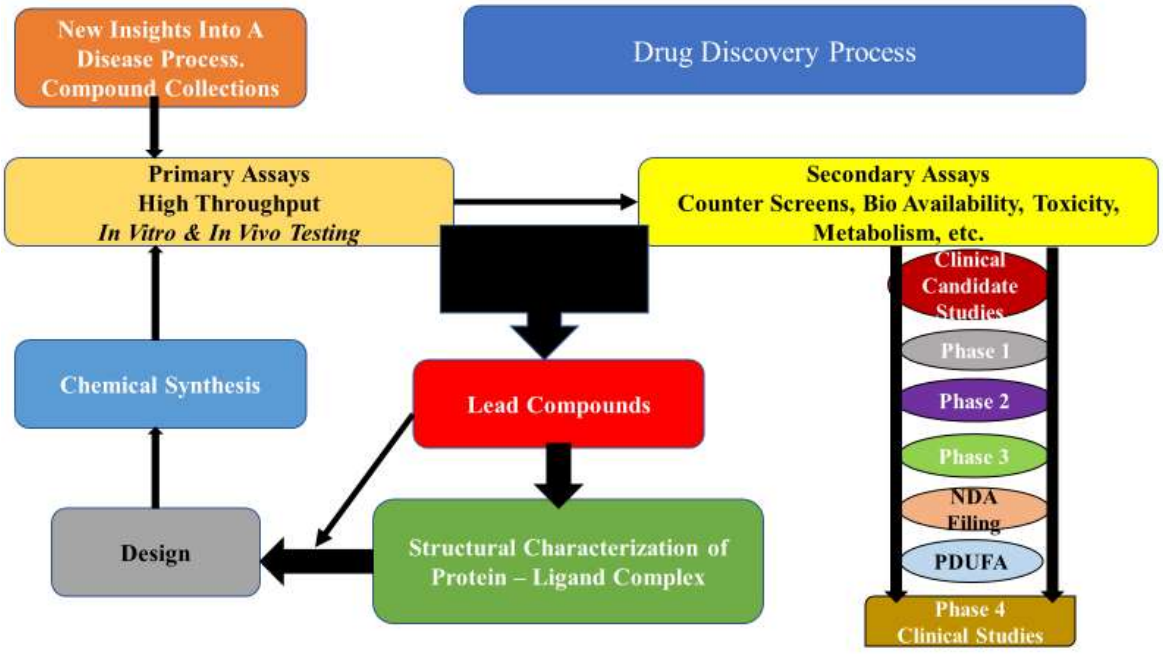

Fig. 2 Drug Discovery Process

Step 6: Phase 3 clinical studies
Safety remains a huge priority and efficacy plays a big role. This phase trials involve even more patients, maybe thousands. This step by far the longest and costliest of all components of the drug development process and drug developers will begin to think to ramp up production based on the promising results.

Step 7: New Drug Application (NDA) filing
Starts with filing a New Drug Application with the FDA. An NDA can be tens of thousands or perhaps 100,000 or more pages long, and it contains all research and safety data examined during each of the six prior steps. If the NDA is accepted a Prescription Drug User Fee Act (PDUFA) is issued. Then a date is set 10 months down the road (for a standard application) for FDA may make its decision.

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Step 8: PDUFA date and decision
The FDA will wait until the PDUFA date to release its decision. Meaning the FDA has three choices: (i) approve a drug; (ii) it can outright deny a drug; (iii) can request additional information by sending a complete response letter (CRL). If FDA approved, then the drug ready for commercial production.

Step 9: Phase 4 clinical studies
FDA approved drug can make it to medicine cabinet but that doesn't mean the drug developer is off the hook yet. It's not uncommon for the FDA to request long-term safety studies even after approval.

Paradigms in drug discovery
The new emerging therapeutic modalities are cell and gene therapies. The cells themselves are developed as medicines and their full potential realization requires a new paradigm, as shown in figure 3, where new organizational approach, management strategy, technology development, manufacturing is conducted in parallel from the earliest stages of research to the clinic. The drug discovery and development process for small molecules dictates that 5000 to 10,000 (or more) chemical compounds initially undergoes laboratory screening. Approximately 2.5–5% will go through preclinical testing. 0.1% will enter clinical testing. This entire process from discovery to marketing of a chemical drug can take 10–15 years. Cell-based and gene therapies have certainly turned a page with multi-step processes resulting gene-expressing cell product.

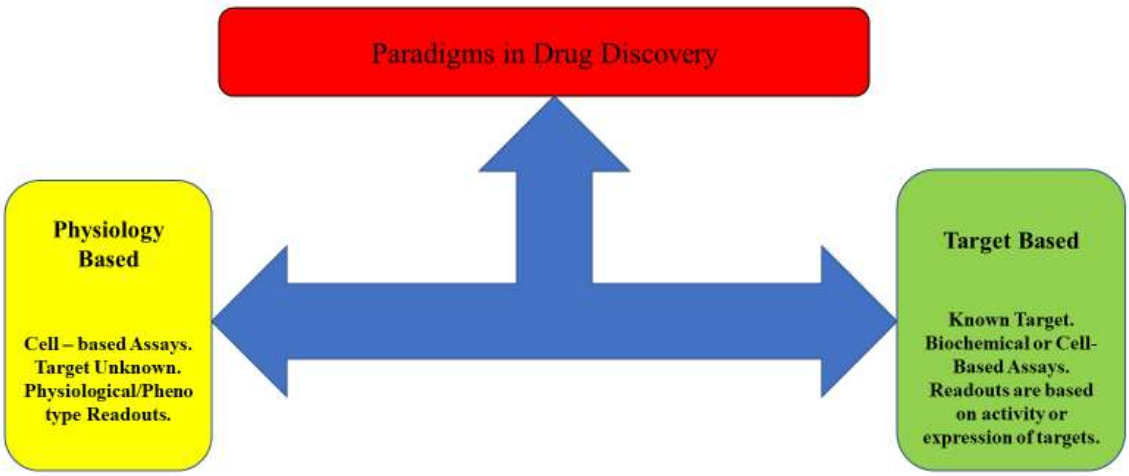

Fig.3 Paradigms in Drug Discovery

Assay development, as shown in figure 4**,** is an objective method for screening compounds to determine interaction of the target. During the design stage, assay conditions and procedures are selected to minimize the potential sources. A significant portion of the investment is invested in the identification of molecules that exhibit significant medicinal activity against a disease, usually called 'hit'. Most of the research in drug discovery focuses on hits of low molecular weight which constitute around 78% of the drug market.
Assay development and optimization process can be thought of as a cycle in which several variables can be tested. Assay validation demonstrates that the assay is acceptable for its intended purpose.

The followingkey considerations in Assay development are: (i) Relevance, (ii) Reliability, (iii) Reproducibility, (iv) Robustness, (v) Practicality, (vi) Cost, (vii) Automation. The quality of an assay determines the quality of the data - compromising on assay development can have substantial downstream consequences.

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Drug development challenges

- Drug development is a complex, lengthy, and very expansive process with a high degree of uncertainty.
- The unknown psychophysiology makes target identification challenging for nervous system disorders.
- Animal models cannot recapitulate an entire disease.
- Heterogeneity of the patient population with extended clinical phenotype is a challenge.
- Emphasis on data lead to increased target identification and validation.
- Lack of validated diagnostic and therapeutic biomarkers to detect and calibrate biological states.

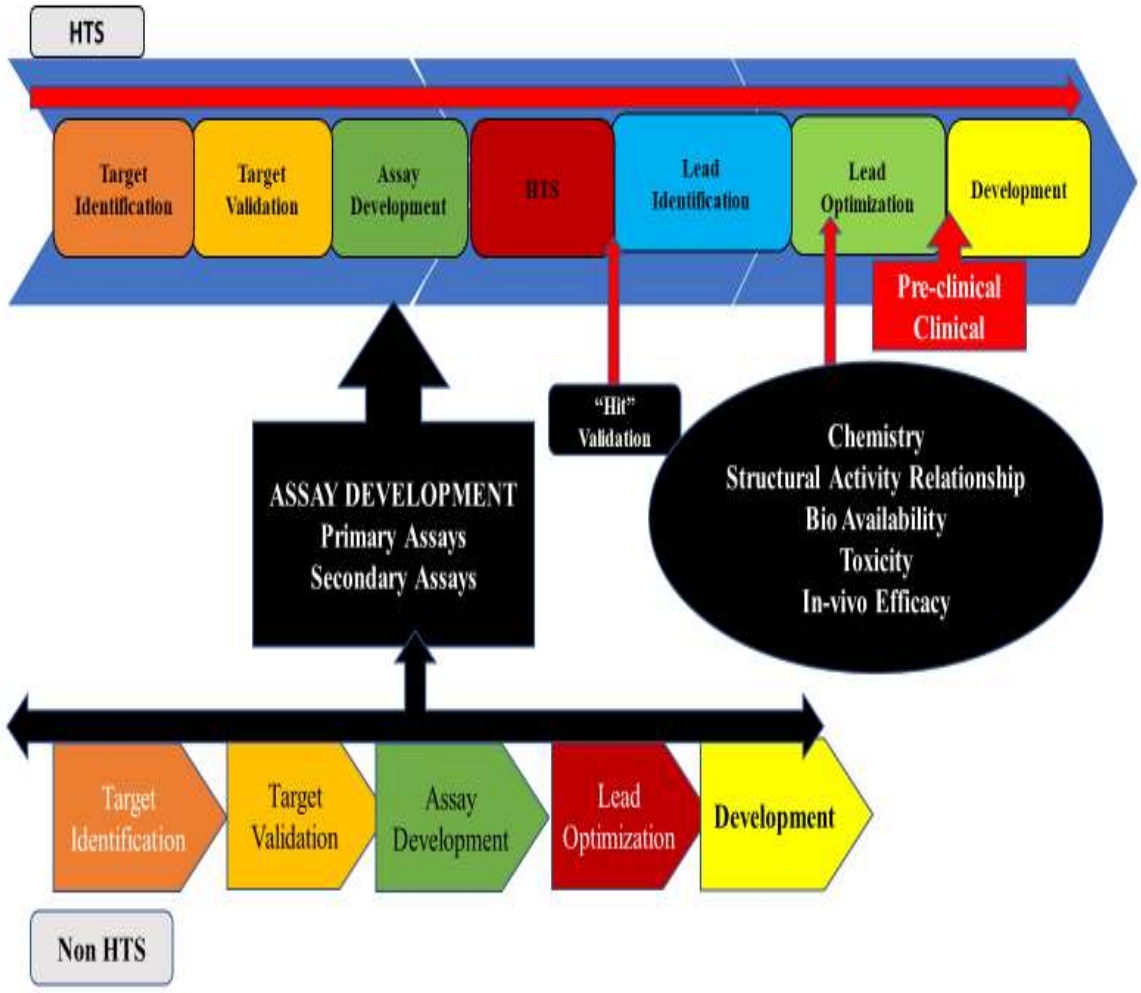

Fig. 4 Illustration of Assay (Primary & Secondary Assays) Development

APPLICATION OF QCIC TO DRUG DISCOVERY PROCESS

Life science is populated by a plethora of 'omics' spawning into the so called 'Big Data' pool. Given there is no apparent end to knowledge, the greater challenge in a modern world of 'Big Data' is its conversion to useful and actionable data. In the context of drug discovery, it is therefore imperative to take advantage of quantum computing and quantum data processing in a manner that provides a direction to undertaking drug discovery whereby the information is pertinent, valuable and grows useful actionable knowledge.The costs of developing a new drug doubles every decade. The implication is that the increasing costs of drug discovery prevents economic agents in the market investing huge resources needed for therapeutics development for rare and yet unsolved diseases. To solve this daunting problem, new methods of drug discovery are essential.

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Quantum theory toaccelerate drug discovery
Molecular mechanics (MM) is a computational approach to modeling in medicinal chemistry, synthetic organic chemistry, and various aspects of drug design. But MM methods have limitations, particularly when used to study electron-based properties within the drug-receptor microenvironment. Quantum mechanical (QM) methods increase the accuracy of predictions providing much more relevant models of biological and chemical objects and their interactions.But QM methods are extremely costly for computation. The emergence of density functional theory (DFT) have increased in the computation power and the distributed cloud-based computational infrastructures.

The following computational start-ups in quantum calculation methods are promising to boost the success rates of the drug discovery research: (i) ChemAlive – founded in 2014, is focused on application of technologies, including quantum mechanics [2] calculations and machine learning for accurate prediction of chemical reactions and molecular properties, as well as modeling processes for drug discovery research.

(ii) founded in 2014, Cloud Pharmaceuticals is applying a set of computational technologies, such as machine learning, cheminformatics, and quantum mechanics, to accelerate and improve the drug discovery process. Through the key components of artificial intelligence and quantum mechanics applications, the company uses the Quantum Molecular Design (QMD) platform to generate drug like hits quickly and cost-efficiently for a wide range of biological targets. https://www.biopharmatrend.com/post/99-8-startups-applying-quantum-calculations-for-drug-discovery/

Quantum tools for drug discovery
Over 7 decades of digital (classical) computer development have accelerated the creation of drug discovery applications. Companies, like Silicon Therapeutics and Atomwise race to cure diseases like cancer and malaria through high-volume computation. Drug discovery applications quickly adopt increases in computing power. For instance, IBM's Q System and D-Wave's 2048 qbit Quantum Annealer has solved various quantum chemistry challenges by determining minimum energy states of atoms in molecular structures. Quantum**Simulations accelerate drug discovery.** Assuming to double computational bits every 2 years, a 100,000+ qbit Quantum Annealer will be created in the next decade. The author contends that future quantum computers can build atomically accurate models of large-scale matter. These simulations can be accessed through intuitive virtual reality (VR) interfaces — providing information to users at optimum speed and ease. Today, drug researchers evaluate tools for accessibility and communicabilityandcanbe addressed at the interface level. Users can exchange information with a program via interfaces. Drug discovery is inherently collaborative, and insights need to be shared.Interfacial thinking is key driver for the usage of quantum tools in drug discovery applications. User friendly interfaces expand the accessibility and usefulness of information. User interfaces are a form of translation. Quantum computing makes simulation engines more robust. Molecular simulation can be widely accessible via intuitive VR and unlocks the full potential of human – computer interaction. https://blog.matryx.ai/quantum-tools-for-drug-discovery-building-the-optimal-interface-e3c326064165

Quantum computing for drug discovery
Quantum computing allows for complex equations and problems to be solved exponentially quicker than is currently available and is a marvelous aid in a drug discovery crisis. The intersection of biology and quantum computing can help structural based approach for de-novo drug design.Quantum computers offers the biggest benefit to unlock simulation capabilities for molecules of increasing size and complexity. Many materials require computing power that classical computers do not possess. No two fields of research and development (R & D) more naturally fit to quantum advantage than materials design and drug discovery. There is no question that the shortcomings of classical computers limit R&D in the drug discovery process. Materials design is a slow laboratory process characterized by trial and error.Global pharma firms spend more than US$40 billion a year on candidate material selection, synthesis, and testing. Quantum computing will improve the material design workflow yielding substantial cost savings and reduced time to market.Scientists expect more powerful simulations to generate replacement value over today's generics as larger molecules produce drugs with fewer off-target effects. Quantum computing is expected to yield up to $75 billion in annual operating income for end users once pharma companies have access to fault-tolerant quantum computers.

Quantum advantage has significant implications.Quantum simulation enables researchers to model interactions among materials as they grow. Pharma companies can reduce or even eliminate lengthy lab processes through quantum simulation. Example: Zapata Computing - quantum-advantaged molecular simulation can drive significant

cost savings and better drugs development making market entry sooner. Zapata focuses on quantum computing software solutions that could apply specialized algorithms to some of the world's most intractable problems such as drug discovery applications.https://www.sciencemag.org/news/2017/09/quantum-computer-simulates-largest-molecule-yet-sparking-hope-future-drug-discoveries.

In Jan 2019, IBM announced the world's first commercially available quantum computer called IBM Q "System One" harnessing the power of the 20-qubit machine over the cloud and has made quantum computing as a cloud service available to the world for the first time. IBM's 53-qubit quantum computer will be launched during Oct 2019 and will be the largest universal quantum computer that's available for general commercial use. Google has managed to attain "quantum supremacy" a major milestone claiming that sycamore quantum computer (72 – qubit processor as a testbed) can complete a task in 200 seconds which would take a state-of-the-art supercomputer 10000 years (roughly) to perform.

Google's announcement is not a commercialized offering. In 2017, Intel announced the delivery of a 17-qubit superconducting test chip for quantum computing to research partner Qu Tech in the Netherlands.https://newsroom.intel.com/newsroom/wp-content/uploads/sites/11/2017/10/17-qubit-fact-sheet.pdf,

Quantum technologies are one of the most exciting emerging developments in computing, communications and harnesses insights from quantum physics to make computers much faster and much more efficient than existing classical models. Quantum computer-aided drug discovery and design is an emerging tool that uses quantum computational approaches to discover, develop, analyze drugs to reduce the time taken for the process of drug development and expense. As shown in figure 5, technologies such as quantum computing (QC), 6G wireless communications (6G), artificial intelligence (AI) and blockchain (BC) are on the cusp of disrupting all four Ps' (Product, Process, Price and Promotion) of the marketing mix across the pharmaceutical ecosystem and unleash wave of disruption on all aspects of health care business globally creating paradigm shift across consumer behavior in the contemporary society.

Quantum computing advances are closer to commercial usage for the drug discovery application - a promising area that will find several uses such as quantum simulation that will enable faster and more accurate characterizations of molecular systems than existing quantum chemistry methods. In addition, advancements in algorithmic in quantum machine learning provide useful biochemical applications for the early phases of drug discovery. Research shows that quantum computer has simulated molecules such as beryllium hydride (BeH2), and lithium hydride setting a world record of largest molecule yet, sparking hope of future drug discoveries.

6G for drug discovery and Internet of Medical Things (IoMT)

6G wireless communication is in the embryonic stage. At present, research efforts are aimed at the quantum realm to intersect with 6G. Currently, a United Nations body (the International Telecommunication Union - ITU) is studying what a 6G world might look like. Globally, research scholars at various universities are pursuing new technology research that could become the basis for "6G and Beyond". S. K Telecom (South Korea) partnering with Ericsson and Nokia pursuing 6G wireless research and development. Ting mobile is the first carrier to claim in North America offering 6G mobile network technology. Qualcomm and Samsung have started working on 6G and exact capabilities are still in the speculation phase. The objective of European QI alliance is to enable quantum communication applications between any two points on earth.

6G will drive the demands for machine-to-machine communications, including the Internet of Everything (IoE), robotics, autonomous drone delivery, and transport systems. Other future trends for 6G include ultra-dense cell networks, reconfigurable hardware, millimeter (mm) Waves for user access, enhanced optical-wireless interface, and intelligent networking to enable a fully immersive experience for users. Users will demand greater global coverage, higher capacities with always-on connectivity for QI services and applications. The driver for the 6G is the increasing trend of Software Defined Networking (SDN), Software Defined Radio (SDR) and Inter-Vendor Operability (IVO) enabling the user's an easier way to upgrade to cloud-based resources endowing numerous applications. https://www.google.com/search?client=firefox-b-d&q=software+defined+network

6G is the network that will connect Internet of Medical things (IoMT) ubiquitously. IoMT devices are going to have big data demands and the 6G network needs to support them all from everywhere to everything. To work effectively, a fully realized Internet of medical things (IoMT) ecosystem must have a 6G network that connects all

of thedevices and takes into consideration the data demand, use of power, and spectrum. With its ultrafast connectivity, data capabilities, and intelligent management, the 6G network enables new possibilities in terms of health care including quantum simulation of molecules, imaging, data analytics, diagnostics, and treatment. IoMTalso includes devices like clinical wearables and remote sensors to electronically transmit medical data.The advancement in medical diagnostics is an important capability.6G will provide the machine type communications which will help to expand monitoring and provide real-time analytics in seconds that can improve health outcomes.

The year 2018 has been marked by an impressive number of investments among artificial intelligence (AI) driven drug discovery ventures — a significant indication that the "AI for drug discovery" domain gaining serious attractiveness for the investors. Example: a unique start-up called Insilico Medicine (USA), developing a "full-stack" artificial intelligence system based on generative adversarial networks (GANs), allowing for an "end-to-end" drug discovery process — from basic biological modeling and biomarker development, to hit-molecule generation, lead optimization and pre-clinical validation of drug-candidates.

Pharmaceutical giants show continuous interest in partnering with the start-ups such as BenevolentAI, Atomwise, VergeGenomics, Owkin, XtalPi, BenchSci, Engine Biosciences and other emerging AI ventures to leverage the power of algorithms for boosting own drug discovery programs.

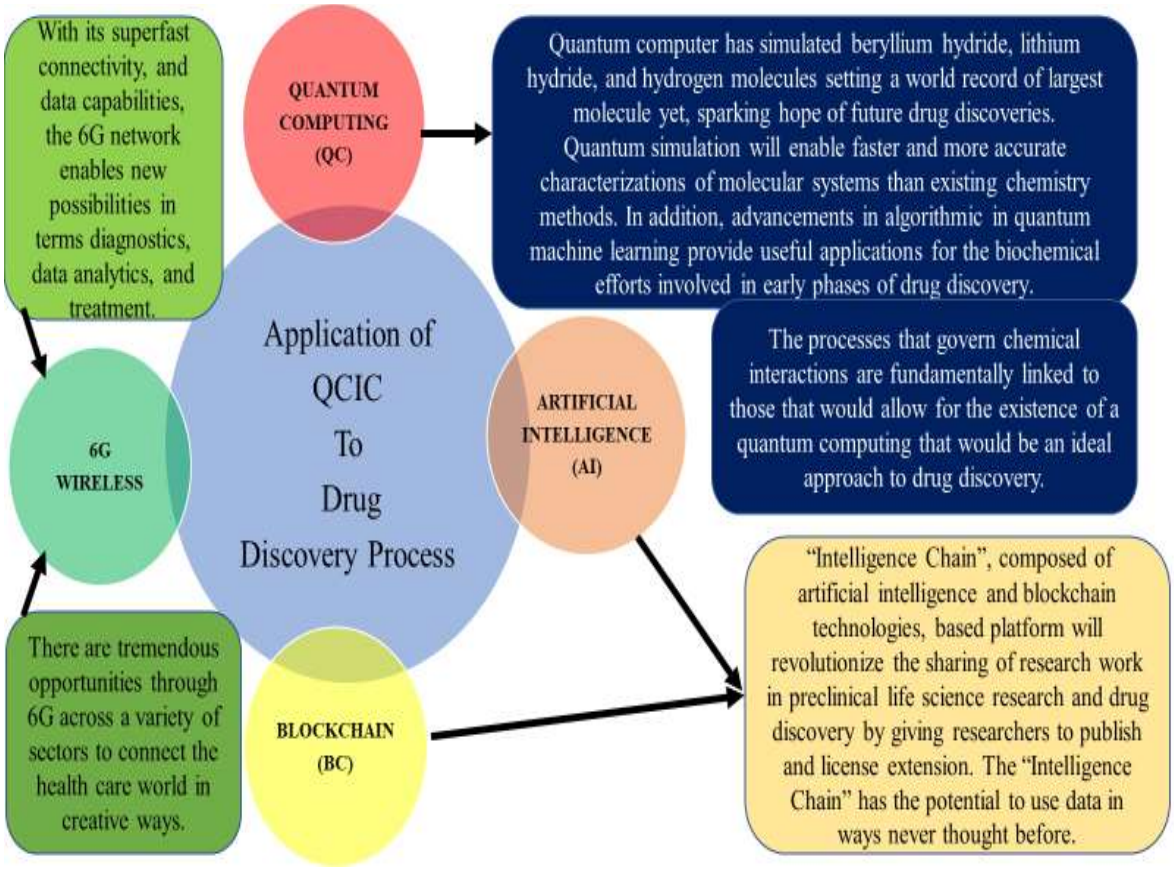

Fig. 5 Application of QCIC to Drug Discovery Process

Application of "Intelligence Chain" in drug research

On Oct 1, 2019, a partnership announced between Novartis and Microsoft to use artificial intelligence (AI) in drug development to design molecules, personalize medication dosing, and optimize the manufacturing of CAR-T cancer therapy. This alliance will focus on two core objectives:

AI Empowerment - The lab will aim to bring the power of AI to the desktop of every Novartis associate. By

bringing together vast amounts of Novartis datasets with Microsoft's advanced AI solutions, the lab will aim to create new AI models and applications that can augment our associates' capabilities to take on the next wave of challenges in medicine.

AI Exploration - The lab will use the power of AI to tackle some of the hardest computational challenges within the life sciences, starting with generative chemistry, image segmentation & analysis for smart and personalized delivery of therapies, and optimization of cell and gene therapies at scale.https://news.microsoft.com/2019/10/01/novartis-and-microsoft-announce-collaboration-to-transform-medicine-with-artificial-intelligence/

Insilico Medicine entering the new era of AI-enabled drug development that could generate viable lead compounds in just a few weeks. Insilico demonstrated that it could conceptualize 30,000 novel small molecules using its machine learning (ML) approach, narrow them down to six potential candidates for a fibrosis target and then test them preclinically in less than 50 days.https://www.fiercebiotech.com/medtech/insilico-signs-200m-ai-drug-discovery-partnership-china-s-ctfh

Machine learning plays a vital role in chemical research, such as in the discovery and development of new materials and molecules. Researchers have demonstrated artificial intelligence to enable efficient photodynamic simulations. To understand photo-induced processes, one need to understand the motion of molecules under the influence of UV light. Furthermore, classical mechanical calculations need quantum mechanics that is computationally extremely demanding and cost intensive.https://www.sciencedaily.com/releases/2019/09/190911113017.html

The author has introduced and coined the term "Intelligence Chain", composed of artificial intelligence and blockchain technologies, based platform that will revolutionize the sharing of research work in preclinical life science research and drug discovery by giving researchers to publish and license extension. The "Intelligence Chain" has the potential to use data in ways never thought before. AI using innovative techniques such as in silico (on a computer) drug design for the mapping of drug structures and targets, can allow the development of more successful drugs without the costly scientific development. Quantum technologies, quantum communication, machine learning, artificial intelligence and other technologies are expected to make the hunt for new drug discovery quicker, cheaper and more effective. Disruptive innovation of blockchain and evolution pf pharmaceutical ecosystem can address data integrity, transparency and security aspects in the pharmaceutical ecosystem with efficient and effective collaboration.

The new iPlexus – a secure, blockchain/AI based platform will revolutionize the sharing of research work in preclinical life science research and drug discovery by giving researchers for publishing and extending license. The combination of the two technologies (AI & BC) has the potential to use data in ways never thought before. Data is a vital ingredient for the development and enhancement of AI algorithms. Blockchain secures this data and allows to audit. AI takes to draw conclusions from the data and allows individuals to monetize. AI is incredibly revolutionary. It must be designed with the utmost precautions. Blockchain can greatly assist in the design endeavor. The author contends that the interplay between the two technologies has the potential for true disruption in the drug discovery. The following ways in which AI and blockchain are made for each other: (i) Artificial Intelligence (AI) and encryption work very well together (ii) Blockchain can help to track, understand and explain decisions made by Artificial Intelligence. (iii) Artificial Intelligence (AI) can manage blockchains more efficiently than humans, (iv) better security, (v) open market for data.

Understanding the position and flow of products within a drug industry supply chain is vital. Nowadays customers demand transparency and regulators globally require information about supply chains. Quantum E-Commerce [3]depend on trust and transparency to operate correctly. Historically, distrust between stakeholders of companies has discouraged sharing data. Blockchain can remedy such distrust with a shared record of ownership. Artificial Intelligence (AI), simply put, the theory and practice of building machines capable of performing tasks that require intelligence.

The intellectual property (IP) is one of the most significant aspect of any new drug. Composition of matter is the core and critical part of IP (patent). To provide a patent requires four aspects: (i) proof of the inventor, (ii) when was it invented, (iii)what was included on the date of invention or creation, (iv) proof that the content was not changed.

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Blockchain (BC) & AI systems integration perspectives

Humans create the artificial neural networks and teach the computer algorithms with the help of machine-learning algorithms. Yet, the developers of artificial intelligence are not able to predict its actions. The AI-systems are sort of black boxes for human intelligence. The machine's memory contains more information than the brains of the most intelligent people in the world. It must differentiate which of the information is important. Algorithms are created to teach the computer to do this. If all the decisions of the AI system are recorded in the blockchain, the extensive database is received and able to check the decisions taken by AI to explain their logic. Also, it will ensure the security of the data since the information stored in blockchain cannot be falsified. Blockchain transactions are validated by the data miners. The AI trained by machine learning algorithms able to guess the code in an intelligent way enabling to speed up and cheapen the process of validation. The data-storing methods of blockchain can also be optimized with the help of machine-learning algorithms. Blockchain technology is used for improving clinical research quality[4].

The work of decentralized artificial intelligence is based on a parallel computing system. The distributed nature of the system can analyze huge data sets quickly. The dataset will be split into smaller units and can be united into an integral database. This vast information (world database) can be available to every member of the network and possible to use this vast data for training the advanced AI-algorithms.

The following businesses are dealing with big data analysis: (i) pharmaceutical industry, specifically drug discovery and development process, (ii) fashion industry, (iii) telecommunication and media.As shown in fig.6, The drug discovery researchers will initiate blockchain upload of intellectual property (IP) documents through a dedicated interface locally encrypt the document, create an encrypted document and upload it to a secured document storage system of the user's choice or an enterprise document storage system to a create a record.

The encryption key generated in this process is shared on the blockchain system. A blockchain certificate is issued and allocated to the researcher. Thus, security, confidentiality, trust and legally accepted record, proof of origin, date/time stamp and ownership can be attained all at once.

Quantum Computing (QC) & Blockchain perspective

Quantum computing uses factorials and exponentials in algorithms and is based on the use of qubits instead of bits. Quantum computing is emerging as a hot topic, scientists and developers have started to work to safeguard the future of blockchain and internet in general. Another option is to use private blockchains where access permissions are strictly controlled to be validated by the network creator. Both quantum computing and AI may have a negative impact on blockchain protocols and solutions, but the author contends that both are undeveloped, and it will take ample time to become a real risk. The quantum computing security risk is manageable. Experts are suggesting quantum computing may render blockchain obsolete. This type of computing can hack the cryptography hash that universally secures the blockchain and in general the internet. Therefore, quantum computers may complete fraudulent transactions and steal coins. Given the exponential power, quantum computers threaten blockchain's future security. Blockchain are synced throughout a peer-to-peer network and consists of encrypted nodes connected on a chain, therefore it is impossible to hack. The order of entries adheres to the blockchain protocol, which makes it counterfeit-resistant. https://hackernoon.com/quantum-computing-is-it-the-end-of-blockchain-9ce4a9664720.

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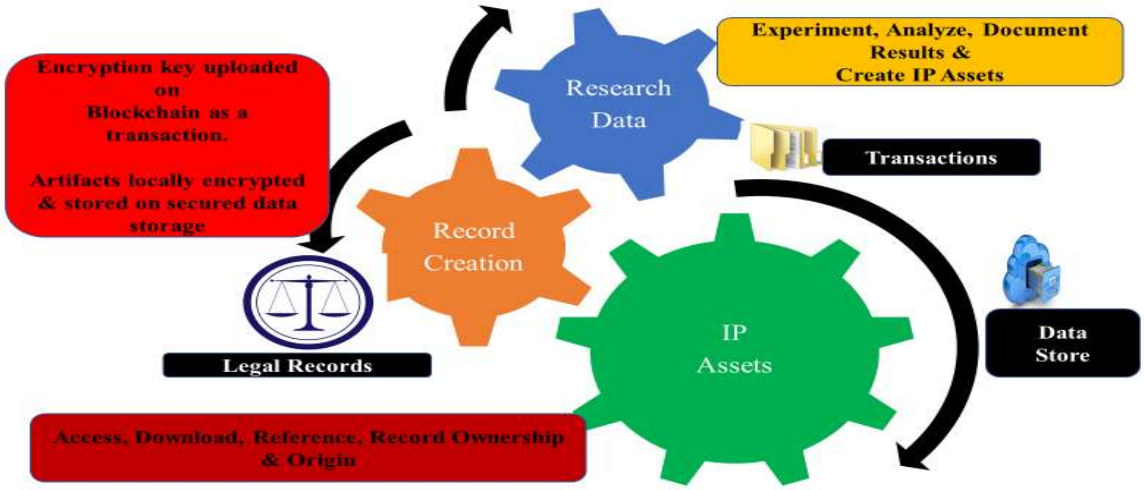

Fig 6. Illustration of Application of blockchain in IP assets and patent

METHODOLOGY

In this study, the research methodology includes the following foursegments [5]:

1. Exhaustive literature review.
2. Quantum systems thinking (QST) perspective and modeling on QCIC software development.
3. KLAS (Kanban, Lean, Agile, Scrum) methodologies, a termcoined by the author, is used to structure, plan, and control the process of developing quantum softwaredevelopment system.
4. Perpetual Product, Process, Service Innovation (P^3SI) for drug discovery process**.**

Segment 1: The comprehensive literature review explores various terms broadly the keywords and includes explanation on the sections mentioned above: (a)introduction, (b)research background on historical perspective on drug discovery, drug discovery paradigm, Assay (primary & secondary) development, and the various phases of drug discovery process, (c) analysis on the applications of QCIC to the drug discoveryprocess.

Segment 2: Quantum systems thinking (QST) perspective and modeling on QCIC software development.Quantum thinking is an integral part of "Quantum Being" that includes six elements: quantum thinking, quantum feeling, quantum knowing, quantum seeing, quantum trusting, and quantum acting. The six constituents are interlinked to each other, as shown in figure 7.

Systems thinking - has evolved as an alternative to the old paradigms. Many methodologies are derived from the systems thinking. With systems thinking, designers learn how their organization interact. Systems Thinking was originally proposed as an analytical paradigm to different scientific disciplines like life science, biology, psychology, the social sciences, etc. Nowadays systems thinking has become an established perspective on the management process. One of the goal of systems thinking in management is conceptual understanding of the structure and behavior of complex organizations and the benefits.

Quantum system thinking (QST) - is an exceptional exercise of quantum leadership [6], humility and empowerment. In the quantum systems thinking process the inconceivable starts to thrive and wildest dreams are possible. When one recognizes the magnitude of being all-inclusive thinkers, everyone faces the humility that represents the awe-inspiring reality of quantum system thought. Quantum system thinking is big picture thinking that extrapolates responsibility to self, others and the world. It's an amazing tool that have the power to transform the modesty of attainments because everyone is tiny piece of the intellectual fabric of the universe. To embrace quantum system thinking, everyone needs to fully comprehend the effect of a positive choice.

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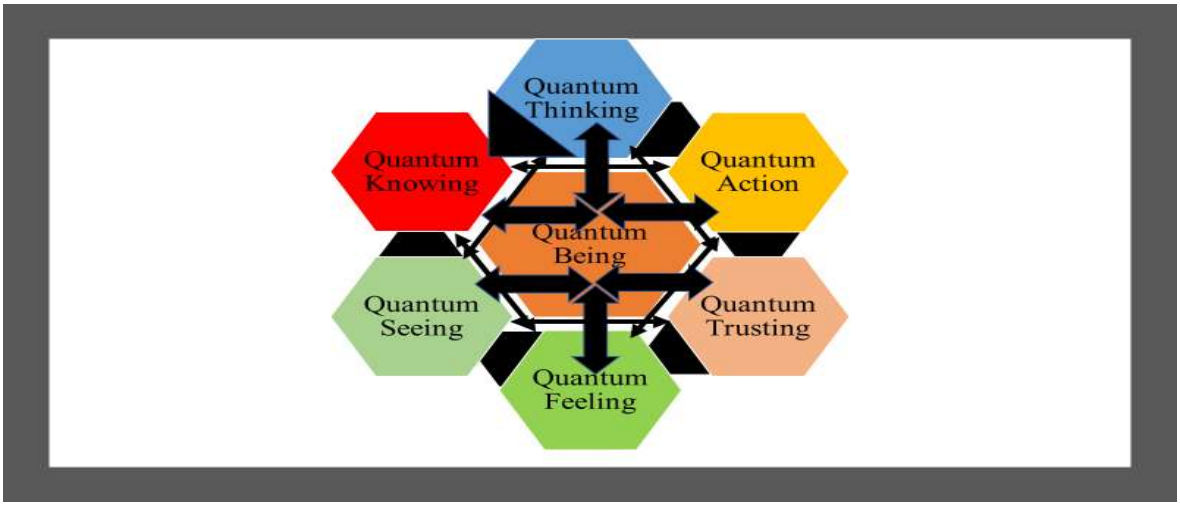

Fig. 7 Illustration of "Quantum Thinking" is an element of "Quantum Being"

The author introduces the quantum systems thinking and modeling methodology as a conceptual and analytical method relevant to the drug discovery process. This approach is based on the system dynamics methodology developed for the theory of information feedback systems to understand the decision-making process and for the development of stimulating mathematical models in quantum computing. The development of quantum systems thinking, and modeling methodology involves the following six distinct phases and can be used separately or individually, for value added purpose, as shown in figure 8:

(i)Quantum thinking – a new mental superpower involving a paradigm shift from linear thinking to holistic thinking and the ability of the mind to function at a higher level of creativity and innovation that allows one to envision the next generation products, process and services. Quantum thinking is also the fuel to fire those creativity-innovation cylinders. Quantum mechanics fueled quantum computing, quantum internet, and semiconductors revolutionized pretty much everything from smartphones, laptops, and communications. Quantum thought hold two opposing thoughts at the same time and the key to creating quantum value co-creation (QVCC).

(ii)Problem structuring involves scope and boundaries consisting of (a) problem areas concerning to stakeholders, (b) collection of information and data, (c) conducting group sessions for creative problem structuring.

(iii)Causal loop modeling – conceptual models of the problem is created through (a) key variables identification, (b) behavior for the key variables, (c)developing influence among the key variables, (d) discussing dynamics of the behavior, (e)identification of system archetypes, (f) identification of leverage points, (g) developing strategies to intervene.

(iv)Dynamic modeling involves the following phases: (a) development of a high-level systems map of a potential simulation model, (b)defining variable types , (c)collecting detailed and relevant information and data , (d)construction of a computer simulation model, (v)producing graphical and output of the model, (e) verifying model equations and validate the model's behavior, (f) performing sensitivity tests , (g) test and design policies/procedures with the model to address management concerns, (h)developing test strategies.

(v)Scenario planning and modeling includes strategies and policies for all stakeholders: (a) developing general scope, and timeframe, (b) identification of key drivers that could have a significant impact on the decisions, (c) constructing pro/con scenarios, (d) simulating the scenarios with the model, (e) evaluation of the performance of the strategies with the model for each scenario.

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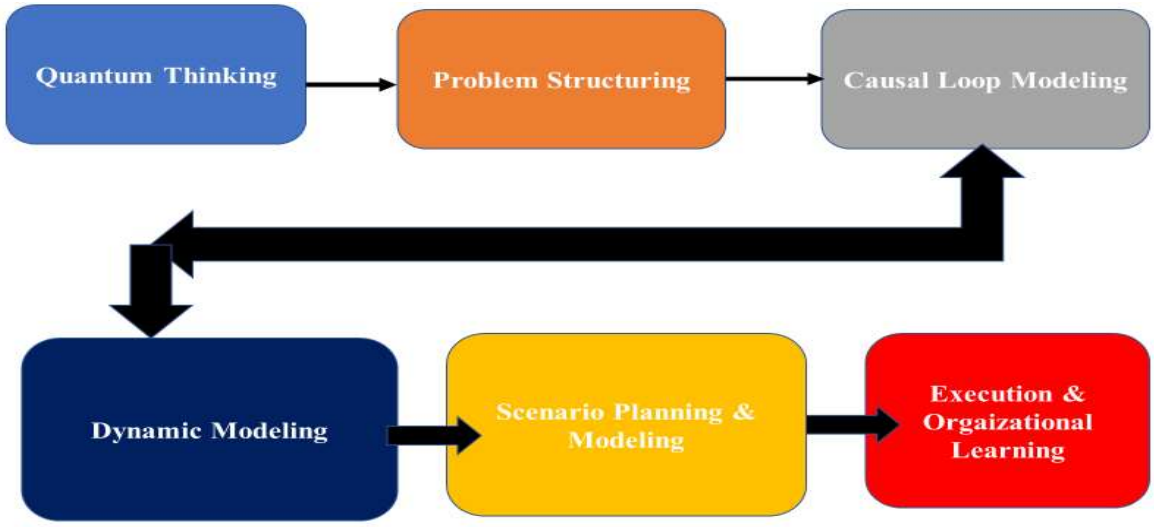

Fig. 8 Quantum systems thinking & modeling methodology

(vi)Implementation and organizational learning, most beneficial and enduring outcomes of systems thinking and modeling, includes (a) preparing a report for all the stakeholders, (b)communicate outcomes and insights to all stakeholders, (c)developing a detail picture for the simulation model, (iv)develop and use the learning lab process to facilitate learning for stakeholders.

Software development projects and pharmaceutical industry have quite a bit in common. Both are highly complex and rely on multidisciplinary teams. They are also often judged based on safety, reliability, and efficiency. Both software and drug development teams aim to produce efficacious, compliant, effective, safe, and commercially viable products. But they take very different approaches to development.

As shown in figure 9, a common systems perspective on design and development process consists of three subsystems, namely sensors/controller system, software development system, and customer System. Software development environment requires often change during the design and development lifecycle to meet business needs, minimizing headaches for development teams. The software development system has requirements and resources as inputs, and software as output. The inputs and outputs are flow of information. Ex: the customer system has software (e.g. information about the software's actual functionality) as one input, and it produces requirements (e.g. information about the software's desired functionality) as one output. The outputs of such a system are not only dependent on the inputs, but they also depend on the system's state. This create dynamics that result in time delays between input changes and corresponding output changes of a system. Delays can cause two effects: (i)the system needs more time to respond to changes, (ii) delayed flows of information result in outdated information.

The quantum computing software solutions pioneered by Accenture and partners, is breaking new grounds to accelerate advanced molecular design and result in faster drug discovery for treatment of complex (computationally this is a very difficult problem) neurological conditions. This process should lead to novel therapies for patients with different neurological conditions.

Given the complexity of the conditions and the variety of candidate molecules, only quantum computing can process the complex data in a reasonably fast time frame. http://www.digitaljournal.com/tech-and-science/technology/quantum-computing-initiative-advances-drug-discovery/article/496462#ixzz61mtg4Wd1

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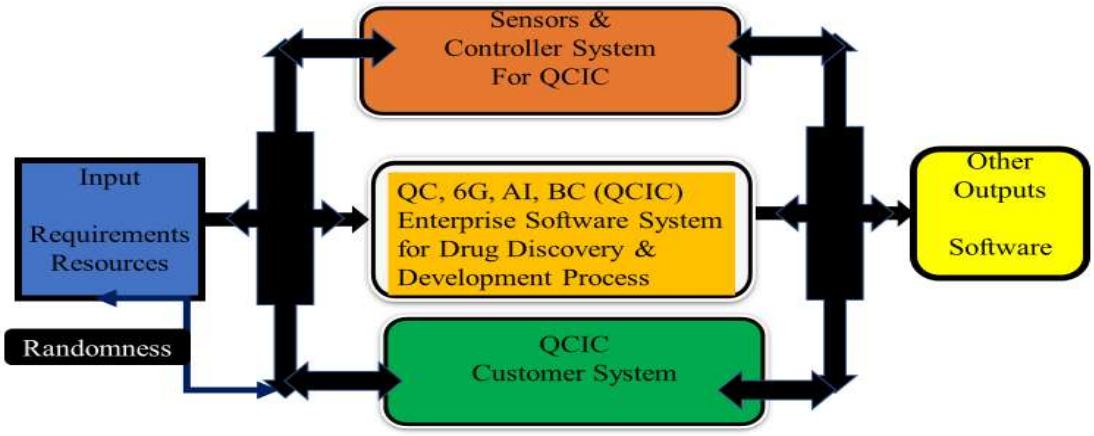

Fig.9 A systems perspective of QCIC software development

Segment 3: Quantum Systems thinking approach with KLAS Methodology **-** To understand how systems thinking in drug discovery management works, the author has introduced a novel holistic - interdisciplinary approach, as shown in figure 10 & 11, for enhancing organizational performance through KLAS (Kanban, Lean, Agile, Scrum) methodologies, a term coined by the author.

Softwaredevelopment methodology is a framework that is used to structure, plan, and control the process of developing an information system. Although systems thinking and KLAS methodologies operate at two different levels, the author has learned from personal experience that an understanding of system thinking dramatically improves the learning curve of KLAS techniques and practices.

Over the past two decades KLAS methodologies have been steadily gaining popularity in various business fields. Although many companies are currently executing or leaning towards these methodologies, only a few understand the entire process to capture value for project management. Lack of knowledge among the staff of an organization leads to lower motivation and poor performance. Hence methodology basics must be learned and shared by every employee involved. Considering the above, the following are the reasons the author has chosen "systems thinking" in this study: https://realtimeboard.com/blog/choose-between-agile-lean-scrum-kanban/

(i) Being lean is essential to adapt and survive the cutthroat competition.
(ii) Due to rapid growth of technology market, particularly software sector introduces other industries to adopt lean and scrum mindsets.
(iii) Trend toward perfection makes everyone proud designing and developing products to offer the best price and best quality.
(iv) Proper management reduces stress, increases welfare and satisfaction.

The literature on using KLAS methodologies in distributed development software projects has steadily been growing. However, to date, there is little effort made to systematically select, review, and synthesize the literature on this topic.

Kanban
Kanban is a scheduling system of visual management aimed at just-in-time delivery. Many companies have tried Kanban scheduling and implementing Kanban without a clear idea of the goal is doomed to fail. Hence, most of them go back to conventional approach applying enterprise resource planning (ERP) systems. Kanban is about taking all ambiguity out of the information flow throughout the supply chain eliminating the individual judgments and is a great tool for revealing the real leverage points for improvement in delivery systems.

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Blockbuster status of a drug is both a scientific and business success. The largesse of the successful drug also leads to complacency and inefficiencies in the drug discovery process making the pharma companies a prime candidate for Kanban project management enabling to streamline the business process and minimize expenses. Kanban method also applied to maintaining drug inventory.

Lean

Lean movement was born in manufacturing industry (automotive industry) aiming at loss reduction and sustainable production. Later, adapted for software development with relevant lean principles. A lean company follows a learn – measure – build cycle, conducts many tests, continuously connects with customers to understand, and improve the value creation process. Lean methodology helps launch software products far more quickly and cheaper than conventional methods. So far, the lean methodology hasn't spread quickly through most industries. Many have tried, only few achieved successes. Very few companies are lean yet, because most still have trouble understanding the fundamental link between information and production. Based on extensive experience of the author, the "Systems Thinking" contributes significantly by providing an overall framework to lean methodology. Lean systems thinking is a methodology aims at creating unique lean enterprise that sustains growth by aligning customer satisfaction and organizing human activities to deliver higher productivity to the society.

The tenants of lean efficiency and operation in life cycle manufacturing still have applications in pharma industry, specifically as blockbuster drugs lose their intellectual property (patent) right protections impacting on pharma drug pipelines to produce new drugs.

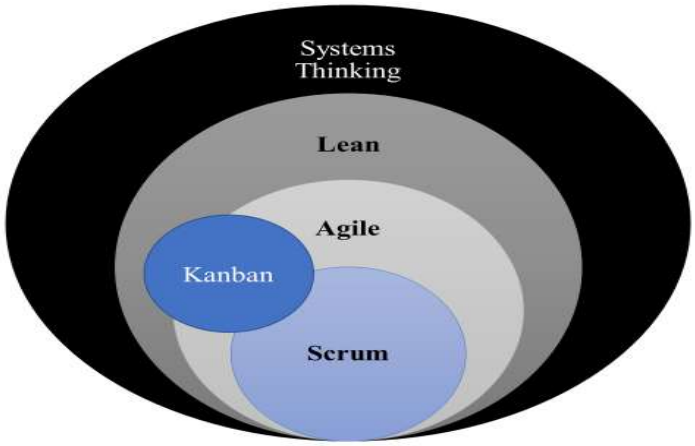

Fig. 10 "Systems Thinking" composed of KLAS Methodologies

Although pharma has recently started to adopt and execute Lean Six Sigma, their potential is already being realized. Pharma companies pursuing to integrate the tools and culture of Lean Six Sigma into their infrastructure and operations are recognizing the benefits that includes increased capacity, higher throughputs, increased capacity and fewer errors, productivity, and better utilization of personnel, and resources.

Why Lean Six Sigma works for Pharma?

(i) Pharma products are new molecules, instruments, or reagents. Lean Six Sigma principles is applied to these continuous processes.

(ii) Research and Development is not a process. The output of R & D is new knowledge and the flow of knowledge can be monitored and tracked.

(iii) Data based approach of Lean Six Sigma complements FDA's process analytical technology initiative.

(iv) Lean Six Sigma implements various statistical techniques to minimize the number of experiments and prototypes.https://hyper38.com/kanban-drug-discovery/

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Agile
Agile was born to improve productivity in software development and expanded into other disciplines such as Marketing. When a team follows the relevant value principles that can be considered 'agile', then time-focused, iterative philosophy allows to build a product incrementally. One of its primary benefits is the ability to adapt and change at any step to supply relevant products to the market.

Among information communication technology professionals, agile methodology is the primary approach. "Agile Development" is an umbrella term for a set of methodologies and apply time-boxed iterative and evolutionary development, adaptive planning, evolutionary delivery, and other values. Given the current struggles to shrink the product development life cycle in drug development, a more responsive, adaptive, and agile model is needed. To sum up, agile methodology is showing itself a promising way of working and moving beyond software development projects and soon will find its place in other industries like pharmaceuticals.

Scrum
Scrum is the art of getting things done. Efficiency and agility are not associated with the highly regulated pharma industry. Since drug pricing under intense scrutiny, the pharma business model is changing, and companies are embracing various ways to enhance their operational efficiency. Most of pharma companies still uses a traditional waterfall approach for drug discovery. Waterfall method work best when the requirements of a project is not evolving. But the drug discovery process is complex, lengthy, and undoubtedly things (market demands, patient needs, industry regulations) evolve throughout the drug discovery process. The author contends that pharma needs to leave its traditional waterfall approach and pursue a more agile and efficient model. All pharma companies have a common goal to develop the best quality drug in the shortest span of time. Furthermore, the intellectual property (patent) expiration clock is always pulsating. Hence, scrum is a method that allows flexibility, and maintains a level of urgency by providing constant deadlines.https://www.pharmamanufacturing.com/articles/2016/scrum-the-art-of-getting-stuff-done/

Scrum is a software development methodology for managing knowledge work and addresses complex adaptive problems while creatively delivering products with highest value creation. Scrum assumes that the systems development process is an unpredictable, complicated process, enhancement of the commonly used iterative object-oriented development cycle, and workable techniques that a development team build systems.
Scrum is a special way for a team to work together to develop a product, as it occurs in small pieces. Scrum can also be thought of as a simple framework for effective teamwork in complex projects which provides a small set of rules aimed to create just enough structure for teams to be able to focus.The aim of Scrum is to be able to respond fast and have flexibility in the development process without sacrificing quality, cost control, motivation or customer needs. In preference to orientation upon high-level and extensive planning and heavily documentation, it emphasizes the need for customer interaction during incremental and focused development cycles. The goal of Scrum, responding fast and flexibly to changes in requirements during the project, without sacrificing quality, cost control, motivation or especially user requirements, is a best fit for product development life cycle in drug development

Both (Scrum and Kanban) methodologies follow the principles of Agile and Lean. They track processes via scheduling system to ensure transparency. Scrum limits them by time units — iterations, Kanban limits work in progress per workflow state.

Segment 4: Perpetual Product Process Service Innovation (P^3SI) for drug discovery process - Pharma companies that compete based on technology innovation strategy need to contend with how their products, process and service delivers value. Pharma enterprises need better systems thinking in their strategic delivery actions. The success of the pharma firm depends on all stakeholders to interact to co-create value. Literature shows the application of systems thinking help to maximize the return on innovation investment that drives profitability, sustained growth, and competitive advantage. Technology leaders responsible for delivering technology solutions in complex systems markets also need to develop their employees to think in terms of systems, adopt systems practices, and apply relevant strategic tools to leverage systems thinking. Innovation systems are considered a key factor to enterprises' long-term success. Considering the important role of innovation to the firm, an innovation systems model should be designed using systems thinking approach. The aim of the model is to enhance innovation activity in the firms of manufacturing industrial sectors. Systems thinking methodology has been used to uncover the complexity of the innovation systems framework and reveal the underling structures which generate change.

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As shown in figure 11, the author introduces the "Perpetual Product, Process & Service Innovation (P^3SI)", - a holistic-interdisciplinary approach [7]that is synergetic with systems thinking to create unique product, process, service, management, and strategy for sustainable development of pharma products that truly works in practice.

P^3SI, a term coined by the author, is essential to the development of new products, processes, services and innovative climate for the sustainable success factors of an enterprise to create value. Perpetual innovation ensures high quality of the products and services to maintain legal certainty through intellectual property protection that helps to establish as a major player in the market raising the profile and unique differentiation from the competitors to attain the sustainable competitive advantage. Perpetual innovation creates superior and unique products and services. To create and sustain perpetual innovations, legal measures makes economic sense to attain perpetual creation to protect.

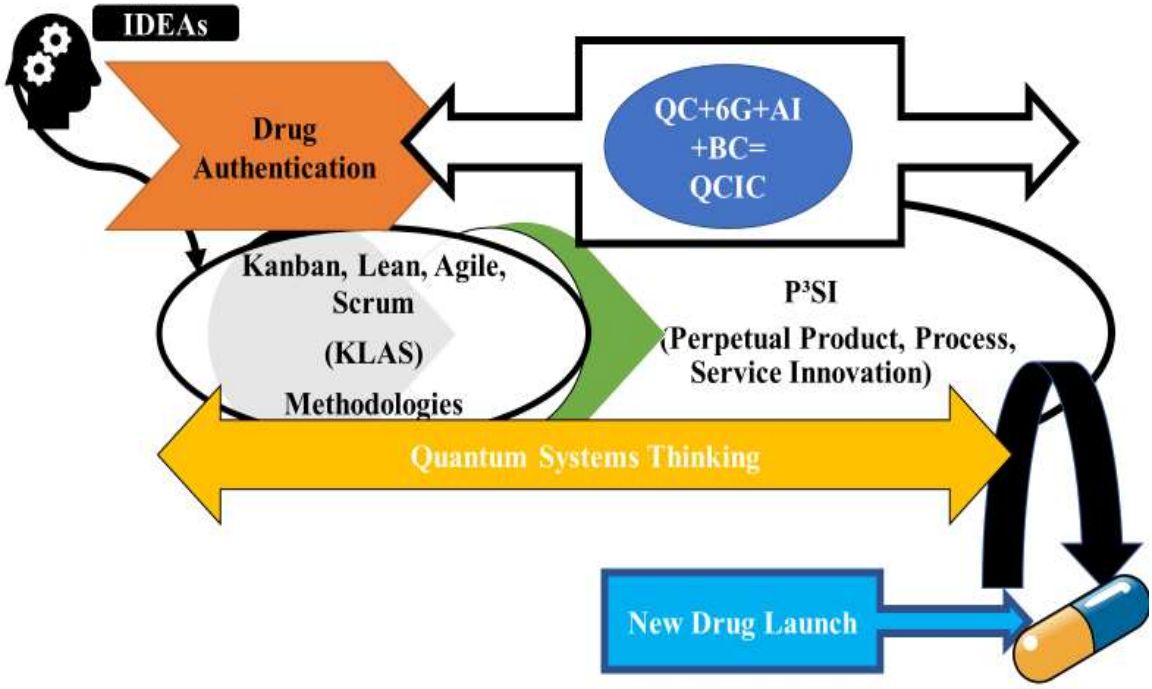

Fig.11 Quantum Systems thinking approach with KLAS Methodology and P^3SI for drug discovery process

The Pharmaceutical firms are a vital part of the global economy and are challenged to become efficacious to stay competitive. Most of them have not yet adopted to bolster the ability to think holistically to apply the unique strength of quantum systems thinking concepts to overcome competition, attain efficiency, improve value co-creation process, and drug discovery paragon. The aim of this study is to investigate the influences of quantum systems thinking in the design and development of drug discovery process from the viewpoint of aetiology of diseases. The author has introduced KLAS (Kanban, Lean, Agile, Scrum) methodologies, as shown in figure 1, that focus on delivering the best possible evidence-based research and perspective on drug discovery design integrated with the QCIC application.

Digital transformation as the end goal should not be the mission of any enterprise because it is only as successful as the human experience delivers. Enterprises need to change the way they view transformation, treating it as an unceasing process instead of an end goal. Perpetual innovation enriches businesses to constantly adapt, evolve and drive forward change within the drug discovery process. To attain perpetual innovation, enterprises must first move beyond static infrastructure. Therefore, it is imperative to focus on migrating to the quantum cloud. A dynamic, quantum information technology (QIT) environment is crucial for driving continuous delivery of new drug products and services facilitating enterprises the building blocks to enable perpetual innovation at the speed clients demand. Perpetual innovation requires a flexible and scalable QIT ecosystem to accommodate the pace of change. Quantum

cloud-native architectures built on microservices foster faster development and deployment processes.

QUANTUM VALUE CO-CREATION (QVCC) USING QST & QCIC APPLICATIONS

Quantum computing, artificial intelligence, blockchain, Internet and mobile businesses have sparked interest in co-creation of value defined as the collaboration of service providers, producers, and consumers through the production, delivery, and use of products, process, and services.

Co-creation of value in marketing is a business strategy promotes and encourages active involvement from the customer to create on-demand products.Quantum value co-creation (QVCC) - a business strategy focused on QCIC applications inscribing economic, sociocultural and environmental issues by recognizing sustainable competitive advantage that brings community quantum benefit. In this study, the author has coined the term QVCC and the definition is as follows [8]:

(i)Quantum term refers to scale and scope where effects become important.

(ii)Value is described in two ways. From an economic point of view, value is defined as the utility of goods and services as well as the benefits arising from ownership.In the ethical sense, value denotes something of significance and contribution to society to make a positive difference in humanity.

Creating *new value* is the most challenging, even though some pharma organizations operate effectively. To create new value requires breaking into a whole new way of doing things. New value emerges from the need of new customers to access a new target market. ***M****ore value* can be created by applying one of three strategies: One can (i) keep the purchase price the same and deliver more with every purchase; (ii) lower the purchase price and deliver the same quantity of value; or one can do both. Since value is in the eyes of the beholder, any adjustments shift that perception in the purchaser's favor. One should strive for lowering the investment and deliver more value. Pharma companies should try this strategy. This's an example of creating *more value*.

(iii)Co-creation is a form of economic strategy or management initiative, that brings different stakeholders togetherto jointly produce a mutually valued outcome. Co-creation is getting other people to do the work and love the brand for it. Nowadays, most businesses are learning to listen, consult, co-operate to work with stakeholders. Furthermore, co-creation is a management dynamism, contemporary business thinking and a new frame of reference that brings the stakeholders together to jointlyproduce a mutually value-added result. While most people think of co-creation to innovate to transform the competitiveness, it is also a way of cutting cost. With co-creation, consumers get exactly what they want and have a hand in making it happen.

(iv)Co-creation of value brings the unique blend of ideas to innovative ideas for the brand to provide unique experiences for the stakeholders with continual learning and enhanced market performance drivers.Co-creation of value is not new, but new disruptive technologies create new possibilities and opportunities. The following are the two-best-known value chain processes for co-creation of value:

(a) Stakeholder´s revetment process - the brand like Apple, able to cut promotional costs. Why is Apple so profitable? Among many other reasons, it draws its stakeholders to market to each other. Apple does not spend marketing dollars to promote products and services (https://www.Apple.com).

(b) Product or service development process - the company like IBM, engage third-party resources in product and service development processes. Why is IBM able to reduce its R&D cost? By setting up ―Collaboratory's where its co-partners, as key stakeholders, not only bring their expertise in specific domains but also underwrite some of the cost of that research and development (https://www.IBM.com).

Still, to date, thetop leadership team of mostpharmaceutical firms consider drug discovery process as a one-dimensional opportunity. Such a one-dimensional approach provides pharmaceutical enterprises shortcomings to deal with the challenges in a strategic way. Quantum value co-creation (QVCC) requires a multi-dimensional approach by pharmaceutical firms to achieve optimum performance. Multi-dimensional approach comprises of assessing and implementing methods, tactics, strategies that consists of more than one feature and/or design to

address a complex situation.
In this study, the development of a QCIC framework through quantum systems thinking is focused on the quantum value co-creation framework that involves the synergetic relationship of four technologies (QC, 6G, AI and BC) applications and the relevant value chain in a multidimensional opportunity involving all stakeholder's participation. The building blocks of the quantum value co-creation (QVCC), as shown in figure 12, are: (i) QCIC applications, (ii) quantum systems thinking among the stakeholders, (iii) stakeholders' participation in the entire value chain of the drug company, and (iv) products, process and services interactive actions with the application of QCIC.Quantum value with information communication technology business is to achieve measurable high-performance results. Quantum computers (QC) began solving industrial problems that today's classical computers cannot.

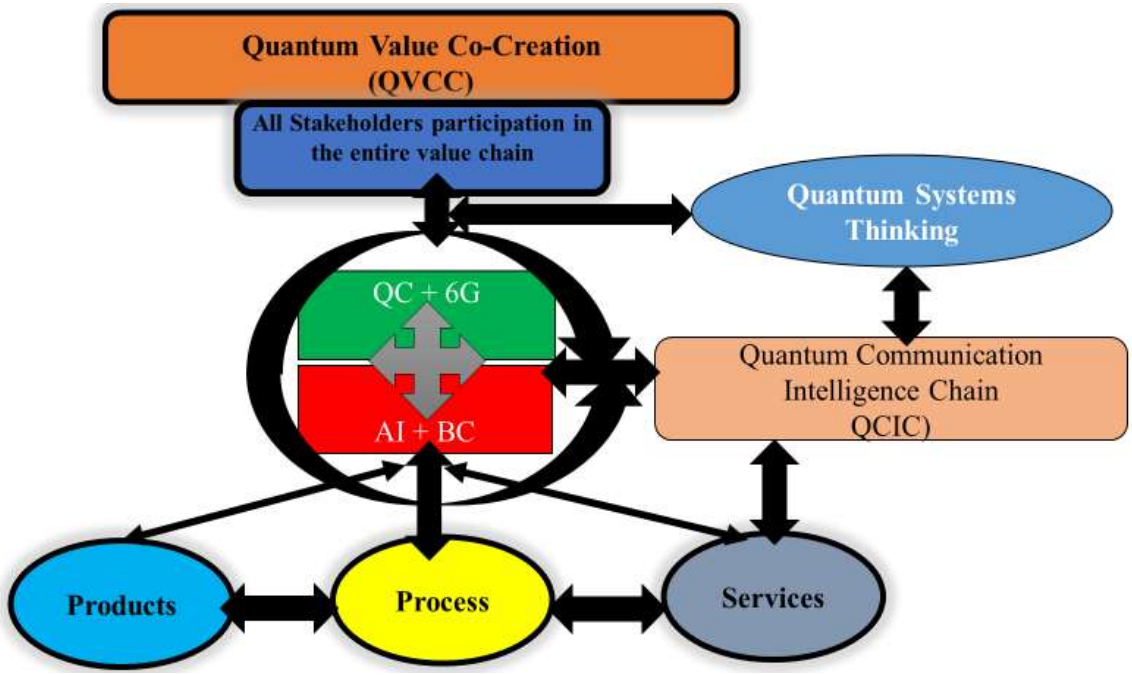

Fig.12Quantum value co-creation using QST&QCIC applications

It is estimated that quantum computing productivity gains—both revenue opportunities and cost savings —to exceed $450 billion in operating income annually. QC developments are being done over three phases with exponential progress. Quantum computing is an ideal candidate for a precipitous breakthrough that may happen at any time. Companies with complex simulation and optimization requirements, such as chemicals, pharmaceuticals, aeronautics, finance, and automotive, should gain the potential impact of quantum computing by pursuing a partnership strategy with a quantum computing technology provider.Starting in 2025, value will increase rapidly as the QCIC applications commercial viability mature. Quantum business value creation will depend on the steps the pharma company stakeholders take now to put their firms in the best position to capture QCIC applications value.www.image-src.bcg.com/Images/BCG-Where-Will-Quantum-Computers-Create-Value-and-When-May2019_tcm9-220664.pdf.

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CONTRIBUTION

The contribution of this research provides quantum systems thinking approach to the QCIC application for the drug discovery process to attain quantum value co-creation. Finding reveals that drug discovery designers ought to use the quantum systems thinking with QCIC technologies as "holistic and interdisciplinary" approach for the transformation of value chain to attain transcendence and stakeholder satisfaction.This study provides precept to pharmaceutical enterprises, drug designers, academia, entrepreneurs, industry practitioners, investors, and policymakers to assuage socio-economic benefit for the contemporary society.

CONCLUSION

Drug discovery often takes more than a decade and billions of dollars investment before a molecule can be recognized as a drug and the process has been so complex that it cannot be contained within the confines of the pharmaceutical industry. Therefore, it requires a flexible and diversified industrial base.

99% of new molecules fail to deliver drug discovery. More than 50% of all scientists are unfamiliar with artificial intelligence (AI) applications for drug discovery. Research shows that lack of knowledge and lack of talent pool is the biggest barrier in the application of QC, 6G, AI and BC to drug discovery process.

Developing the future therapeutic agents involve the basic science disciplines that have always been at the core of drug discovery. Taking drug discovery to the next level will require an entirely new systems approach with the application of QCIC. Quantum systems thinking requires new mindset to integrate quantum computing, artificial intelligence, blockchain, high speed wireless communication (6G & Beyond), bioinformatics, and nano technology with appropriate methodology into the development process to pursue the next stage of advances in drug discovery.

QCIC transformative value is five to ten years away for the drug discovery process. The fundamental question one should ask- why should drug enterprises consider investment now in QCIC applications? The simple answer - QCIC is a new technology paradigm that presents formidable ramp-up challenges, even for firms with advanced technological capabilities. Early adopters will gain expertise, visibility into knowledge, and even intellectual property ownership that will put them at quantum advantage as QCIC gains commercial traction. Now is the time for the pharma industry stakeholders to implement the seamless integration of QC, 6G, AI & BC because it will give immense benefits with regards to productivity, performance and cost savings with quantum value creation.

So far, the current literature does not provide any comprehensive information on the quantum systems thinking and the holistic perspective of QCIC applications to the drug discovery process. The objective of this research has been to analyze the literature to-date and apply quantum systems thinking approach with KLAS methodology with perpetual innovation to understand the applications of QCIC for the drug discovery process. Thus, this study fills the vacuum with new knowledge to the literature.

REFERENCES

[1] Padhi, P.K (2019). Quantum Communication Intelligence Chain: A Cardinal Coadjutant Model, IJETRM Journal, Vol 3, Issue 3, p.59-80, http://www.ijetrm.com/issues/files/Mar-2019-29-1553878354-9.PDF https://zenodo.org/record/2619266#.XWLxsntlDHo.

[2] Kislyakov, A & Mayes, R (2019). The Physics of Health Care: Viewing the U.S. Healthcare "System" from the Perspective of Quantum Mechanics, World Medical and Health Policy.https://doi.org/10.1002/wmh3.300

[3] Thapliyal1, K & Pathak, A (2019). Quantum e-commerce: a comparative study of possible protocols for online shopping and other tasks related to e-commerce Quantum Information Processing.https://doi.org/10.1007/s11128-019-2309-3.

[4] M. Benchoufi and P. Ravaud, "Blockchain technology for improving clinical research quality," Trials, 2017.

[5] Padhi, P.K (2019). Systems Thinking Augment Aestheticology Apotheosis, IJETRM Journal, Vol 1, Issue 2, p.26-40, www.ijetrm.com/issues/files/Feb-2019-22-1550813886-6.PDF

[6] Papatya, G & MA Dulupçu (2008). Thinking quantum leadership for true transformation: the talisman of "not to know" at the threshold of new leadership,https://pdfs.semanticscholar.org/26f5/baf60daa23f98ec30d76218d9bc577279f35.pdf

iJETRM
International Journal of Engineering Technology Research & Management

[7] Padhi, P.K (2018). A Quest towards Fashion Design Protection Model for the Intellectual Property Rights Global Regime, International Journal for Research in Applied Sciences and Biotechnology, Vol. 5, Issue-5, p. 4-14.\ doi.org/10.31033/ijrasb.5.5.2

[8] Padhi, P.K (2019). A quest towards quantum internet model, International Journal of Engineering Technology Research & Management , Vol (03),Issue (08)pp. 30-54, http://www.ijetrm.com/issues/files/Aug-2019-28-1567011004-05.PDF , http://doi.org/10.5281/zenodo.3380463

BIOGRAPHY

Prafulla Kumar Padhi, a serial entrepreneur and techno-market futurist, has over 43 years of global business experience and held the Founder, CEO and Chairman of the Board positions for more than 25years and managed up to US$1.2 Billion revenue operations. His education qualification includes a Master of Science degree from the prestigious Massachusetts Institute of Technology (MIT), Cambridge, USA and a graduate of the Ivy League Wharton School of Business, University of Pennsylvania (USA) and holds seven diploma certificates from the Ivy League Columbia University (USA), the Ivy League Dartmouth College (USA), and Kellogg School of Management (USA). For more than 40 years, as a pioneer, Mr. Padhi has been involved in entrepreneurial venture endeavors in disruptive technologies and smart fashion wearable ventures globally. So far, he has done business in 46 countries and travelled to 142 countries. He is an author, freelance writer, independent researcher, teacher, innovator, pioneer, product marketing architect (patent/copyright holder) in the creation, design, marketing disruptive technologies and products.