Compact Edition

Digital Building Platform

Build New Infrastructure for Digital Transformation

Platform Empowerment · Ecological Win-win Success

让每一个工程项目成功

Making every engineering project a success

Glodon 广联达

Build New Infrastructure for Digital Transformation

Foreword

Digitalization brings about a large-scale transformation in multiple industries, providing unparalleled opportunities as well as challenges. As humans spend most of our time indoors, the building sector has no reason to lag behind in the sweeping trend.

Digital transformation of the building industry cannot be achieved overnight but requires overall planning and gradual development.

The Digital Building Platform is a core engine and new infrastructure that builds a digital base for the industry and establishes an operation logic that maps the virtual and physical world, creating a new form of the industrial digital twin to promote the transformation.

Glodon has been publishing the White Paper on digital building for four consecutive years. Grounded in our knowledge and expertise in the built environment, this year's *Digital Building Platform White Paper* sets out a comprehensive framework for a more socio, holistic and integrated digitization of the building industry.

It answers key questions such as what is the digital transformation of enterprises, why do enterprises need digital transformation, and how do enterprises realize the digital transformation.

The future is coming, as this White Paper makes clear we need to change the way of thinking and better utilize fast-growing sci-tech innovations to prepare for a triarchic world that integrates digital, physical and mental dimensions.

This compact edition of the *Digital Building Platform White Paper* summarizes key concepts and findings of the full version.

I hope you find our White Paper insightful and valuable.

Pierpaolo Franco
Glodon – Vice President International Markets Development

Introduction

The way we are thinking impacts the way of living. Digital technologies have transformed the way humans design, build, and operate the places we live and work. Hence, there is a need to transform and upgrade building sector in a more socio, holistic and integrated format. On this basis the paper introduces digital infrastructure, digital building, and digital building platform in a way to change drastically the **thinking and operation of the building sector**. The value of the digital infrastructure is to promote the transformation of the building industry where digital building helps industrial strategy, use state of the art digital technologies, to lead industrial transformation and its upgrade. Digital building platform creates collaboration among stakeholders, connect and integrate projects' data to support decision making and develop data – driven intelligent services to optimize, simulate, prevent, and control projects' process. Furthermore, these three elements contribute towards the upgrade of the building sector by creating a new range of services in design – construction – operations of our buildings and thus impact to the industrial goals of making every project a success.

Digital Transformation in the Building Sector

The way our world changes in the digital era impacts on the way we learn and transform our built environment. We are surrounded by a big volume of data that impacts the operation and maintenance of our living and working spaces. Hence, its digital transformation becomes an inevitable need for the building sector to improve the way we live and work. The development of a triarchic world (figure 1) where digital twin forms a new industrial development, data become a new production element, and industrial Internet becomes a new infrastructure boost people's awareness to understand and change the world by reducing the costs and improve the construction process significantly.

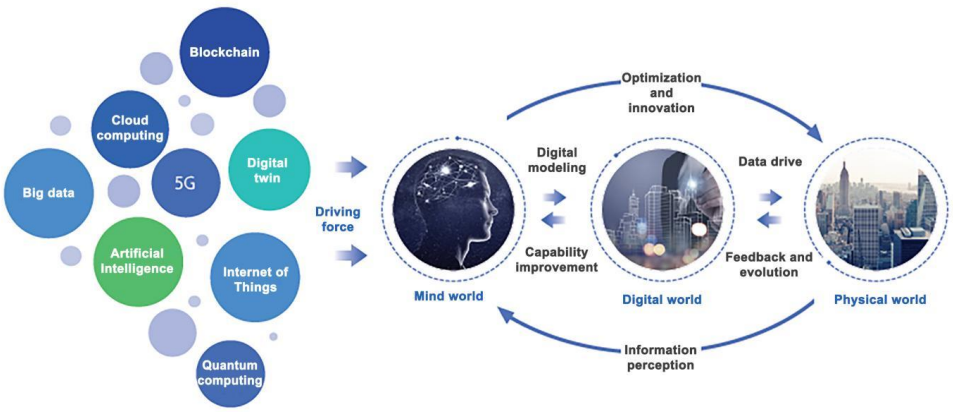

Figure 1: Social Development into the Digital Age Promoted by Scientific and Technological Advances

Digital twin of a building that incorporates assets information becoming a valuable tool that offers a new system that enhances collaboration, lower the cost and error, and improve intelligent decision-making. Hence, for its digital transformation then the right

digital infrastructure is required to ensure project's high cost-efficiency, availability, and reliability. This infrastructure works as the backbone of helping reorganization and reformation of business processes and production methods to form a new system of boosting industrial collaboration, optimize resource allocation and offer value creation. Consequently, this systematic approach creates a more dynamic socio-centric driven approach (figure 1) that with the driving force of digital technology develops a more sustainable built environment with less uncertainties.

The UK Government took already an action to boost productivity and target reduction of projects' costs by 1/3, elimination of CO2 emission by 50%, increase the delivery progress by 50%, foster collaboration and better management control as well as "Zero Quality Defect" and "Zero Safety Accident" (Figure 2). Upon successful implementation of digital transformation of the sector with the relevant support and incentives by the governments, our buildings can be delivered with individuality, environmental friendliness, health and industrial quality and thus provide a better living and working environment.

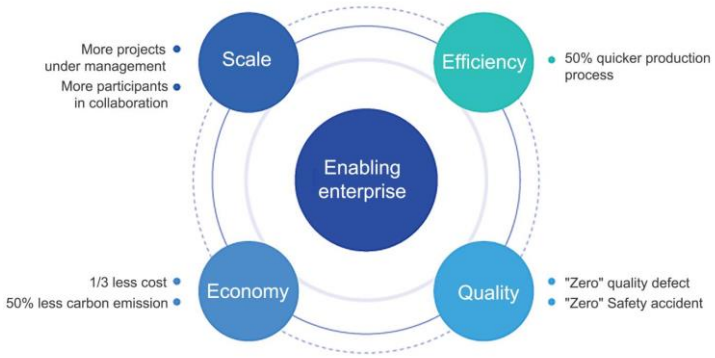

Figure 2: Digitally Enabling Enterprise to Make Every Project A Success in Terms of Scale, Efficiency, Quality and Economy

Hence, digitalization becomes the most critical tool to transform enterprises to form new innovative business models and production processes as well as to lead the future of the industrial development. Digital transformation is the key to enable building enterprises to become more competitive and thus to make every project a success!

What is "Digital Building"

This digital transformation to be achieved requires several changes to be taken places: change the relation between upstream and downstream of the industry chain; change the whole process collaborative relation in the project and change the production relations within the organization. These changes lead towards the development of **digital buildings** that bring new changes for the building industry where: the transformation of production method will drive the construction process from physical to digital twin construction following by new changes in management and transaction method as well as transformation of business model towards the development of large-scale customization and service-oriented construction. *Therefore, digital building refers to an industrial strategy that uses BIM, cloud computing, big data, IoT, mobile Internet, AI and other information technologies to lead the industrial transformation and upgrade that is complemented by advanced lean construction.*

Through effective integration of personnel, processes, data, technology and business

systems, digital building allows the digitalization, networkisation and intelligentisation of the whole process with all the elements and participants of the industry, to structure a platform of a new ecological system that involves projects, enterprises, and industries. This cooperation will drive the industrial upgrade towards new design - construction - operational & maintenance method and contribute to the industrial goals of making every project a success. But is it easy for building enterprises to achieve this goal? This is something cannot happen overnight.

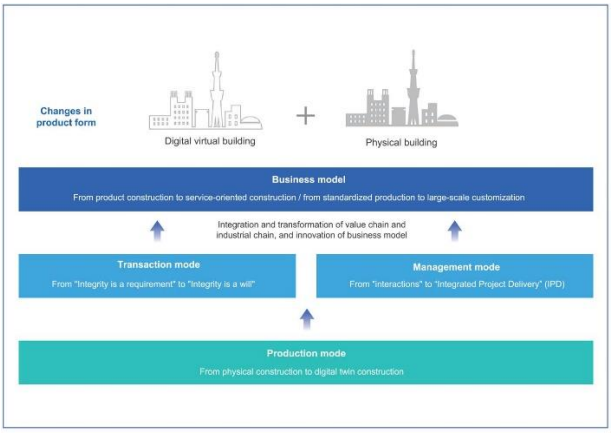

Figure 3: Digital Building Drives the Upgrading of Construction Industry

Moreover, implementing digital building benefit construction enterprises that consequently improve quality and efficiency, eliminate costs and energy consumptions, and create value innovation. This integrated catalytic effect of the digital technologies with the traditional building industry forms a new system that incorporates process, elements, and participants whilst digitisation, on-line operation, and intelligence build up a new industry.

In addition, a new digital building industry is created that establishes a new productivity with integrated new design, new construction and new operation and maintenance (based upon digital transformation). This focuses on customers' needs and connecting better the demand and supply through digitisation. Henceforth, among others fully digitised samples are produced; industrialised construction and intelligent operation and management services are offered; continually promoting innovation on product, business and organisation are achieved, as well as pre-identification of uncertainties and risks.

4- Steps Lifecycle

As the core engine driving the transformation and upgrading of the industry, **digital building** powers the continuous development of the building industry. However, this to be achieved requires changes that cannot be taken overnight but requires overall planning and gradual development (over 4 steps: tool assistance, integrated development, intelligentisation and finally smart substitution) that leads to a range of new offered services throughout the lifecycle (figure 4).

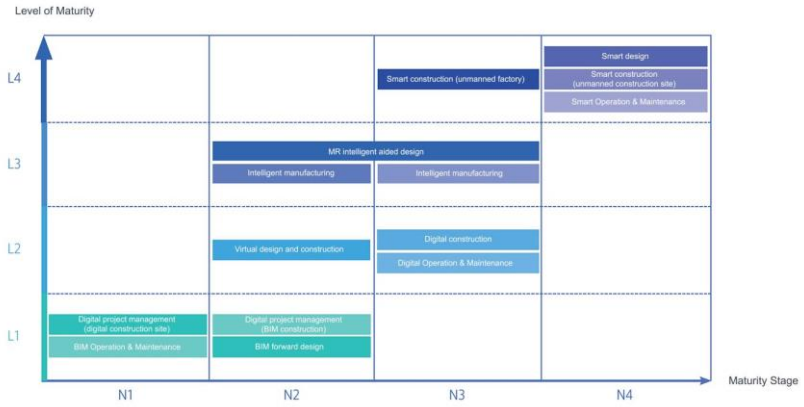

Figure 4: Maturity Period of Typical Scenarios under Digital Building

Hence as a web – based industrial platform of the building industry, the **digital building platform** is becoming the new infrastructure for implementing the strategy of the digital building industry that contributes to the industrial goal of making every project a success!

Digital Building Platform as a New Infrastructure for Digital Transformation

Digital Infrastructure

"**Digital infrastructure**" to promote the transformation of the building industry, is based on the Internet of Things that builds a web – based building industry platform driven by engineering software and data, empowering all parties to realise "digital intelligence" (digital, intelligent and smart) management and decision-making. The web – based character of the building industry supports the comprehensive interconnection, flexible supply, and efficient allocation of all factors (including both industrial and value chains) and thus to promote the digital transformation of production organisation method, business operation logic, and value creation mechanism (figure 5).

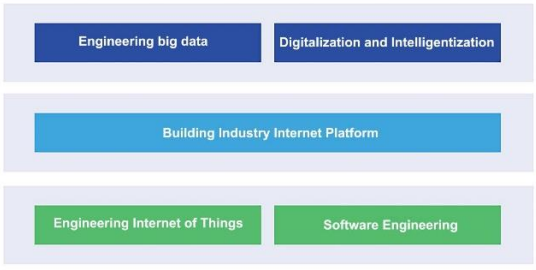

Figure 5: Major Components of the Building Industry Internet

Digital Production Line

On this basis, the digital building platform builds a "digital base" for the industry (figure 6) to lead to the digital twin world over a "digital production line" (figure 7). This revolutionary approach changes the product form (having both physical and virtual

asset to the client) and boost industries businesses models to offer more service – oriented construction and operation products. In addition, improves the management method to a more integrated delivery as well as develop a trustworthy system. Finally, it creates a unique iterative construction production mode that is digital twin driven; the digital twin construction.

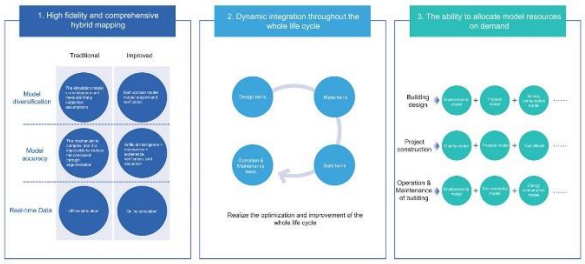

Figure 6: Building the Digital Base of Digital Twin World

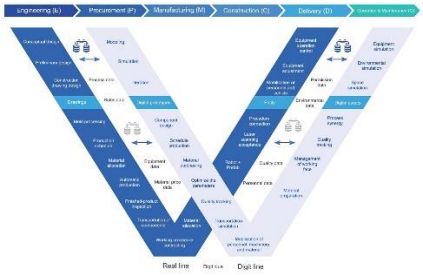

Figure 7: Digital Production Line

Operation Logic of Digital Building Platform

Moreover, the **digital building platform** establishes a logic (figure 8) that maps the virtual and physical world, forms a closed-loop business of "perception, description, analysis, decision-making, and execution", builds a new form of industrial digital twinning, and empower all parties in the industry to greatly enhance the ability of digital construction and service and offer better management in the whole process.

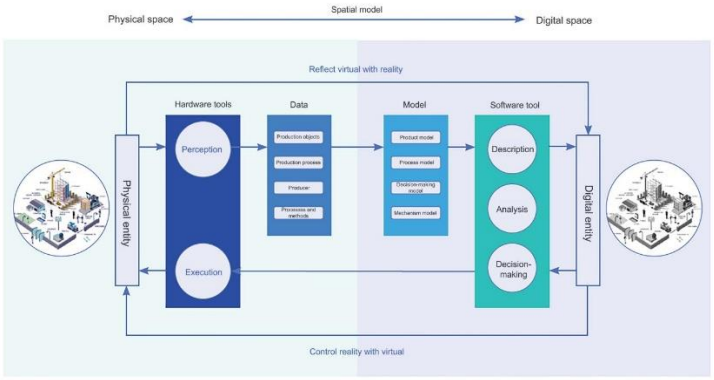

Figure 8: Operation Logic of Digital Building Platform

Features of Digital Building Platform

The main **features of digital building platform** (figure 9) are based on the digital twin and establishes the ubiquitous connection of the total process, factors, and stakeholders of engineering projects through digital technology. All parties in the industry chain cooperate to complete the design, procurement, construction, use and operation, and maintenance of buildings through the platform and demonstrate optimal allocation of resources in the whole industry chain more efficiently. Intelligent service is provided based on data drive. Furthermore, digital building platform architecture contains: **Technology platform** that includes the cloud computing platform, the graphics platform, Internet of Things platform, BIM model platform etc; **data** middle platform

is the hub that provides a unified data interface for all application systems and the application market that provides comprehensive, efficient, safe, and diverse applications that can affect the process of industrial digitalisation; **business** middle platform refers to the digital project integrated management platform that empowers all participants in the project, realise data-driven lean construction around the whole process of project construction, and comprehensively improve the integrated and refined management level of the project; **application market** the final indicator of business digitalisation is various applications and services: systems that end-users of enterprises directly use or interact with.

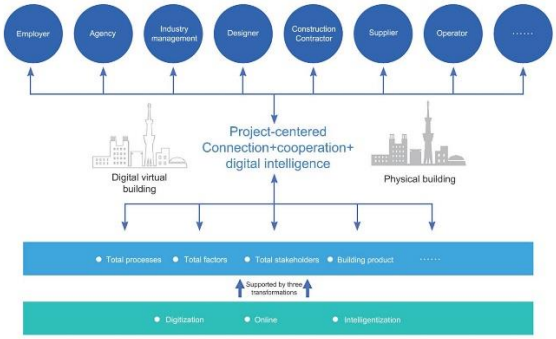

Figure 9 Digital Building Platform Features

Improvement of Production Efficiency by Empowerment of Digital Building Platform

The use of digital building platform empowers the whole process including (figure 10) engineering, procurement, manufacturing, construction, delivery, O&M so that the production efficiency of the industrial chain can be improved most efficiently. Further to this the digital building platform digitises key construction factors (labor, machine, materials, methods, environment) and upgrade timise the allocation of production materials over a real-time interconnection of the project site, as well as the mapping between the physical and the digital virtual site in the cloud, by building a digital twin smart site.

Whole-process	Engineering (E)	Procurement (P)	Manufacture (M)	Construction (C)	Delivery (D)	Operation & Maintenance (O)
Scenario	• All-discipline integrated design • Whole-process simulation • Coordination between all participants	• Smart supply & procurement • Digital credit information • Supply chain finance	• Digital marketing • JIT production • Automated production	• Process priority scheduling • Smart construction site • Twin building	• Digital delivery of completed works	• Predictive maintenance • Personalized and accurate services
Value	• Improving design quality and efficiency	• Integrating and optimizing supply chain • Constructing transparent value chain	• Demand-driven intelligent production	• Improving construction quality • Reducing project costs • Increasing efficiency	• Constructing project digital assets • Supporting smart operation and maintenance	• Improving quality of operation and maintenance services • Reducing operation and maintenance costs
Evaluation indexes	• Approximate 100% of building function rationality • 50% reduction in design cycle	• 80% increase in supply-demand matching efficiency • 60% reduction in credit service costs	• 65% increase in marketing efficiency	• 70% reduction in engineering changes • 50% increase in management efficiency • 80% reduction in engineering rework	• 50% increase in construction efficiency of operation and maintenance digital model	• Approximate zero equipment failure rate • 20% reduction in Operation and maintenance costs

Figure 10: Improvement of Production Efficiency by Empowerment of Digital Building Platform

Upgrade of the Building Industry in 4 Levels

Consequently, the upgrade of the building industry is achieved in 4 levels (figure 11): operational; project, enterprises, and industry level. With the empowerment of the digital building platform, digitisation at the **post operation level** improves the efficiency and quality of operation level; improve the efficiency of project management at **project level**; link the business, information, and capital flow at the **enterprise level** by optimising the resource allocation; and finally build a supervision service platform and system to promote industry governance and service level.

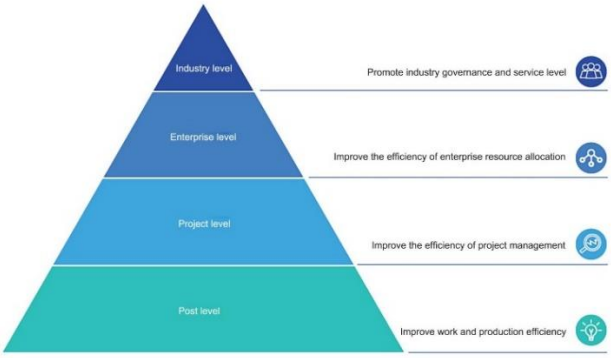

Figure 11: The Platform Promote the Transformation of the Industry at "Four Levels"

Digital building platform empowers added value activities

In fact, with the empowerment of digital building platform into the building industry, two buildings: physical and digital virtual building will be delivered to the owner at project's completion (figure 12). Through the virtual building, all kinds of digital information of the building construction process can be traced and tracked at any time, use information models to support operation and maintenance of the asset, and ensure building's sustainable operation. Hence, the utilisation of the digital building platform brings great results to the transformation and future existence of the building enterprises and the broader sector.

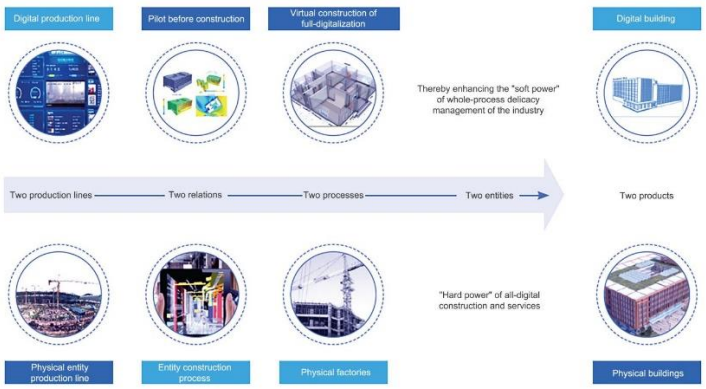

Figure 12: Upgrade of Whole-process Management of Project Empowered by Digital Building Platform

Henceforth, the digital building platform establishes the online connection between building enterprises and users to boost digital productivity (figure 13) and develop new business models in which **users customise** online and building enterprises build offline; build products (assets) by creating a **human-oriented**, healthy, and comfortable living environment as well as to provide to customer with **data – driven personalised** and accurate services through the digitalisation of building space, online equipment, and intelligent management. With the function of **virtual design and construction** within the digital platform it creates all-digital samples, to guide physical construction and building O&M. In addition, **all – discipline integrated design** features the digital building platform integrates different disciplinary design software to provide a unified design environment to maximise project quality and efficiency. On this basis digital assets are developed to form a unique design data source in real – time. Moreover the team **simulates** among others the process schedule according to the procurement plan, clash detection, coordination between suppliers, realise the reasonable and efficient construction plan etc.. Using the digital building platform, it offers a **digital supply and procurement system** with real-time connection, data drive and open empowerment will be built. Connect the supplier resources of the global building industry chain through the digital building platform, **establish a digital supplier library**, and update the supplier information in real time according to the online performance data of the project to reduce significant risks. Through the digital building platform, **a decentralised accounting system** is established based on blockchain, to build a transparent market environment for project transactions as well as **project transaction and performance data** of all stakeholders that can be aggregated so a range of financial activities could take place so ensuring project delivery free of financial risks (fintech). In addition, realisation of lean construction based on digital twin through digital building platform, closes **the performance gap** between design – construction – operation. In addition, the visualisation of uncertainties through interaction between virtual and physical world also **minimises waste and maximise value** of the construction process (figure 13).

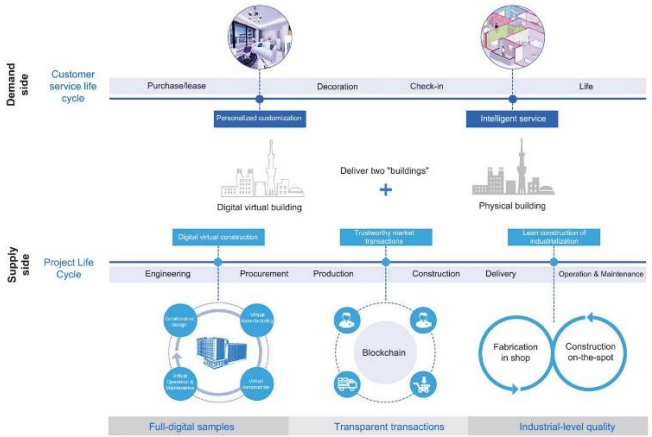

Figure 13: Platform empowers the building industry to endorse digital productivity

Henceforth, the **integration of factories and sites** using the digital building platform, the whole industry chain coordination and flexible production can be realised.

Is it easy or not to Digitally Transform the Building industry?

The digital transformation of enterprises directly affects the success of the industry upgrade. Enterprises have to go through the process to be capable and ready to become leaner, make efficient (data driven) decisions and systemitise project management (figure 14). At present, most enterprises are faced with confusion in the transformation due to lack of enough understanding of digital transformation and methodological support. So key questions need to be clarified are: *Why do enterprises need digital transformation? What is the digital transformation of enterprise? How do enterprises implement the digital transformation?* figuring out three questions: "why to transform", "how to transform" and "what to transform" it will provide strong support for the digital transformation of building enterprise.

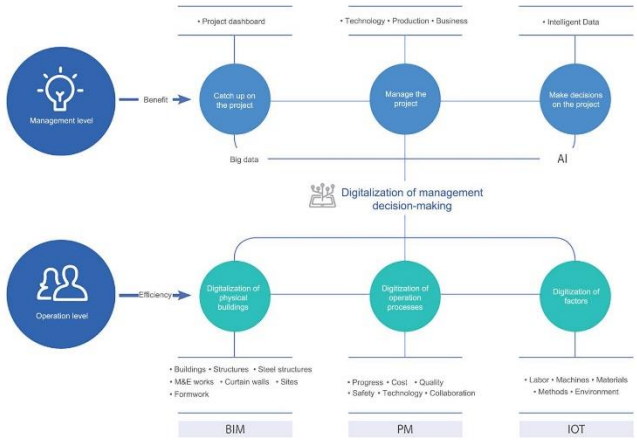

Figure 14: Digital Building Platform Promotes Lean Management at the Project Level

At the same time, typical cases of different types of leading enterprises provide practical reference for building enterprises to set clear transformation goals and cultivate suitable transformation paths and strategies, to ensure the smooth implementation of enterprise transformation.

Why do enterprises need digital transformation?

Digital transformation pushes industrial development and thus boosts to shift industrial economy to digital economy. By transforming the industry then will be easier to meet our goal by “making every project a great success”. However, seeing the fast growth of both scientific and technological innovation that pushes towards social development, then these innovations should be taken into consideration towards the transformation of the industry. Therefore, the need to integrate these three worlds (mind – digital – physical world) requires a better utilisation of these scientific and technological innovations e.g. Big Data, IoT, BIM, 5G etc to meet our goal. Hence, effective integration of digital technology and building industry, **"digital building" becomes the core engine to lead the transformation and upgrade of building industry** (figure 15)**.**

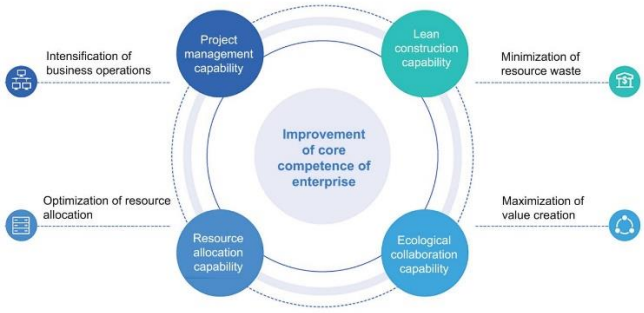

Figure 15: Digital Transformation Powers the Improvement of Enterprise's Core Competence

How do enterprises realise the digital transformation?

Digital transformation of construction enterprises is an important measure related to the sustainability and development of enterprises, and it is also a new journey for most enterprises to explore. According to the characteristics of the construction industry, the transformation of construction enterprises can be advanced in a **systematic and orderly manner according to the strategy and steps of "grasping the development trend - figuring out the strategic route - enhancing capabilities"** (figure 16). The digital transformation of enterprise needs top-down planning where top management team have to really understand the digital vision of the transformation and its outputs. Therefore, the thinking should be “end user driven” by determining the digital transformation direction of the enterprise, set clear transformation goals, design business architecture and IT architecture under the guidance of enterprise architecture methodology, and plan specific transformation path that maps with industry’s transformation and upgrade.

Moreover, business architecture is the foundation of enterprise architecture, and it describes the structure and interaction among enterprise strategy, business process, organisation and governance. Thereafter by designing the IT architecture according to the business architecture then the strategic objectives, operation method and processes of the enterprise be realised and implemented. This covers application architecture, data architecture and technology architecture. Application architecture is the epitome of enterprise architecture, and it describes the blueprint of application development, the structure and interaction between applications, and the relationship between applications and core business processes.

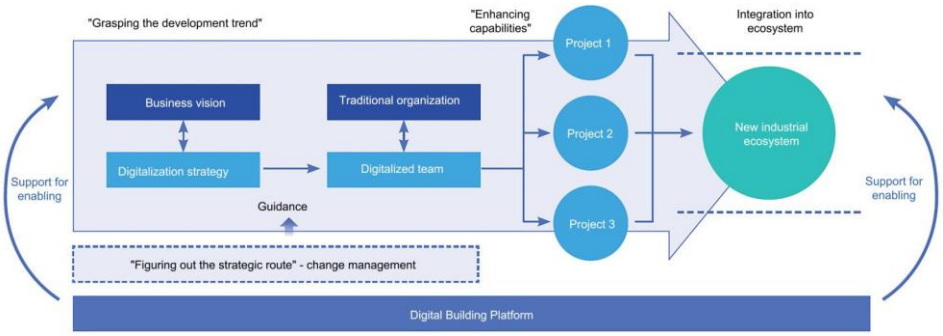

Figure 16: Strategies of Digital Transformation of Building Enterprise

Data architecture is the core of enterprise architecture, and it describes the structure and

interaction between data types and sources and logical and physical data assets and resources. Technical architecture is the support of data and applications. Under the two-wheel drive of business architecture and IT architecture, the enterprise digital transformation strategy will be implemented to achieve the expected strategic transformation goals. So, the key to success: Pilot project first and iterative promotion. The digital transformation of enterprise will not succeed overnight but should be promoted gradually according to actual conditions.

What is the digital transformation of enterprises?

Digital transformation of building enterprises is not a simple innovation and application of new technology, but an all-round transformation of development concept, production, management, business, and organisation method (figure 17). **The digital building platform is coming to close the gap in the industry and boost industrial transformation in a more comprehensive, integrated, holistic and social driven approach** that will allow enterprises to: create value-driven business digitalisation and digital business; integrate application of digital technology supported by a platform that becomes the key to technological transformation; and create a customer-centered self-driving and empowering organisation that becomes the focus of transformation of organisation.

Figure 17: Contents of Digital Transformation of Building Enterprise

Future the transformation of building industry

Digital transformation of the construction industry is progressing. However, construction industry representatives need to change the way of thinking towards a more unified, integrated, and collaborative triarchic world (digital, physical and mental) that utilises fast growing sci-tech innovations to build a better sustainable built environment. This idea of "digital building" lead and promote the digital transformation of the industry.

Moreover, the digital building platform supports the construction of new infrastructure for the digital transformation of the industry, utilising digitalisation, networkisation and

intelligentisation throughout lifecycle process. Consequently, the creation of the new ecological system requires the involvement of projects, enterprises and industries to operate in a more collaborative way that can drive the industrial upgrade offering: new design, new construction technologies and new operational and maintenance methods. Therefore, the digital building platform forms a dynamic new industrial ecosystem that creates the opportunity for a better symbiotic development of projects' participants that will result towards win – win outputs. Therefore, the successful digital transformation process guarantees the smooth transformation of construction enterprises and its industry accordingly.

Consequently, to be able to vision and demonstrate a Triarchic World "digital building" thinking, in which building industry is transformed and upgraded, requires linkage with "digital cities" by boosting cities digital transformation (CIM). This comprehensive holistic approach allows us to innovate in planning, construction, and management to transfer our cities towards autonomous, controllable, safe, and reliable places. We need therefore digital platforms that are based on big data and prop-tech to offer value – added services to lead towards the upgrade of the building sector and later transformation of our cities to happier and liveable cities. Henceforth, digitisation swift can improve the way we live! Think Smarter - Live Better!

Digital Building Platform Service Provider

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Glodon Company Limited

Glodon Building, Building 13, Eastern District, No.10 Courtyard, Xibeiwang East Road, Haidian District, Beijing

Tel.: 86-10-56403000

Post code: 100193

Official WeChat of Glodon

WeChat of Digital Building Institute