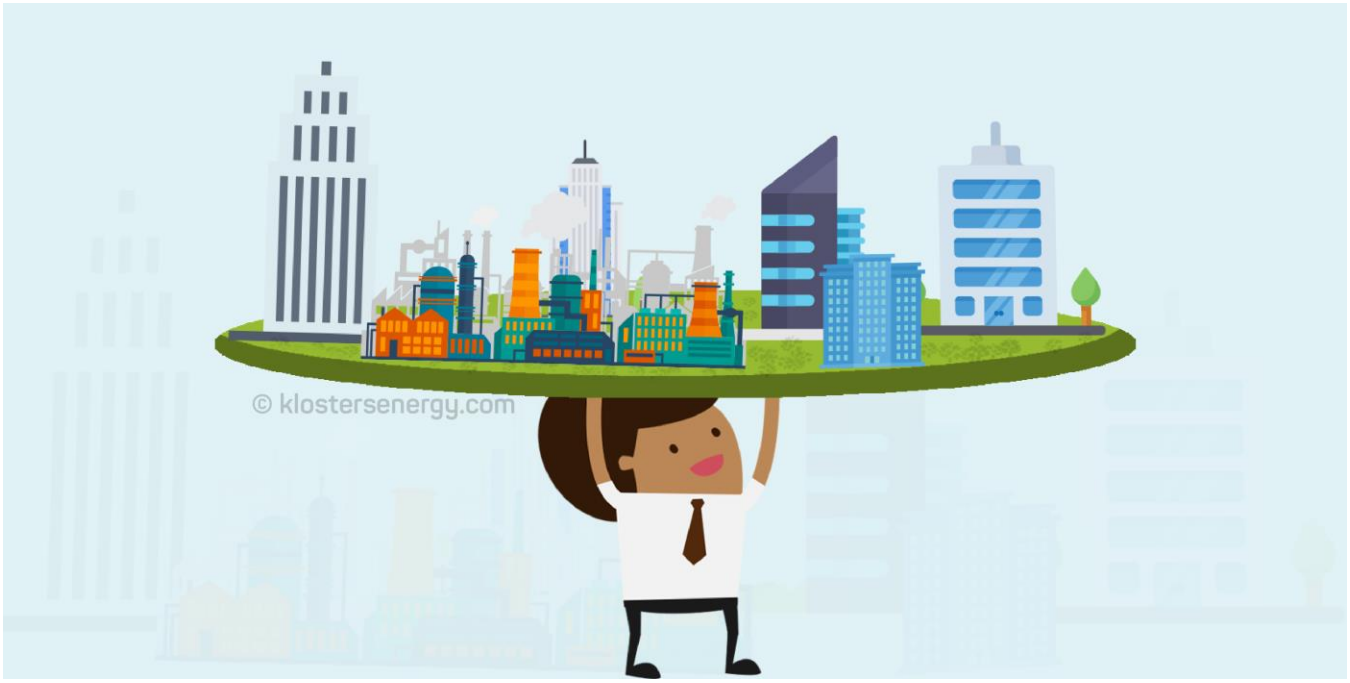
KES Notes

A Big Platform for the Engineering and Energy Enterprise – What Is It and Why Do We Need It?

Echezona C. Chukwuka[1], Chukwunyelu C. Chukwuka[2], Chidiebere T. Nwaoha[3]

September 2019



[1] Chief Executive officer
[2] Chief Operating Officer
[3] Risk Management Lead, Klosters Energy Services Limited

Summary

Assets in the energy and engineering industry still face the challenge of attaining and maintaining optimal production (OP): a state of maximum production output with optimal costs and no compromise to health safety and environment Despite the advances in traditional operations and maintenance, which have no doubt impacted on industry, there still remains considerable challenges to the achievement of OP. Digitization has been suggested as a very potent means of surmounting these challenges.

This paper presents insights on the digitization paradigm, including the current challenges it faces. The case for a big platform is examined with parallels drawn from conventional massive web-based platform software.

Lastly, KadMap® – a digital solutions platform is presented as a potent means of achieving digitization efficiently, effectively and securely.

Keywords: Digitization, Big Data, Enterprise, Industrial Internet of Things, Artificial Intelligence, Massware, Data Standardization, Data Convention, Big Platform, KadMap.

Contents

Introduction

The paramount goal for the engineering and energy (EE) asset (i.e. plant, facilities, machines, etc.) is that it is fit for purpose – whatever purpose that may be. Related aspects such as availability, cost, safety, maintenance are appendages of the means to this end. The ideal aim is to achieve and operate at optimal production (OP); a state of maximum production output with optimal costs and no compromise to health, safety and environment (HSE).

Asset integrity, HSE and O&M strategies etc. are means to achieve OP. While these have advanced the cause of OP over the years, there still remains considerable challenges to achieving a revolutionary breakthrough towards OP. The digital paradigm has been suggested as the key to this breakthrough. Calls for a digital revolution within the last 7 years has been intensified (also in light of the oil price falls and inconsistency since 2015) as the way to significantly surmount all the OP challenges.

Understanding EE Assets from a Digital Point of View

Over the last 20 years, we human beings have been, on a very accelerated scale creating a digital copy of the earth (see: *The Engineered Future – A Likely Preview*[4]).

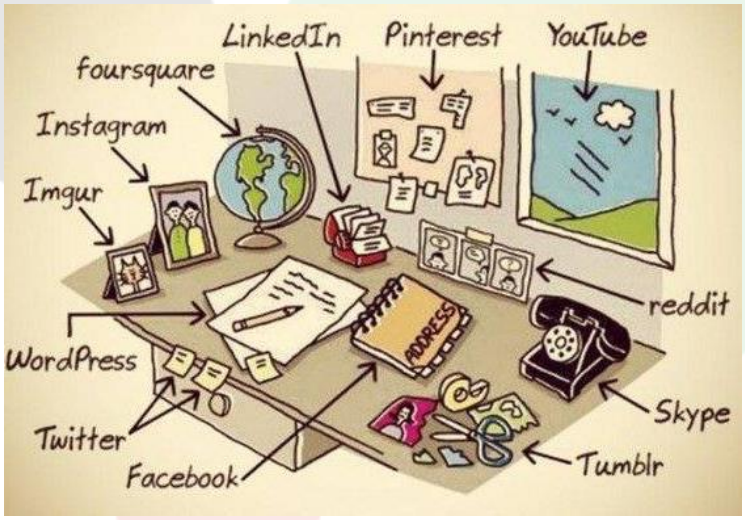
Development of a Digital Earth

[4] http://bit.ly/EngFuturePrev-KES

We have been replicating all sorts of phenomena that exists in the real world and putting them into this digital world – a euphemism for the world wide web (www).

Global Digitization

When we talk about digitization with reference to the digital world, it is basically putting strings of data of what exists in the physical world into the digital world and finding a way to organically link them together. Actions like taking a photo and placing it on the internet is an instance of digitization since you made a digital copy. Digitization as strategy is motivated by the phenomenal impact it has had on our lives in the physical world.



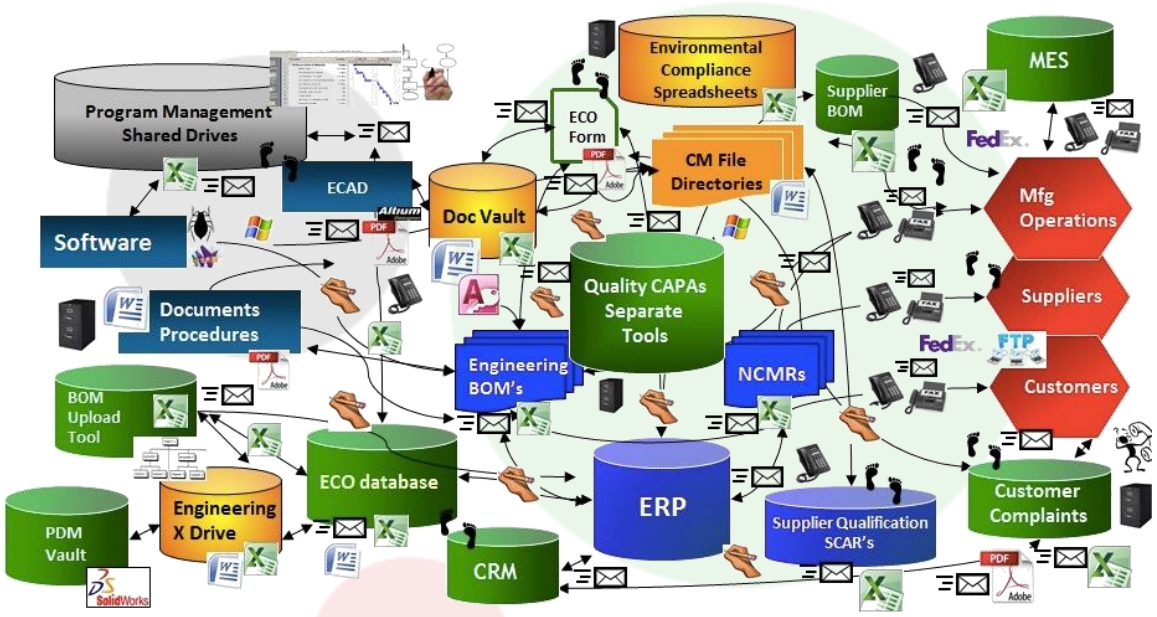
Digital Equivalents (Source: Web)

Global digitization is the storage, transmission, processing, visualization and manipulation, of data in a format that is extensible/programmable for remote use/access across an interconnected network such as the world wide web. Now we need to look at EE assets in this way too; how can we have them digitized in like manner and adequately represent (abstract) them in this digital earth. This is one of the major challenges facing digitization in the EE industry. Digitization is dependent on two main factors:

1. Data and digital representation
2. IT infrastructure

Data and Digital Representation

To look at EE assets from the data aspect of the digital perspective means viewing the EE asset as chunks of data completely analogous to their physical entities. Currently we have asset characterizing data is stored in various forms and formats. These forms or format represent various aspects of asset operations (e.g. flow, structural response, maintenance logs, inspection schedule, etc.) or their physical representations (e.g. P&IDs[5], BOMs[6], CAD[7] files, etc.)



Various Digitally Represented Aspects of EE Assets (Source: web)

While these data currently exist, they are at best, semi-organized chunks of data in need of comprehensive standardized (re)organization and consolidation. There also exists uncharted data territory of digitally un-characterized aspects of the EE enterprise and assets. How do we characterize and classify these data category? What data are we looking for really? What are we trying to represent? Can we and should we represent everything? All of these questions contribute to the data question in EE assets.

[5] Piping and instrumentation diagrams
[6] Bill of materials
[7] Computer aided design

IT Infrastructure

We talked earlier about the digital earth; the digital earth just didn't come about by itself. Several things needed to be in place before it could come into existence in the way we know it today. These are the infrastructure which were developed and evolved from the microcomputer, data storage, the personal computer and the conventional operating systems, the advancement in speed and memory of the computer, the supercomputer, connectivity - the internet, world wide web and technology, websites to the cloud and other data storage technologies, etc. All these trillions of US Dollars' worth of investments, constitute the IT infrastructure - which powers and supports this digital earth.

The Fate of the Comprehensive Digitization of EE Assets Lies with Data and IT Infrastructure

The IT infrastructure makes it possible to have advanced forms of data storage including increased storage capacity which enables the capture of huge chunks of data (big data) into the digital world.

There have been considerable advancements in data technology as well by way of a rising variety of databases (SQL[8], non-SQL, etc.) enabling more complex storage data. Equally important is the transmission of these data – especially the visual feedback of the digitized entities. Transmission is both affected by both the data technology and the IT infrastructure. For example, the advancements of these two important aspects has enabled high quality video streaming at high speeds and created the avenue to go live on several web platforms.

Digitizing EE assets involves complex abstractions and equally requires complex data representations in addition to maintaining a live link/connection with their physical counterparts while utilizing the already present infrastructure. Ultimately the challenge of comprehensive digitization is dependent on the available data and IT infrastructure.

[8] Structured query language

The Contemporary Enterprise Software Ecosystem - The Shortfalls

We can refer to fairly simple forms of digital representation such as how websites can represent an organization's sign board and brochure/profile. We can also cite more complex forms of digital representation coupled with added in operations. For example, we can take the same organization and observe the internal representation and operation digitally, in accounting systems, HR systems, Email systems, etc. A good number of these representations have been achieved in the contemporary enterprise via traditional software in areas like communication, documentation, presentations. They have been very useful and have boosted businesses They are able to perform functions – which were previously impossible beyond a certain organization size, on a very large scale and with more accuracy. The digitization capacity of today's IT infrastructure has moved beyond the enterprise and even geographic locations to encompassing whole industries and the world as a result of the internet. As the silent revolution of digitization sweeps across several aspects of life and business, the EE enterprise stands to benefit a lot from global digitization.

Traditional Software Limits

While the introduction of software into business operations have largely translated to increased efficiency and value, the success is not universal. Several software experience redundancy and start-stop usage like New Year resolutions. A good example is the EAM/CMMS[9]. A key reason for is poor performance lies in developers' failure to adapt it to the existing process in the EE enterprise (ill-defined enterprise operation data abstraction) – for which more than 50% of EAM/CMMS implementations fail within the first 12 months. It places an implicit requirement for the users to adapt to the software instead of the other way around.

Digitization from what we have learnt over the last 15 years, especially with big web platforms is that they are intuitive – they adapt to the user's conventional knowledge and web use and thus almost have no learning curve. They spurned the new generation software generally referred to as apps. This also contributed to the boom in IT as developers began to (or were perhaps forced to) pay more attention to impatient customers/users rather than just providing a tool they are locked in to live

[9] Enterprise asset management, Computerized maintenance management system

with/depend on (for career progression as in the case with enterprises). In this case the life of the IT firms depended on the users and so had to adjust to them.

We can learn some lessons from these apps in this digitization challenge in order to even further increase the overall effectiveness and efficiency of the EE enterprise.

At this point we will compare "traditional software" and the new gen software popularly called "apps", and point out some of pros and cons which could improve the EE enterprise.

	Traditional Software	New Gen Software (App)
Development language	Built on traditional programming languages (C, C++, C#, with UI Fltk, Qt, MFC etc.) These languages are still in use but are becoming more specialist in the IT niche.	PHP, python, JavaScript, ASPX, CSS, Html, UI frameworks (angular, bootstrap, etc.) These form the overwhelming majority of the new gen developer's choice of tools. With most reference material and "help" with several free IDEs.
Hardware resource utility	Heavy and complex functions carried out on local system relying on hardware resources for effective functioning	The app can be frontend focused (user interface) relying on network resources to transfer data to backend for processing. As such, it requires light usage of local hardware resources.
Appearance and user experience	Desktop look and conventions	Web look and icon convention
Dominant platform	Mainly desktop. Not all ports to mobile devices work great due to severe downgrading of functionality.	Portable devices mainly and then maybe desktop
User adaptation	User has to adapt to it with considerable hours of training and certification. It generates expert	It is built to adapt to user. No need for training for basic use. It relies existing conventions in user's repertoire (it is

	class.	assumed that just about everyone is familiar with web conventions).
Learning curve	High learning curve	Very low or no learning curve.
User classes	Aims for user to become intermediate and expert class users as most benefits and functionalities are in this category	Target is to ensure that even the novice/first-time user can get the best out of it
User loyalty incentive	Loyalty is mainly motivated by learning curve and time since going to another software of similar function is another learning curve and time period altogether	Several related apps at least have several related functionalities to avoid any learning curve. Loyalty is motivated by other factors such as reliability, security, trust etc.
Development time	Requires significant development time	Faster to develop (very template-able)
Functionality	Several functions and complexity, makes it challenging to port app versions	Usually single functions, very simple to perhaps the extent where it is too less of utility to develop desktop version
Developer capacity	Built by large enterprises or significant entities	Built by large enterprises and single individuals alike. The spectrum is large with equal chances for success

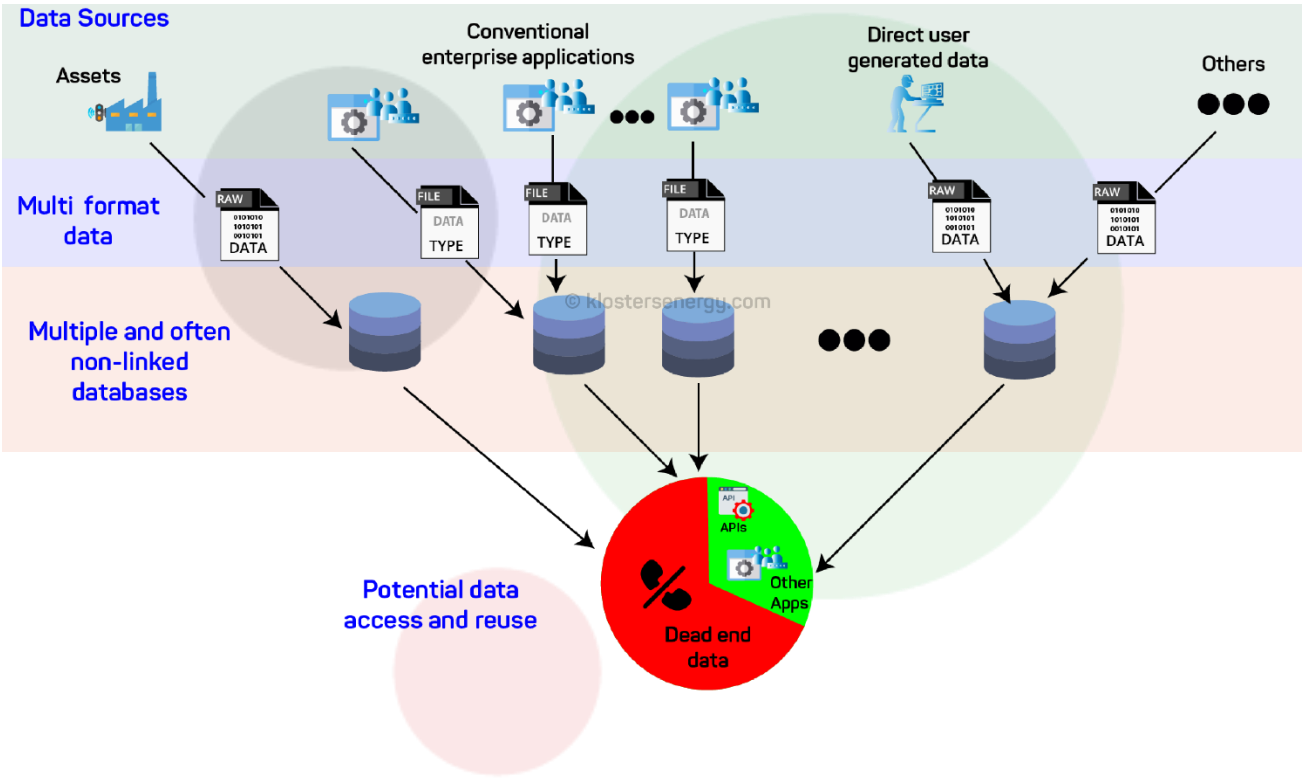
Comparison of "traditional software" and new gen software ("apps")

The ease of learning and use, conventions, interactions, user interfaces (UI) and user experiences (UX), etc. of the new generation software have not been fully imported into the EE enterprise.

Dead-End Data

There is also the matter of dead-end data – data which has little or no reusability, for traditional software. Several software performing similar functions have their own data format and separate databases. This makes it very challenging and nigh impossible for developers to develop applications

that are highly generic; they have to make several exceptions for software of similar function. The data from traditional software is also stored in a database specified by the software. This database may or may not be accessible, and for those with access, the accessible data varies from one software to the other. These all contribute to dead-end data. In the digital era, data is supreme over software (see: *The Engineered Future – A Likely Preview*[10]). 100% data reusability accounts for more than 60% of the digitization paradigm. The connection of apps, people, assets, enterprises and ultimately industries revolve around data – its storage and access.



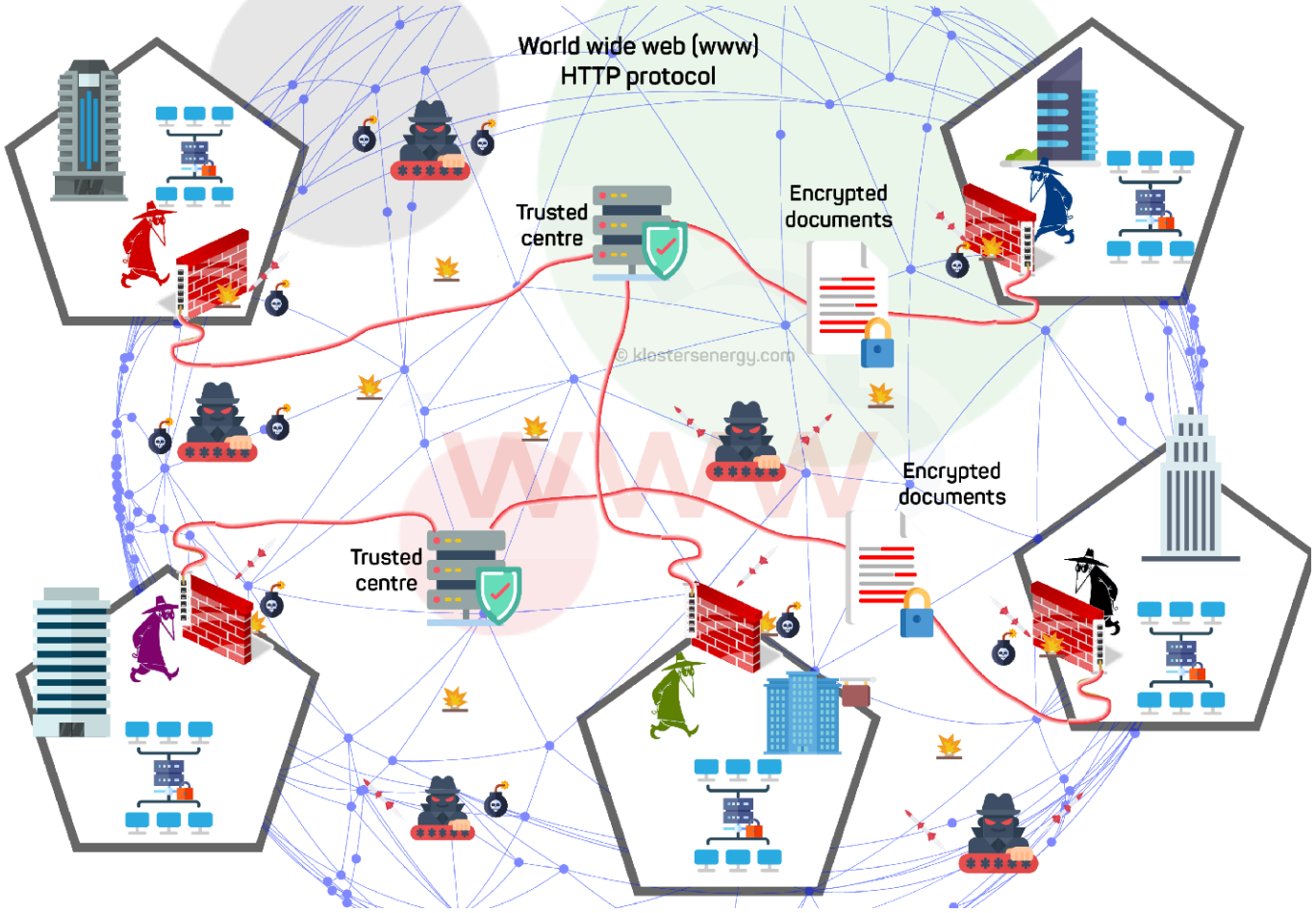
Dead-end Data in EE Enterprises

The EE Enterprise and the Open Internet

The "open internet" is the world wide web (WWW) protocol which can be accessed from anywhere and by anyone. There is the security issue in the case of access between the EE enterprise and the internet. Prominent EE enterprises are hubs of technological innovation and sensitive information and

[10] http://bit.ly/EngFuturePrev-KES

thus are targets for corporate espionage. Thus, their higher-than-usual high security consciousness when dealing with the open internet. They are more or less trained similar to secret agencies in dealing with it. This is a big impediment to global digitization. Currently, any meaningful adoption of digital solution comes with costly deployment of application and infrastructure amidst extensive security clearance protocols. This limits the pool of developers who can provide very useful applications and infrastructure/platform leaving only few big players. This shuts of a vast reserve of potential IT solutions which the EE enterprise stands to immensely benefit from. The explosion of the app market with the rise developer friendly platforms over traditional software and less developer-friendly platforms is an attestation to this point.



High Security Consciousness between the EE Enterprise and the WWW

The Big Platform Paradigm - How it can Operate and Evolve the EE Enterprise Software Ecosystem

There are clear benefits to global digitization as seen in the marketing and advertising industry for example, with reliance on massive web-based platform software ('massware') targeted at the general public (the market). The EE enterprise functions in a largely digitally closed loop for very justifiable security reasons as mentioned earlier. This closed loop is not so friendly with the global digitization definition and definitely unfriendly with massware over the WWW. Thus, the digital potential of the EE industry and several others remains yet unrealized.

We have elaborated on the need for advanced IT infrastructure and data technologies for digitization to be successful. Assuming these have been surmounted, the next task will be to create the digital representations of the physical EE enterprise, assets and operations. These digital representations require significant definition and development methodologies with an explicit framework of manageable conventions similar to how we have a framework for project management (see: *Project Management Body of Knowledge (PMBOK)*[11]). These digital representations are complex and numerous and require a robust yet manageable framework.

This framework guides the development of a digital platform from which the benefits of digitization are to be achieved. This digital platform should enable people and organizations to interact/collaborate effectively and represent digitally their activities within their assets especially and the enterprise at large. While these can be achieved for individual organizations, the standardization of these conventions will enable for cross-organizational operations between single EE enterprise digital platforms. The real geometric scaled benefits however, are to be found in industrial scale operations which essentially are global for a global industry like the EE industry.

Global scale operations imply digital operations involving the flow of terabytes, millions of digital representations and EE enterprises; the size of, and extent to which, requires a global platform paradigm – a big platform paradigm, similar to that of conventional massware.

[11] http://www.pmi.org/

The EE enterprises are a distinct niche due to the similar challenges they face such as information security and privacy added to the inter-collaboration they often undertake. Such similar challenges imply that a similar solution could be developed to satisfy each player in the EE sector. These challenges, because of the specialized nature, create a distinct gap in the digital world which is exclusive to the EE industry. The big platform paradigm is capable of filling this gap in the form of an exclusive enterprise platform software (EEPS) specifically built for EE industry separate from the territory and targets of massware.

The EEPS solution will have the following base features:

- Exclusive space: This here means a system that exists within the digital space (internet) but excludes the conventional digital space (world wide web)
- Technology cache: It has at the very least similar capacity and capability of conventional digital technologies and advancements available in the world wide web with more to be added on to suit the niche requirements of the EE industry
- Highest security and privacy level: It ensures at the very least, the same high level of security and privacy that EE enterprise advocate and strive to maintain

An EEPS will ensure the following benefits:

(1) Standardized and reusable data
(2) A user interface for data
(3) Faster app development and deployment
(4) A trusted space
(5) Connected apps
(6) Connected industry
(7) Industrial internet of things (IIoT) connection
(8) Interface with existing software
(9) Artificial intelligence (AI) implementation

(1) Standardized and Reusable Data

In the future of IT, there will be primacy of data over software (see: *The Engineered Future – A Likely Preview*[12]). This will be as a result of reusable data, with standard format and reference, which will be promulgated by an EEPS. This already prominent with conventional massware, where several useful applications are built with calls to the standard data using APIs.

There will also be standard references to most of, if not all data at standard storage locations on EEPS powered machines (think of how you have a set location for the pictures, videos and music folders in the documents folder on a Windows® powered computer).

Data standardization improves overall data organization, efficiency of the enterprise and more effective data control by providing a data consolidation base on the EEPS. The EEPS will provide for access levels for what could be read-only or read/write, copy, zero access or custom exceptions.

(2) Data Presentation – Giving Data a User Interface

In 1973, Xerox PARC gave us the metaphorical "desktop" graphical user interface (GUI) in their Alto PC. This was a milestone in the quest to direct control of computer-created data and set the basis for later improvements of graphical interfaces (see here[13] for more info). This GUI formed the fundamental view of an operating system. For a comprehensive global digitization to occur there has to be a reference conventional data and data operation over which applications can be built. This conventional data with its operations have to be visualized to enable usage.

For example, a very pertinent question to guide the development of an EEPS interface would be "what are the fundamental/irreducible data and data operations of EE enterprises/assets?".

Without much derivation we can abstract such basic data from what we can see around us:

We have users (who have comprehensive attributes), departments, shared files, communication, assets (with an extensive catalogue of subsystems and components, along with their attributes) etc.

[12] http://bit.ly/EngFuturePrev-KES
[13] Wiki - History of the graphical user interface

With these data, we can begin to build a useful user interface or a "desktop" equivalent and subsequently other data presentation interfaces using known user behaviour knowledge.

(3) Faster App Development and Deployment

Standard data libraries simplify development and attract a larger pool of developers as development will be simpler and faster enabling development of several brilliant apps in quantity and record time. Standard reference data allows us to genericize data in development and enables developers to develop apps without using private data.

SDKs (software development kits) APIs (application programming interface) and libraries from the EEPS, will further increase speed of development of apps.

The EEPS' standards and quality assurance (QA) checks would ensure app quality and security saving EE enterprises resources and time on QA checks.

(4) A Trusted Space

EEPS will create a strictly monitored digital space for collaboration sharing of documents, large data, location of trusted resources, etc., and other activities like industry events, trainings, webinars, etc. exclusive to EE enterprises, all with the highest security and privacy.

(5) Connected Apps

The EEPS based apps will be able to interface with each other as a result of the interfacing apps (see: IFTTT, Zapier, Slack, etc.[14]) rather than conventional limited plugins/software extensions, Interfacing apps are fully functional apps with access level (mainly read-only, write or read/write) to the same set of base data on the EEPS via API, able to interface two or more apps via data/apps actions such that action in one app triggers a specified action in another app ((the connected app).

[14] www.ifttt.com, www.zapier.com, www.slack.com

(6) Connected Industry

The EE industry is a highly collaborative industry. An EEPS would provide the means to highly interactive and smoother remote collaboration. An EEPS will move beyond emails and conference calls to more innovative forms of collaborations such as joint live monitoring of projects, events, webinars, robust design reviews, asset inspections, trainings, etc. all these using a selection of latest visualization technology such as virtual reality, mixed reality etc.

(7) Industrial Internet of Things (IIoT) Connection

There is the issue of data security and transmission with EE enterprises. Many EE enterprises will rather have their data remain within than sent over the grey area that is the www (security guarantees notwithstanding). An EEPS will serve as a the primary medium for the safe and secure aggregation of data from sensors/devices and connect these data to applications for interpretation and action with option of further connection to other apps all without data leaving the EE enterprise.

(8) Interfacing with Existing Software

The contemporary EE enterprise has several software (enterprise level) installed. These are necessary for vital functioning of the enterprise. An EEPS will interface seamlessly with these existing systems via API/SDK which already provided by a majority of these software providers. The interface will allow for access to the software data on an agreed access basis – read-only or read/write. The EEPS should be designed to run side-by-side with these software and should not conflict with them.

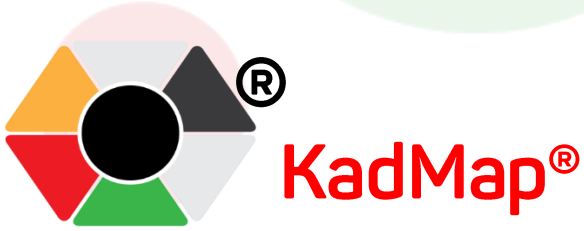
(9) Artificial Intelligence (AI) Implementation

We have looked at AI before (see: *Artificial Intelligence (AI) in Assets - The Knight Rider Facility*[15]) Industries such as digital marketing and advertising which can implement AI have massware which index data on a massive scale (big data).

When we look to augment certain automation with AI (AI is different from automation) which are critical to EE assets for example, the data needs to be consistent, considerable and accessible. Intelligible and well segregated consistent data (see standardized data section above) is crucial to the implementation of AI. There also is the issue of data format. An EEPS allows for consistent data input, storage and access. It also allows for safe and secure sharing of data to reach critical mass that could be useful for AI machine learning to yield best results.

KadMap®

The name "KadMap" is a coinage for the holistic digital framework and infrastructure to deliver digital asset solutions developed and maintained by Klosters Energy Services (KES). Embedded in the name KadMap®, are acronyms for keywords such as asset, data, management and platform.



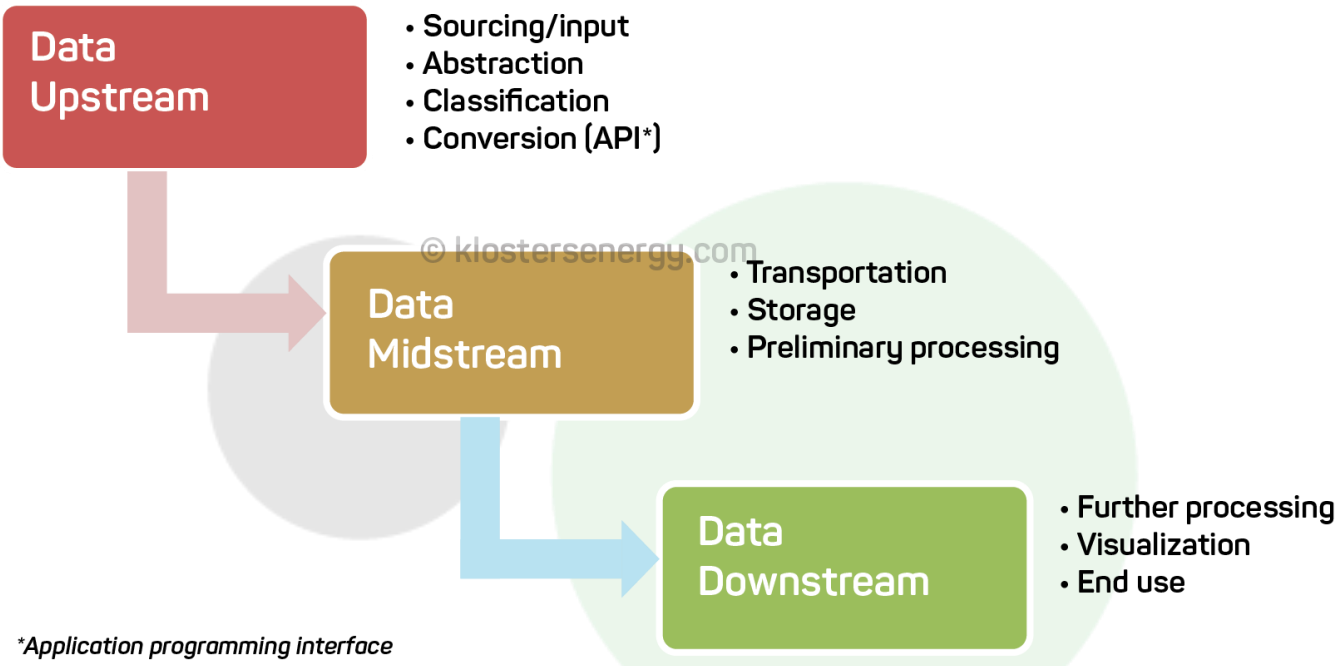
KadMap®

KadMap® hosts a range of digital solutions to myriad challenges affecting engineering and energy (EE) assets and operations.

The scope of KadMap® encompasses several assets and operations of the EE industry.

[15] http://bit.ly/AIAssetsKnightRider-KES

KadMap® is a very data-oriented solutions platform with particular focus on digitization and data abstraction, specializing in the upstream (data sourcing/input, abstraction, classification and conversion) to the midstream (transportation and storage of data, including preliminary processing), to the downstream (further processing, visualization and end use) phases of data.



EE Data Supply Chain

KadMap® is an umbrella for all the technology involved from one end to the other in the EE data supply chain featuring both hardware and software making KadMap® the world's first of its kind end-to-end digital solutions platform.

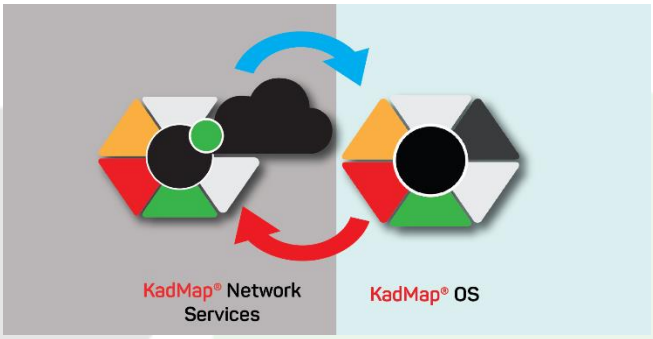
The end-to-end integrated scope of KadMap® is a huge challenge which KES has been progressively addressing since 2007. KES' strategy has been to utilize a project-based approach by creating and executing an integrated project dubbed "KadMap® Development Project", with this challenge as the goal, and each project deliverable a milestone towards addressing the challenge.

Two deliverables are of particular importance in the project:

1. KadMap® OS

2. KadMap® Network Services (KNS)

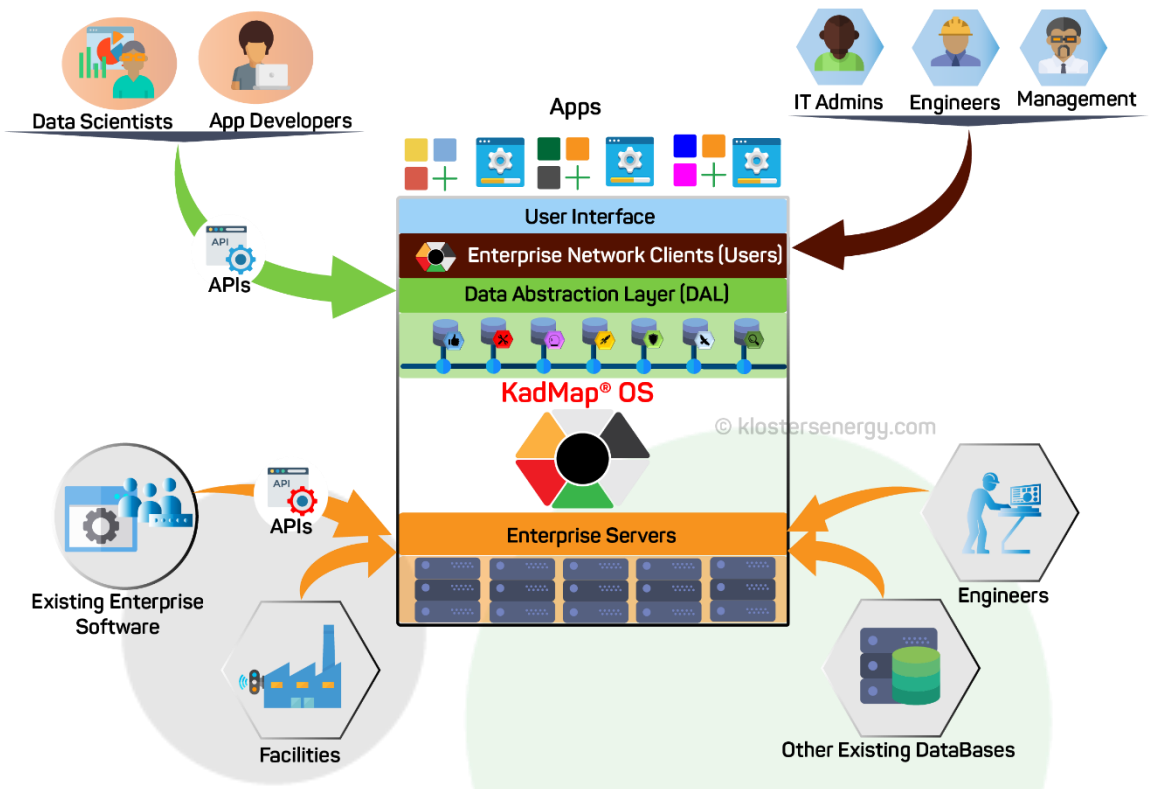
KadMap® OS and KNS both form the base infrastructure required to deliver the entire scope of KadMap®.



KadMap® OS and KNS – the base infrastructure

KadMap® Operating System

KadMap® OS (operating system) is a multi-client (server-based), multi-network, data-oriented operating system developed with the energy and engineering (EE) enterprise and operations in focus. Its architecture was developed with the inherent needs, infrastructure configuration and security concerns unique to the EE enterprise.

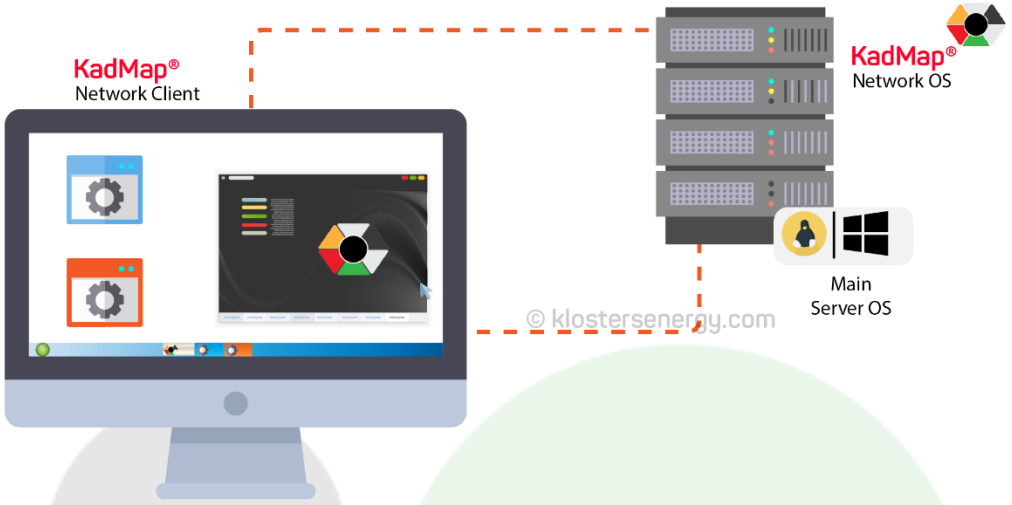


KadMap OS Architecture

KadMap® OS' philosophy and operations centres around data - its transmission, storage, security, visualization, access, etc. and thus features a heavy emphasis on data technology.

There are two main sides/components of KadMap® OS:

1. Client side (Network Client) – Which is for data input, organization, manipulation and rendering of data and application instances. It is installed on the local machines utilized by staff in the EE enterprise.
2. Server side (Network OS) – Which is for local hosting of applications, network administration and storage of data within the EE enterprise. It is also the gateway to KNS which delivers a range of critical functions. It is installed on the main server in the EE enterprise.



KadMap® OS Components (Enterprise Edition)

The network OS on the server side of KadMap® OS holds the data abstraction layer (DAL) which is a collection of KadMap® data libraries and APIs.

The DAL provides a common programmable interface for the development of apps for EE assets and operations.

The DAL is a comprehensive and robust deliverable required to fulfil the fast solution development potential of KadMap®. The DAL would facilitate fast development of applications capable of complex data manipulations/computations and foster the development of light utility apps with very specialized functions for the EE industry.

Part of the upstream aspect of KadMap® is executed in KadMap® OS as it provides means of data input from EE assets, employees and data sourcing from other existing software/databases.

There are several essential enterprise-wide software utilized in EE enterprises. In order to enable the enterprise continue utilizing these software, it is essential that KadMap® OS is collocated (installed) alongside these software. KadMap® OS is designed to be deployed alongside an existing OS while optimizing hardware usage on the machine (server and network client machines) with no conflict.

The industrial internet of things (IIoT[16]) interfacing is also enhanced and facilitated as KadMap® OS provides interface with sensor data from EE assets for several critical applications, analyses or other purposes (e.g. asset integrity. See: *Service-via-Software (SvS) - The Digital Engineering and Energy Services Model*[17])

The client side (network client) KadMap® provides for data manipulation and visualization. These of themselves are done by apps which are hosted on the server side (from KNS, precisely KadMap® App Store) and made available networkwide via the network client. The network client also enables remote collaboration on an industrial scale over given operations.

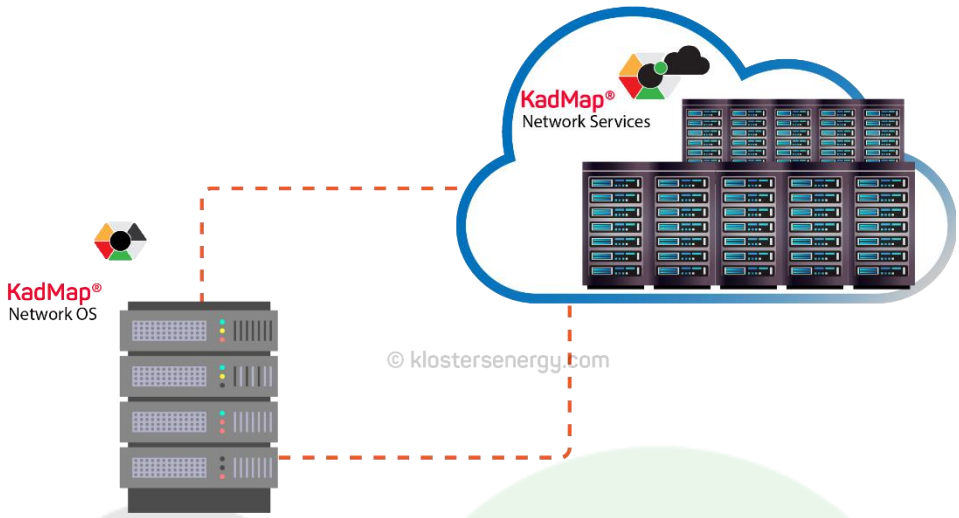
KadMap® OS architecture very importantly, allows for a high level of security and privacy whilst delivering significant benefits to the EE enterprise.

KadMap® Network Services (KNS)

KNS is a distinct network of servers and supercomputers storing and processing data from authenticated and KadMap® OS installed EE networks. Clients privacy and security is paramount and therefore their permission (via contracts) is required and their data is collected anonymously (preserving privacy).

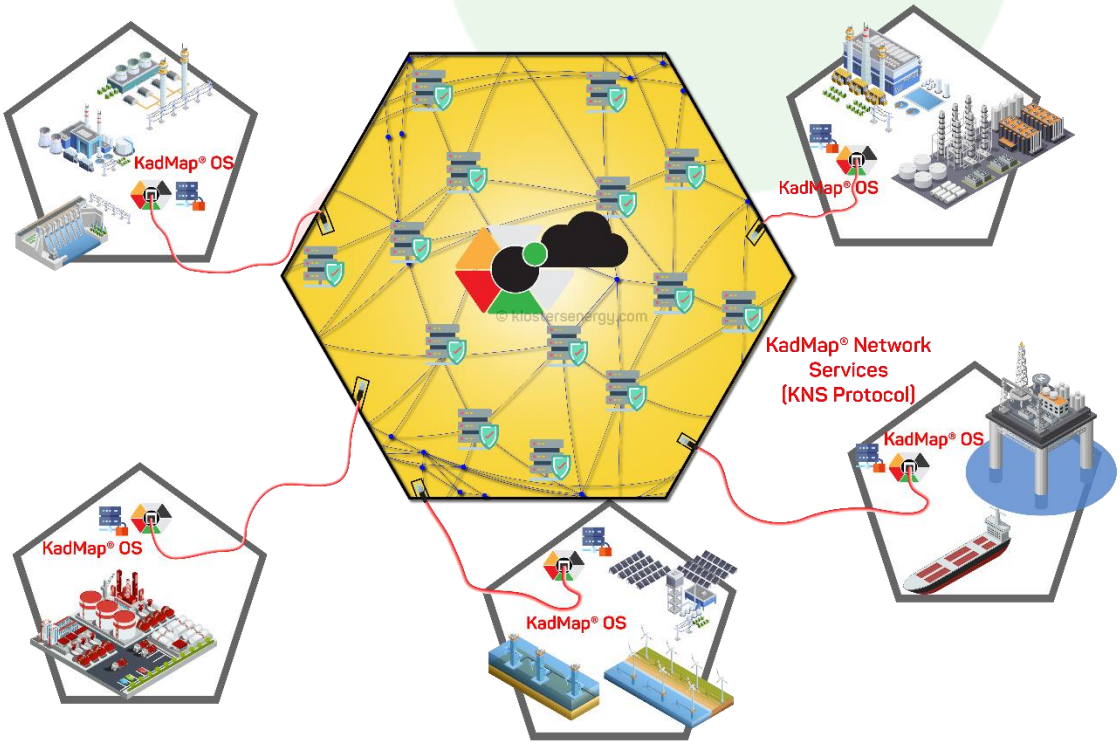
KNS also serves as machine nexus (see: *The Engineered Future – A Likely Preview*[18]) by storing data in a way that is machine readable and programmable without human interference.

[16] The industrial internet of things (IIoT) refers to interconnected sensors, instruments, and other devices networked together with computers' industrial applications, including manufacturing and energy management. (*Wiki*)
[17] Visit http://bit.ly/SvSDigitEngMod-KES
[18] http://bit.ly/EngFuturePrev-KES



KadMap® OS – KNS interface

The KadMap® OS powered machine of the EE enterprise and EE asset interact with KNS remotely and without human intervention.



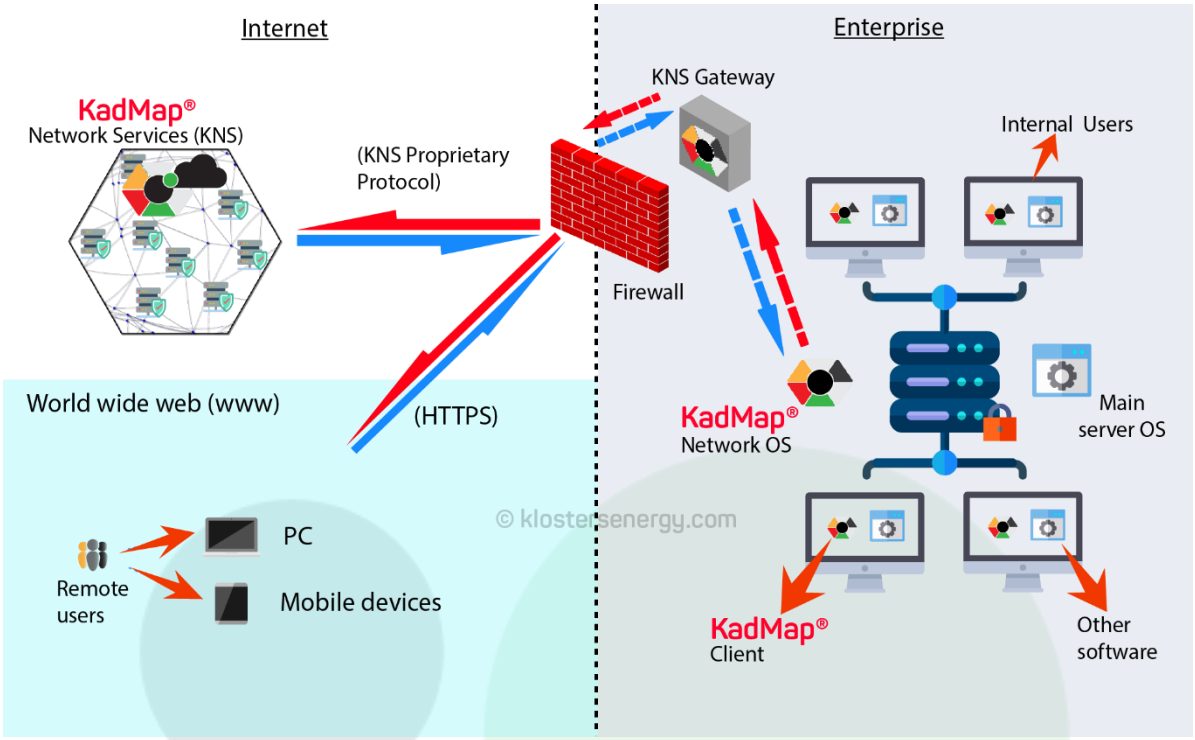
KNS – IIoT resources

The KNS provides an IIoT resource rich environment with high security, privacy and interface enabling developers create highly beneficial applications and enabling data scientists carry out in-depth analyses from feedbacks (live and archived) from EE asset sensors and devices.

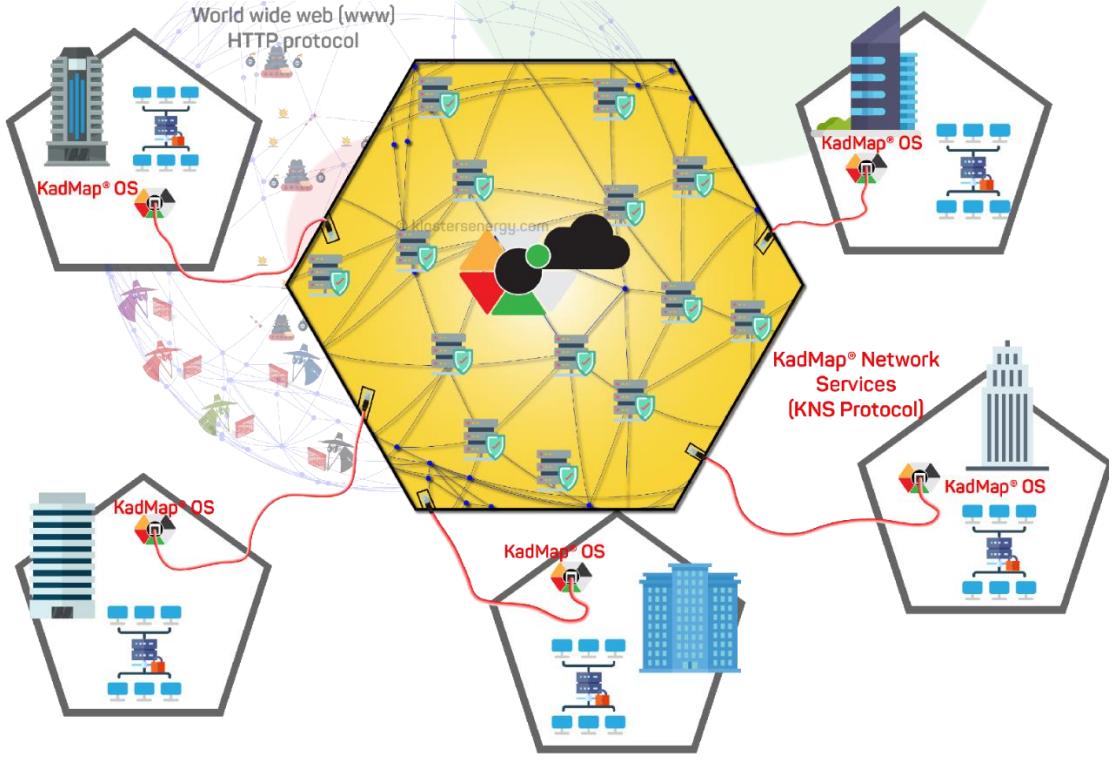
With KNS the EE industry will have a massive niche in cyberspace which is completely exclusive and accessible only by KadMap® authenticated EE enterprises. The hardware (supercomputers and high data storage servers) are high performance machines designed to deliver the heavy machine resources that are required to undertake high precision data analysis and calculations undertaken in the EE industry. The KNS utilizes a highly secure proprietary protocol (different from that used to access the World Wide Web (www) (http)) optimized for data operations which also contributes to KNS' robust security profile.

The KNS can be accessed only via a KadMap® network. Access is monitored and logged. KadMap® applications are also catalogued on the KNS after detailed security and QAQC checks in order to keep clients maximally protected at all times.

The data exchanges, remote collaborations and network access are also highly monitored and logged. Corporate espionage, security threats and malicious programs/wares are greatly minimized if not completely eliminated.



KadMap® OS – KNS Enterprise Architecture



KNS – A Trusted Collaboration Network

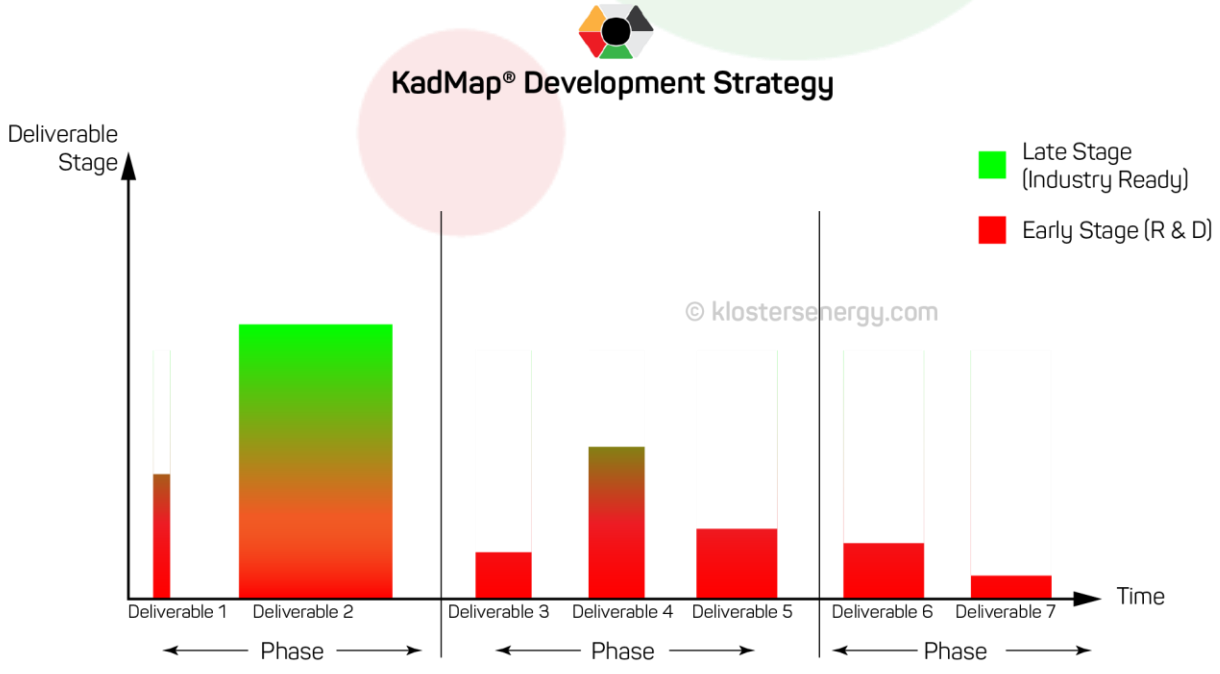
The KadMap® Development Project

The end-to-end integrated scope of KadMap® is a huge challenge. KES' strategy to surmount this challenge has been the adoption of a project-based approach. This involved the creation of an integrated project dubbed "KadMap® Development Project" which is currently in execution. The goal of this project is to surmount the challenges inherent in the end-to-end scope of KadMap®. Each subsequent project deliverable is identified and configured as a milestone towards addressing the challenges.

Thus, the KadMap® Development Project is an ongoing project, outputting multiple deliverables in form of digital solutions and updates to KadMap®.

Each deliverable in this project is realized by following stipulated stages of activities from research to testing, verification, QAQC, industry engagements, etc. among others in a systematic and efficient manner tailored for the EE industry.

Furthermore, the project is split into phases which may overlap in time. The phases have generally specified goals while each deliverable is a push towards the specified phase goal.



KadMap® Development Strategy

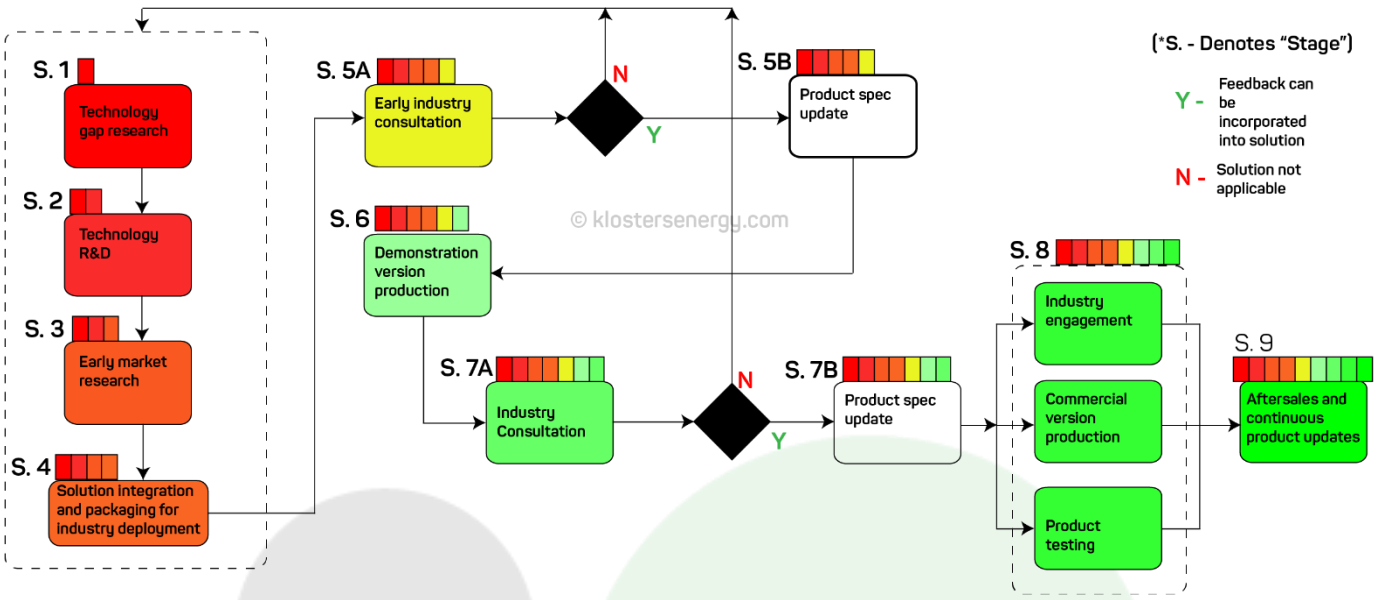
The deliverables are well incubated (and usually developed concurrently) sometimes for several years at a time in order to attain seamless integration, interface and compatibility between all developed solutions.

There are 9 stages in total required for the incubation and development of a KadMap® deliverable from inception to industry:

1. *Technology gap research*	2. *Technology R&D*[19] *including validation/verification of findings*	3. *Early market research*
4. *Solution integration/packaging into distinct product for industry deployment*	5A. *Early industry consultation*	5B. *Product specification update*
6. *Demonstration version production*	7A. *Industry Consultation*	7B. *Product specification update*
8A. *Industry engagement*	8B. *Commercial version production*	8C. *Product testing*
	9. *Aftersales and continuous product updates*	

Stages 1-4 are incubation stages, stages 5-7 are intermediate development stages, and stages 8-9 are full scale production and deployment stages.

[19] Research and Development



KadMap® deliverable development process

At various stages of development of a deliverable, key partnerships are instigated for various purposes such as knowledge, consultation, finance, etc. The Liverpool Logistics Offshore and Marine (LOOM) research institute, Liverpool, United Kingdom, our key partner at the stage 2 of R&D, is one of such instances.

From its early beginnings in 2007, KadMap® has evolved into a very potent asset to facilitate and lead the world's fourth industrial revolution – the digital revolution. KadMap® has been through two development phases and is currently on the third.

Phase	Objective	Timeline	Deliverable
1	Develop robust data framework capable of abstracting the assets and operations of EE enterprises	2007-2015	• KadMap® Framework • *Others*
2	Development and packaging of viable digital	2014-2018	• KadMap® web interface application (WIA)

	solutions for EE industry		• *Others*
3	Deployment of solution to EE Industry	2018-2022	• KadMap® OS • KNS • *Others (including KadMap® Apps)*

Phases of KadMap® Development along with objectives, timelines and deliverables

As an engineering company in the energy industry, our journey started with the development of conventional physical services in the form of asset integrity management (AIM) services. With information technology (IT) as one of our major strengths, we also began software designs of novel enterprise AIM systems. Simultaneously, we also began conceptualizing the digital equivalents of these services with application of our engineering knowledge and experience as our targeted users are engineers as well. This prompted the development of a digital framework (which later came to be known as KadMap®) as the backbone necessary to deliver these digital services.

This framework, KadMap®, quickly became the centrepiece of our attention and developments at KES. Our initial services were limited to a section of the lifecycle of EE assets (see illustration below). As we began to see some success in the design of these digital equivalents and the framework development, we realized that the team could replicate such throughout the entire life cycle of an EE asset.

EE Asset Lifecycle

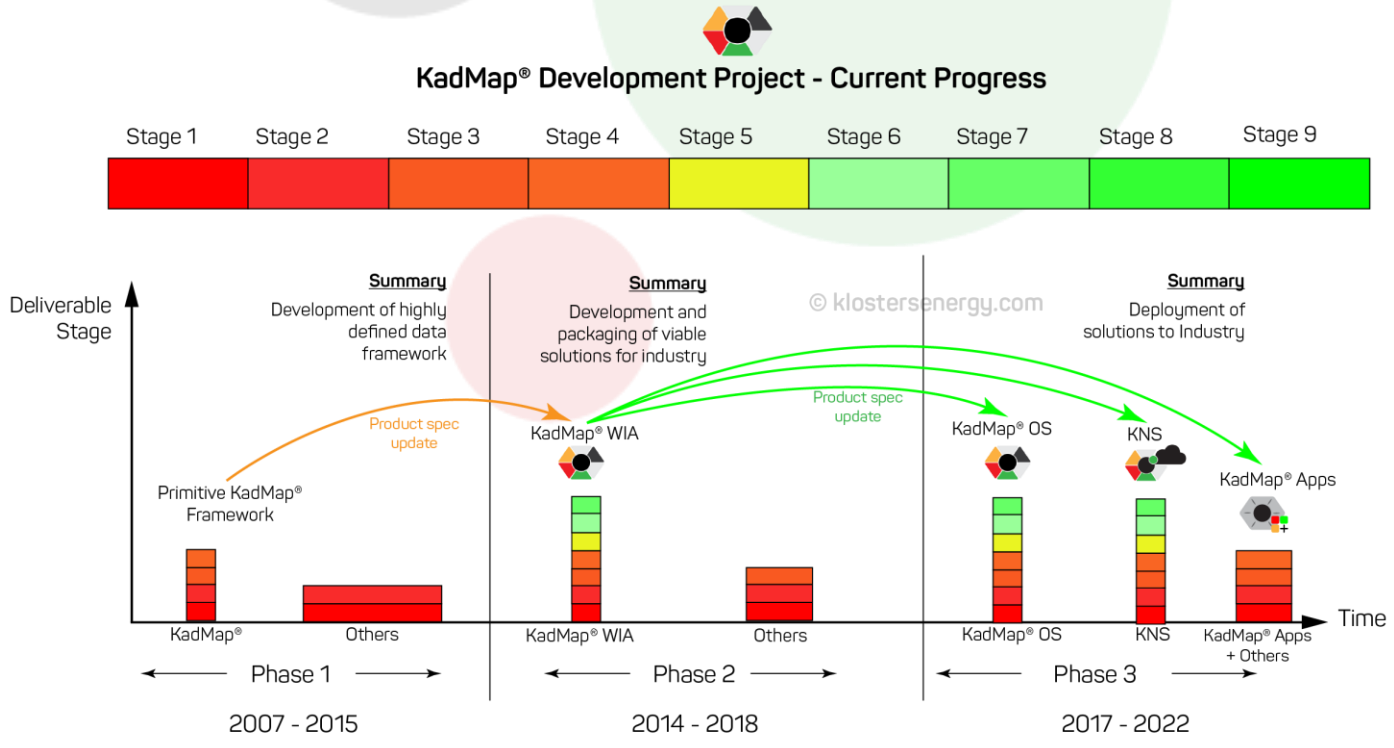
In order to achieve this, we had to increase the complexity and robustness of KadMap®. We also had to device a new strategy of development – the KadMap® development project strategy to maintain sanity and organization even as the complexities and solutions increased.

Sufficient definitions/specifications of the infrastructure, abstraction, data operations and technology marked the beginning of phase 2.

Phase 2 saw us take these definitions/specifications to begin development of KadMap® Web Interface Application (WIA) – to be available/delivered over the www. It also saw the development and deployment of an early version of our first digital service – R-AIM (remote asset integrity monitoring) (see: *Service-via-Software (SvS) - The Digital Engineering and Energy Services Model*[20]).

We had positive feedbacks as well as critical comments/recommendations as we went on several industry consultations. The implementations of these recommendations heavily refined KadMap® WIA as it also increased commendations.

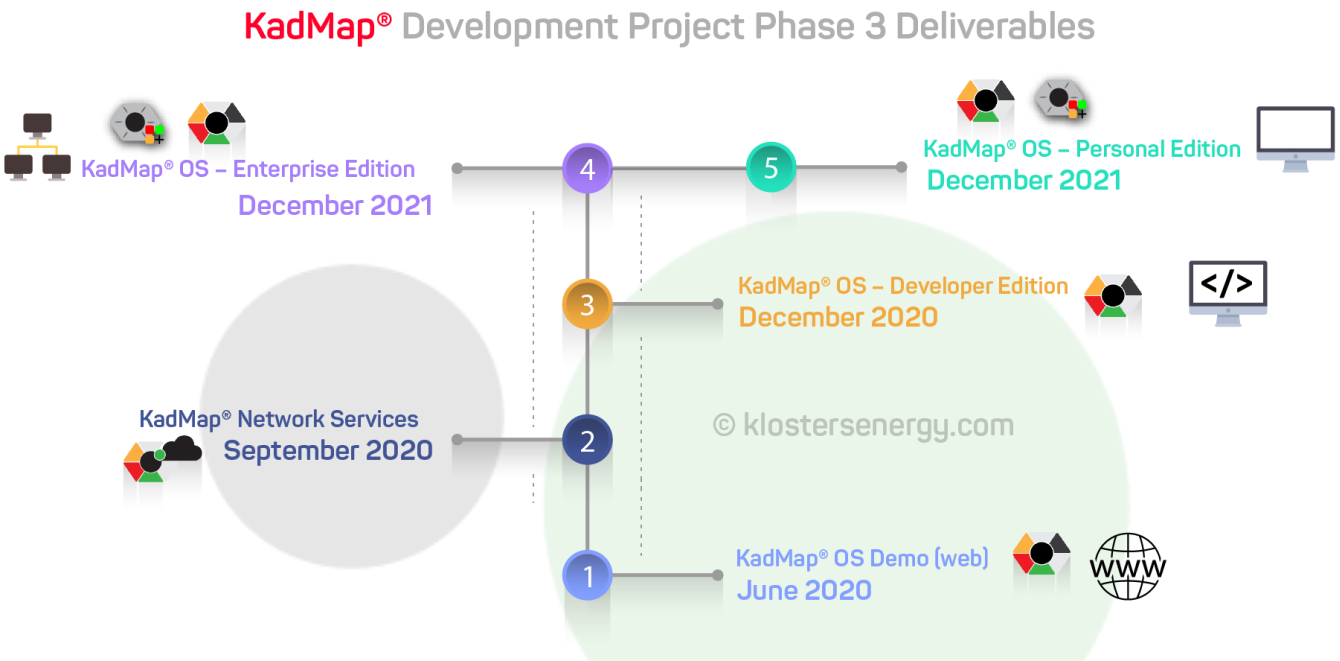
The final product specifications update (stage 7A of KadMap® deliverable development process) manifested as evolution of the user interface, critical details of our R-AIM service and eventually the KadMap® WIA architecture. The KadMap® WIA architecture evolved and split to give rise to 3 subsequent deliverables – KadMap® OS, KNS and KadMap® Apps, all inheriting the progress made thus far.



KadMap® Evolution

[20] http://bit.ly/SvSDigitEngMod-KES

The evolution of the KadMap® WIA architecture marked the start of phase 3 - the final commercial development and testing of these deliverables as well as industry engagement. Phase 3 is currently underway with key dates as follows:



Key Dates for KadMap® Phase 3 Deliverables

Within phase 3, we are also at the stage of industry engagement (stage 8A) which involves mass industry sensitizations of all product stakeholders in form of targeted media outreach, conferences/exhibitions, road shows, etc. and product launching. As such, we will be hosting and attending a series of industry events which will be announced on our websites (www.klostersenergy.com) and (www.kadmap.com) in the coming months. We do invite you to visit and sign up to our news letters to stay updated on these events and our latest developments.

Conclusion

Digitization can offer a whole new dimension in the race to achieve OP. The challenges facing digitization in the form of data /digital representation and infrastructure have been examined. The key to unlocking the digital potential of assets and EE enterprises lies in their successful translation into

digital entities via big platform. Big platform has been examined with instances of massive web-based platform software, 'massware', cited in the digitization of other industries. A solution in the form of an exclusive enterprise platform software (EEPS) has been suggested and its potential benefits reviewed.

KadMap® - an EEPS has been presented as a solution to digitization challenges faced by EE enterprise. KadMap® is currently in development to ensure that the benefits enjoyed in other digitized industries can accrue to the EE enterprise without any compromise to privacy and security. Finally, KadMap®'s development strategy along with release dates have been outlined.

Reviewers

Review Verification ID Link

1. Chukwunyelu Chukwuka
2. Chidiebere Nwaoha

Scan here

Or Click here

http://bit.ly/BigPlatEEInd-KES

Afternotes

Klosters Energy Services (KES) is a technology engineering (TechEng) Company - we combine the traditional feel of an engineering company with the futuristic feel of a "Tech" (IT) company.

We provide digital asset solutions with the latest cutting-edge technology with a view to reducing OpEx, increasing asset availability, increasing efficiency, optimizing performance and maintaining a high level of safety for the global energy and engineering industry.

For more information on our solutions, to follow our development, and get updates:

Visit us at www.klostersenergy.com and www.kadmap.com.

Follow us on Twitter : @klostersenergy @kes_kadmap

And on LinkedIn : www.linkedin.com/company/klosters-energy-services-limited

About Industry Papers

KES' "industry papers" is a series of publications focused on propagating awareness and solutions among professionals in the energy and engineering industry. It features captivating illustrations and is written in lecture or first-person explanatory format giving a conversational feeling to our audience.

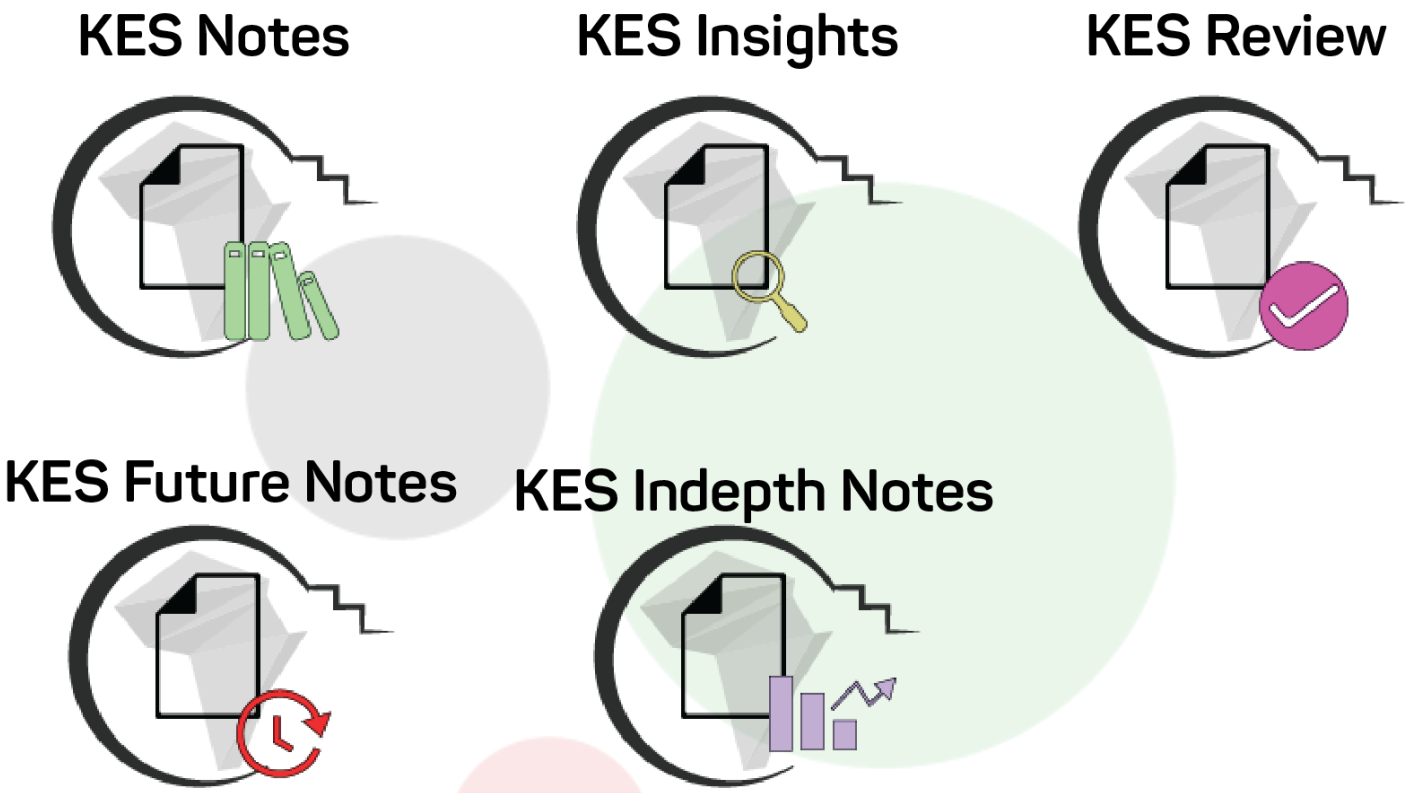
Industry papers uses a unique referencing system and a peer review system populated by our network of academicians and experienced industry professionals. Reviewers of publications can be viewed by the URL provided at the "Reviewers" section of each publication.

About KES Notes

KES' industry papers features various genres distinguished by the focus' depth range and angle on a selected topic. "KES notes" presents a general exposition on a selected topic. Others include:

- KES Insights: It presents KES' perspectives on a given topic of concern

- In-Depth Notes: It presents a more technical exposition on a given topic
- KES Review: It presents our opinions and views on a trending industry topic
- Future Notes: It presents futuristic ideas on certain solutions or scenarios which may not have a complete scientific explanation but will no doubt propel the industry forward



Graphics/Illustration Components:

Graphics and Illustrations (unless sources are explicitly stated) are property of Klosters Energy Services Limited. We acknowledge and credit www.freepik.com and www.flaticon.com for their amazing graphic resources (too numerous to individually credit) which we used in creating our illustrations.

Trademarks

"Klosters Energy Services", "KadMap", Klosters Energy Services logo 

, KadMap logo  , KNS logo  , KES notes are trademarks of Klosters Energy Services Limited.

Copyrights

This paper is published by Klosters Energy Services Limited on www.klostersenergy.com,

September 2019,

Federal Republic of Nigeria.

Klosters Energy Services Limited

15B Mamman Kontagora Crescent,

Katampe Extension

Abuja, FCT

www.klostersenergy.com