KES Insights

The 100% Facility Uptime Challenge - Is it Really Possible?

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

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

Summary

Optimal production (OP) in energy and engineering assets remain the primary goal of asset owners. Availability or uptime of such asset is a fundamental indication of its goal. Availability in turn is influences by factors such as maintenance and asset integrity among others. In this paper we explore some of these common factors that militate against asset availability. The question posed in the title of this paper "is 100% facility uptime really possible" will guide the analyses. We will answer this question by examining the merits of a big digital platform with respect to asset availability.

Finally, KadMap® – a digital solutions platform is presented as a means of achieving ideal asset availability.

Keywords: Maintenance, Asset integrity, Availability, Operations and Maintenance, Reliability, Artificial Intelligence, KadMap, Facilities, Industry 4.0, Supply Chain Network, Prediction

Contents

Introduction

Imagine Formula 1 (F1) racing event without the need to use the pit stop in non-clement weather. Let us rephrase that again, imagine an F1 race car getting into the pit lane (while reducing speed), changing tyres or front wing etc. and getting back on the main track and incur a loss of 3 seconds at the worst?! Presently, the F1 racing teams practice a lot in order to reduce to the barest minimum the amount of time it takes in the pit stop, there are various instrumentation relaying live feedback to the racing team to advice the driver on making a stop or not. The goal: to keep the race car on the track as long as possible and in the best condition which gives the driver the best chance to win the race.

Formula 1 Race Car Model (Image Source: freepik.com)

Today, assets in the energy and the engineering (EE) industry still face challenges in maintaining an uptime of upper 90's in percentage. Greatest among these challenges is uncertainty which is chiefly responsible for reduced availability/uptime of the asset. The main goal of asset operations and strategies is to keep the asset running efficiently and effectively for as long as possible, with optimal cost, while ensuring the maintenance of health, safety and environmental (HSE) goals. The longest possible time is 100% uptime. Of course, this assumes that maintainability has not been designed out of the asset.

Is this 100% possible? We will answer that in this publication.

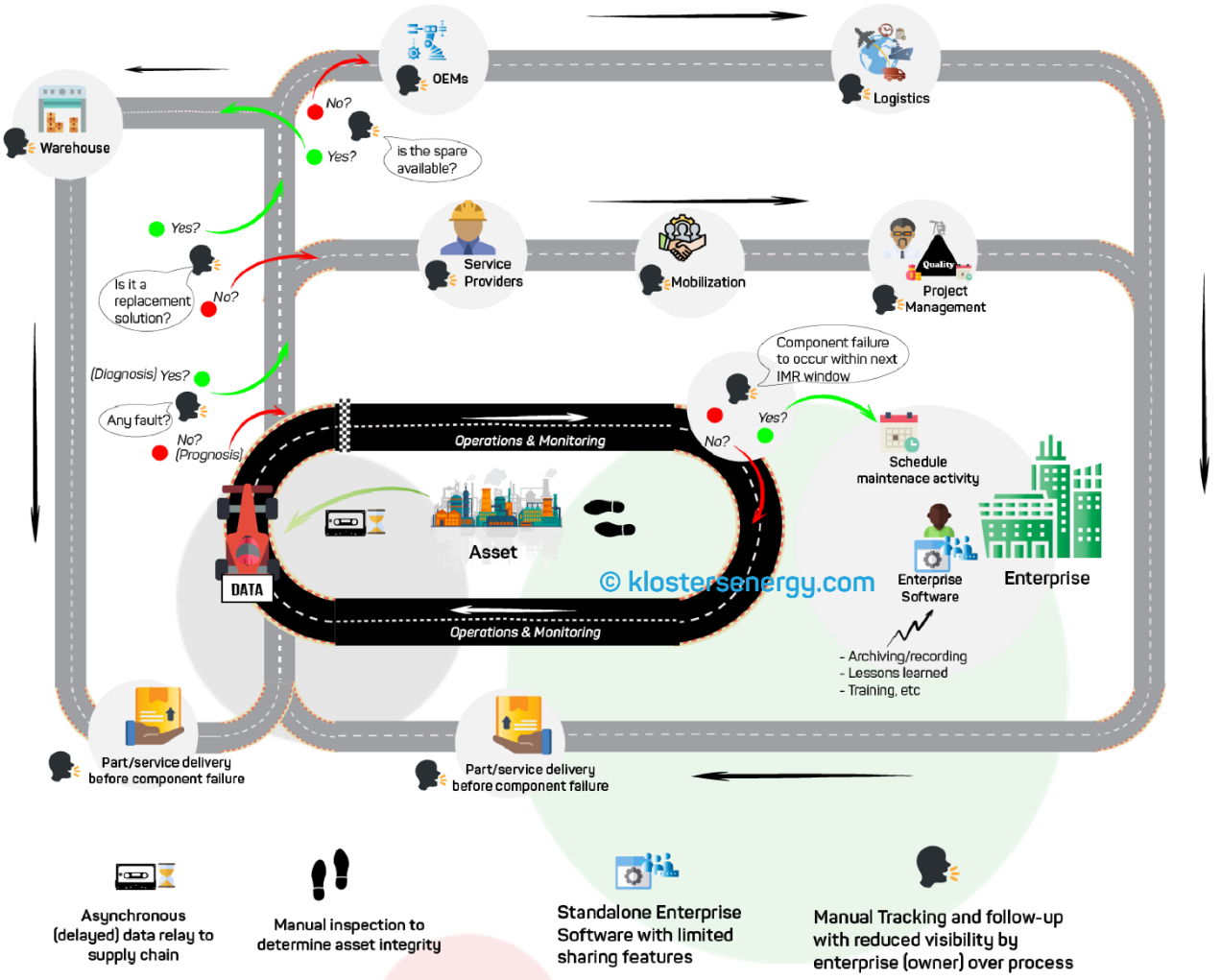
Optimal Production is Still the Zenith Goal

Optimal production (OP); a state of maximum production output with optimal costs with no compromise to health safety and environment (HSE) is the zenith goal of asset owners in the EE industry. From the time of concept design of any equipment we always consider its usage whether it is for the short-term or long-term. For the long-term usage, we set design and operations policies that facilitate the feasibility of the intended life cycle. The operation policies typically include operations procedures, inspection and maintenance stipulations, and more recently, reliability. Availability also known as uptime, is the ratio of asset time spent on functional operations (uptime) to time spent off functional operations (downtime), given as a percentage. In reliability analysis (during the design phase) a target is set for the uptime of the facility in concern - typically upwards of 95%. Sparing philosophy, redundancy etc. are some of the ways to increase availability. In rare cases maintenance is designed out altogether. OP as a goal aims to deliver the longest possible uptime for equipment/assets with maintenance designed into them.

While maintenance regimes and prescriptions are designed into these assets to prevent unnecessary downtimes, the effect of uncertainty is still considerable such that a considerable number of maintenance interventions are reactive.

The Current Convention/System - How Much Room for Improvement Have We Got?

We will examine the race track of the EE asset rather than that of F1 racing. We will examine a generic scenario of the operations of EE assets and the challenges current maintenance practices face in the race to keep the asset on the main track of operations for as long as possible.



Operations and Maintenance Circuit

The schematic shows a generic flow for the operations phase of an existing asset's life cycle.

Ideally, we would like to keep our activities (represented by F1 car conveying data) within the main track of "operations and monitoring". Any venture into other lanes/corners outside this main track is an inefficient operation leading to loss in time, money or increase in asset downtime. The inefficiencies present here are a result of the predominant operations convention currently in use at several EE enterprises. We will examine them.

Dissimilar Enterprise Software

Dissimilar enterprise software implies dissimilar data formats, different information stored, amidst other inherent incompatibilities and their utilization by various enterprises impede capabilities that could enhance asset uptime such as remote collaboration and data sharing which leads to the next point.

Delayed Relay of Information to the Supply Chain Network

The predominantly dissimilar software with restrictive information exchange capabilities leads to a delay (or complete shut off) of information to members of supply chain network. The information we are referring to here is not email communication, but rather raw data feed from assets, enterprise operations and/or software to the members of the supply chain network, whose action timing has significant effect on the uptime or downtime of a facility. Degradation could accelerate because of delays.

Manual Inspections to Determine Assets Integrity

There is still some technological limitation to the needed level of instrumentation an asset would need to have to completely eliminate physical inspection activities. Nonetheless, without these high-level instrumentations including intelligent sensor deployment, frequent and non-essential physical inspections will remain in practice. This continues to add to the downtime experienced by assets.

Manual Data Tracking and Follow Up with Reduced Visibility by Enterprise Over Process

This is once again linked to the preponderance of dissimilar enterprise software and the lack of a robust and globalized digital platform for sharing of critical data with contracted supply chain partners. Again, this is not about email communication. For example, on a particular project or procurement, progress is reported but asset owners are not quite sure of the information communicated due to lack of visibility of the process. Think of a courier service without online package tracking service. Consequently, there has to be periodical meetings, exchange/transmission

of project schedule files etc. to ascertain progress. Let us not to forget the fire brigade calls to cellphones of counterparts. There is lack of digital infrastructure to automatically track progress. The fall back processes (meeting, calls, etc.) contribute to the inefficiencies in asset operations.

Uncertainty

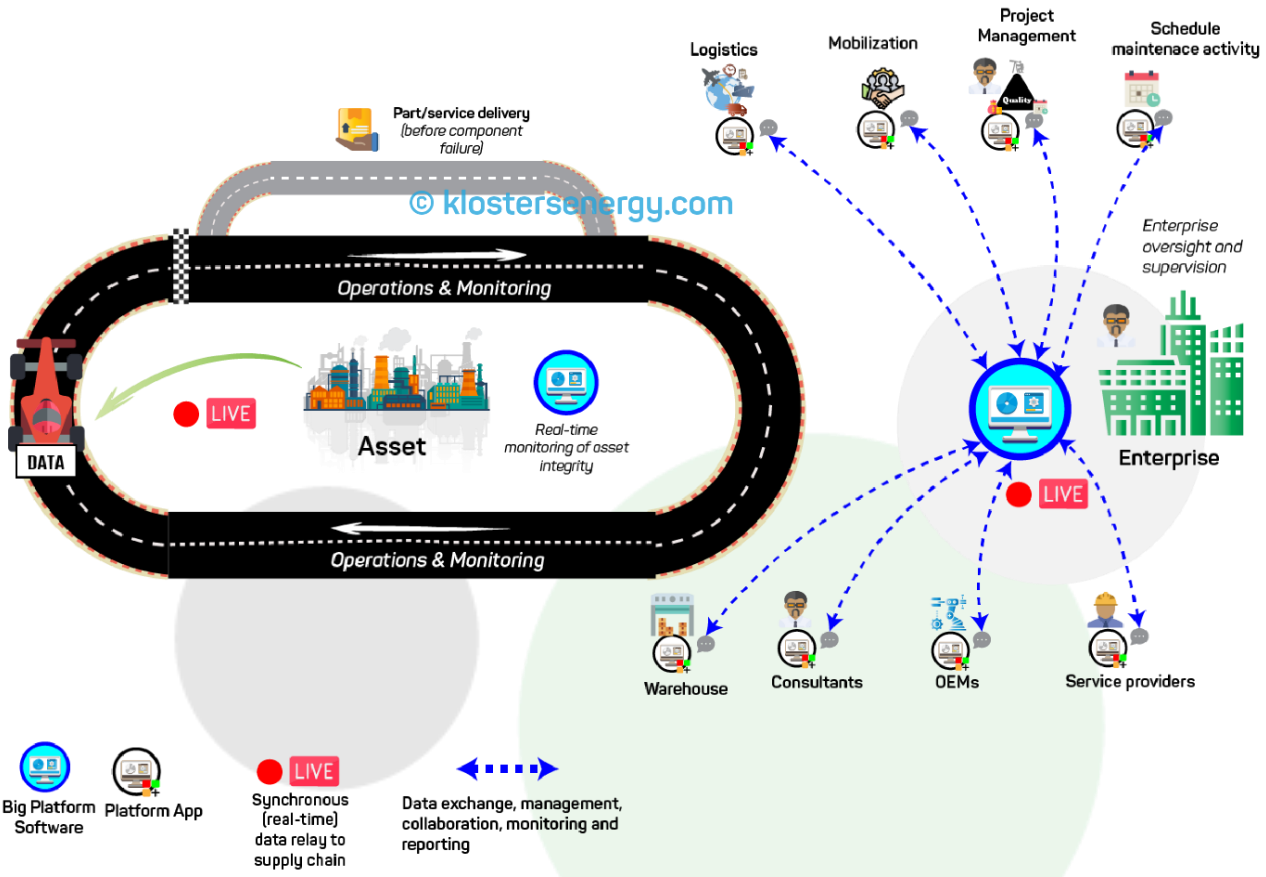
While prescribed preventive maintenance practices are ideal, we are still left at the mercy of uncertainty. There are several aspects in asset operations in which uncertainty influences. It is indeed the greatest contributor to downtime. Uncertainty leads us up the pit lanes of intervention for urgent services or parts, often both randomly and unpredictably.

In summary, dissimilar enterprise, delayed status relay, manual tracking and reduced visibility of activities to decision makers, and most importantly uncertainty are some of the significant contributors to the reduction on target asset availability.

Of course, several publications over decades have talked about ways to surmount these challenges; from training, increased oversight, to monitoring tools, operation procedures, etc. All of which will increase availability, but will these lead to 100% availability? Arguable and highly unlikely. Is there a way round this?

A Better Solution Lies Ahead in a Fast Approaching Future

Going back to our initial question posed by the title of this paper - is 100% uptime in EE assets possible, given the current convention/system? Perhaps! In this section we propose a more potent way to achieve this; one that is more plausible in a fast approaching data-driven future.



Operations and Maintenance Circuit with Big Platform

Just like the previous illustration, we would like again to constrain activities (also represented by F1 car conveying data) to the main track of operations and monitoring. The entire track circumference has been reduced significantly. The only other track outside the main is a "parts/service delivery" lane. The circuit in the illustration can be interpreted that the chances of activities away from main operations and monitoring has been reduced translating to a very low probability of downtime closer to 100% availability/uptime.

The circuit is very straight forward, and constrains activities to the enterprise. This is so because the supply chain network has a virtual presence at the facility. There, they monitor the asset in real-time, with live, synchronous and real-time tracking of all activities, data. This presence is made possible by the introduction of a big platform. We will examine these new critical factors:

The Big Platform Paradigm

We have covered in great details, the fundamentals of 'big platform' (see: *A Big Platform for the Energy and Engineering Enterprise – What is it and Why do we Need it?*[4]) – which is a defined digital platform containing essential conventions and operations of EE assets and enterprises.

This paradigm unlocks many new possibilities including that of surmounting the 100% uptime challenge facing EE assets.

Shared Data

Once again, we do not mean email communication here. This rather, implies a special data sharing carried out by application (app) of each supply chain network member. Each enterprise's platform app (developed on the big platform) is able to request and securely view the relevant data in very high resolution of detail. The accuracy and timeliness of such data enables the enterprise to confidently act on those details almost without recourse to physical site visit.

We will closely examine an instance of data sharing in maintenance operations. With a big platform we will be able to see weak links in our supply chain network, determine vendor capabilities, manufacturer capability/capacity, etc.

With regards to asset integrity monitoring, big platform with predictive capability will greatly complement the maintenance and inspection planning. Even more, there are application/tools which can be developed on the big platform that can be used to coordinate planning.

The members of the supply chain network will move from a passive position of receiving information/requests to playing an active role in maintenance scheduling. This should further facilitate precision execution and further reduce asset downtime.

In all this, keywords such as monitoring, scheduling maintenance activities, contacting and involving members of the supply chain network in planning activities, coordination of operations with precision execution are similarly utilized in actual F1 racing operations.

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

Artificial Intelligence Capability for Prediction

With the use of AI which again is tied to big platform (see: *Interfacing Artificial Intelligence, Risk Management and Asset Integrity*[5]) are able to reduce uncertainty by predicting time to failure of components more accurately.

Real-time, Everything

Big platform will allow for multiple applications authorized access to a common database which replays/streams various live information. This way, the big platform can connect an entire industry in real-time. Part of the big platform's real-time capabilities include real-time monitoring of asset integrity and real-time tracking of an action/operation even for a contractor 10 times subcontracted.

In summary, big platform plays a huge role in reducing factors that lead to downtime and inefficient operations by providing robust possibilities with its inherent features. To answer the original question: is 100% facility uptime really possible? Okay, maybe not 100% but 99.99% sounds great too.

Implications for Old/Ageing Assets

More than two-thirds of the EE assets worldwide are past their service life span (20/25 years). Old and ageing EE assets require more frequent attention thus increasing their susceptibility to downtime. Prescribed maintenance practices to prevent downtime on these assets no longer achieve this goal at this phase of their life. More suited and responsive alternate maintenance practices are recommended. The big platform's monitoring, response and follow-up capability would ensure that there are effectively no delays in getting parts/services as needed.

[5] http://bit.ly/IntegAI-RM-AIM-KES

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. For more on KadMap® click here.

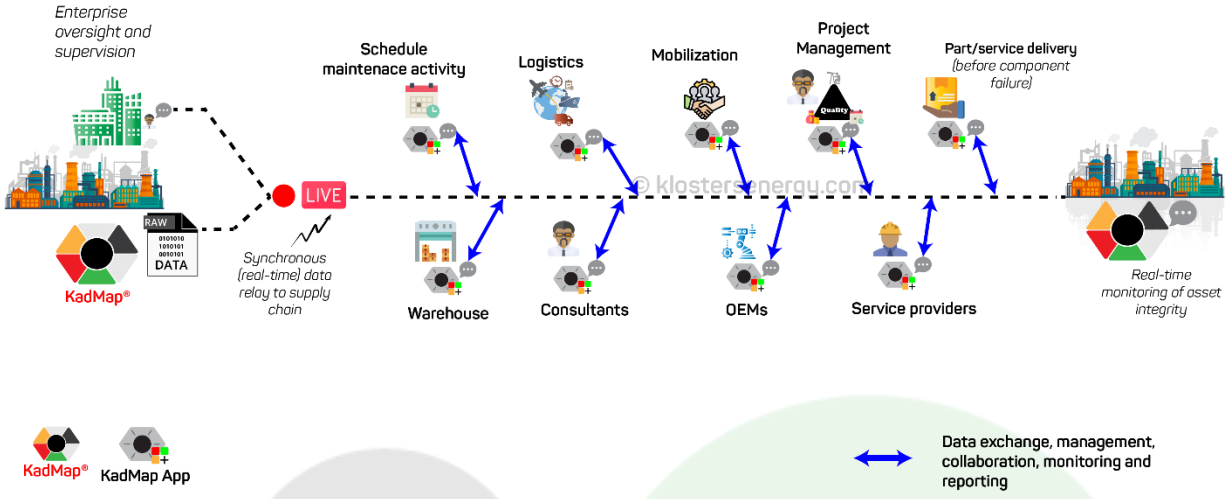
Asset Availability with KadMap®

KadMap® mirrors the big platform paradigm (again see: *A Big Platform for the Energy and Engineering Enterprise – What is it and Why do we Need it?*[6]). As such, features of the big platform such as:

- Standard and reusable data
- Connected apps and data
- Connected enterprises and industry
- Industrial internet of things (IIoT)
- Interface with existing enterprise software
- Artificial intelligence (AI) prediction, etc.

All these facilitate the goal of 100% availability.

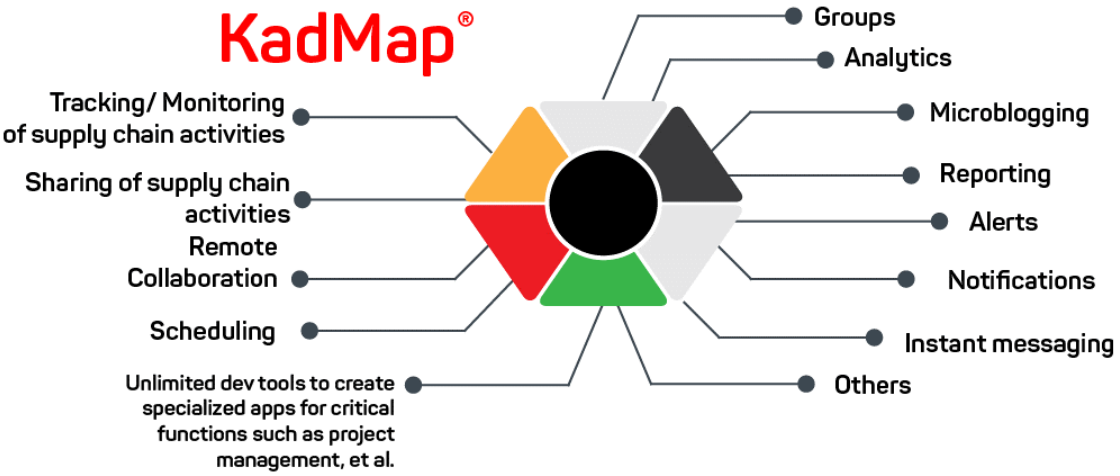
[6] http://bit.ly/BigPlatEEInd-KES



KadMap®'s Data-Driven Approach to Asset Operations, Monitoring and Maintenance

KadMap Asset Availability Features

We focus on some of the features of KadMap® with respect to asset availability. Unlike the industry view in the previous section, we zoom in to the enterprise level to examine some key features which affect the capability to deliver on the 100% challenge. These are illustrated below:



KadMap®'s Asset Availability Facilitation Features

Conclusion

Asset availability is an important factor in the drive to attain optimal production. We have identified some key factors that prevent the achievement of 100% asset availability. Dissimilar enterprise software, delayed replay of information to supply chain network, manual inspections, manual data tracking and uncertainty have been highlighted as some of these factors with critical impact on asset availability.

Big platform has been suggested as the panacea to these highlighted factors. We have elucidated on how the features of such a platform such as shared data, AI capability and real-time capability could key into asset operations in the EE industry to increase operations efficiency and asset availability.

KadMap® has been presented as the implementation of big platform for the EE industry. KadMap® is currently in development deliver the benefits discussed and to ultimately assist owners in achieving OP. Finally, KadMap®'s development strategy along with release dates have been outlined.

Reviewers

1. Chukwunyelu Chukwuka
2. Chidiebere Nwaoha

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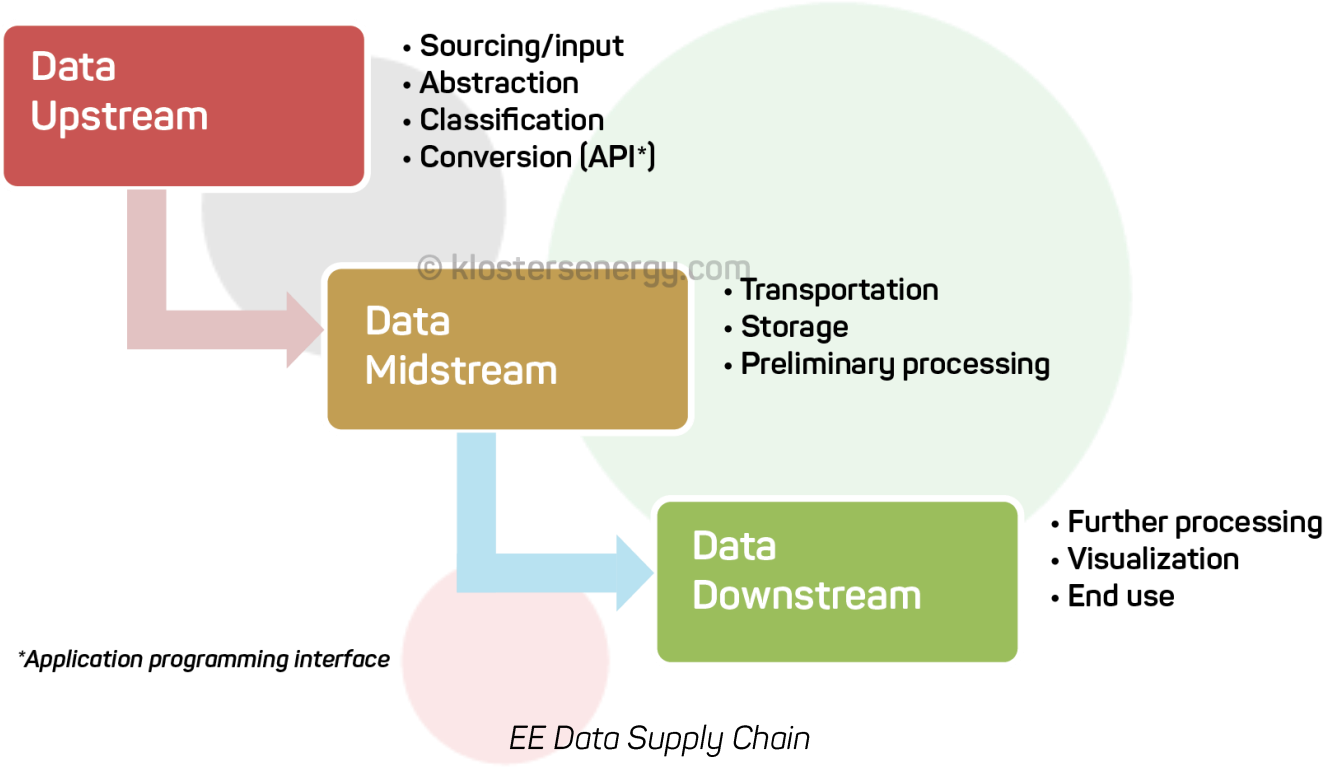
Annex

KadMap®

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.

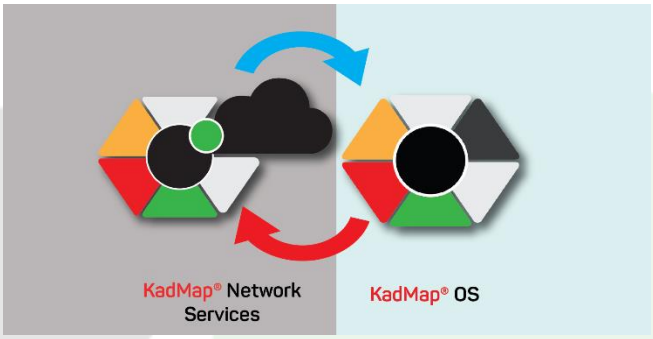
The end-to-end integrated scope of KadMap® is a huge challenge which KES has been progressively addressing since 2007. KES' strategy has been to utilize a project-based approach by creating and executing an integrated project dubbed "KadMap® Development Project", with this challenge as the goal, and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

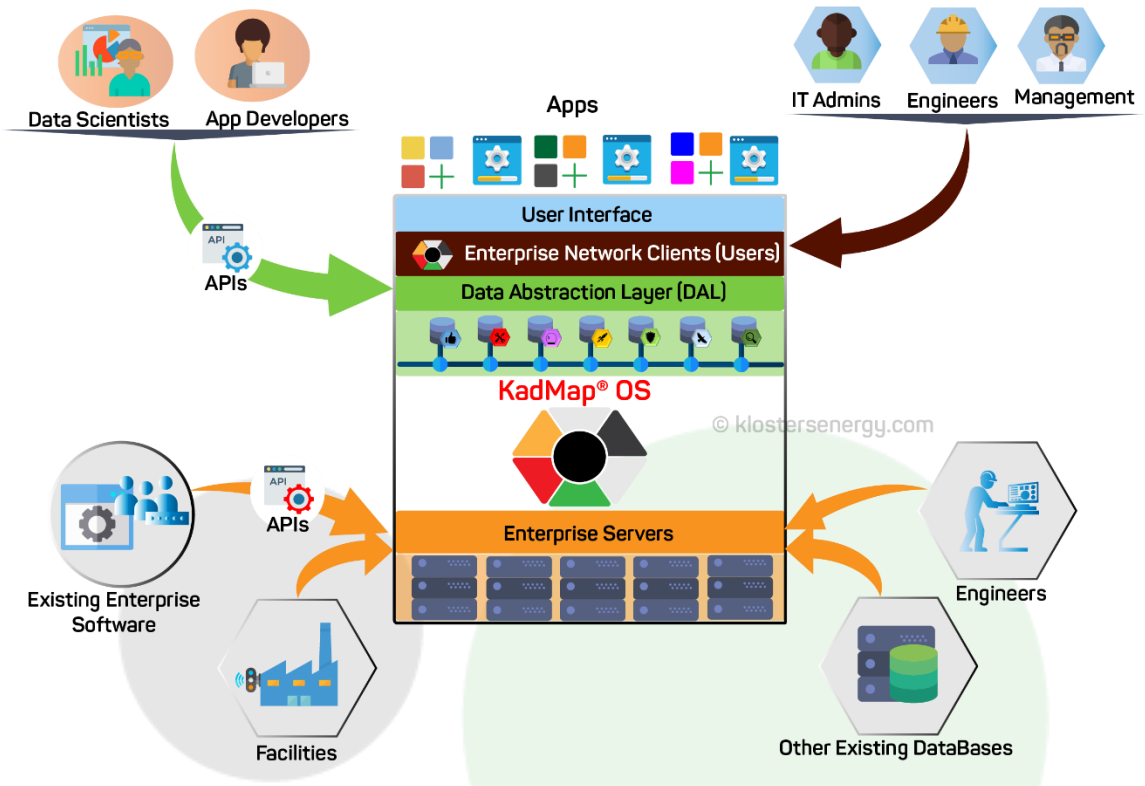
KadMap® OS and KNS both form the base infrastructure required to deliver the entire scope of KadMap®.



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.

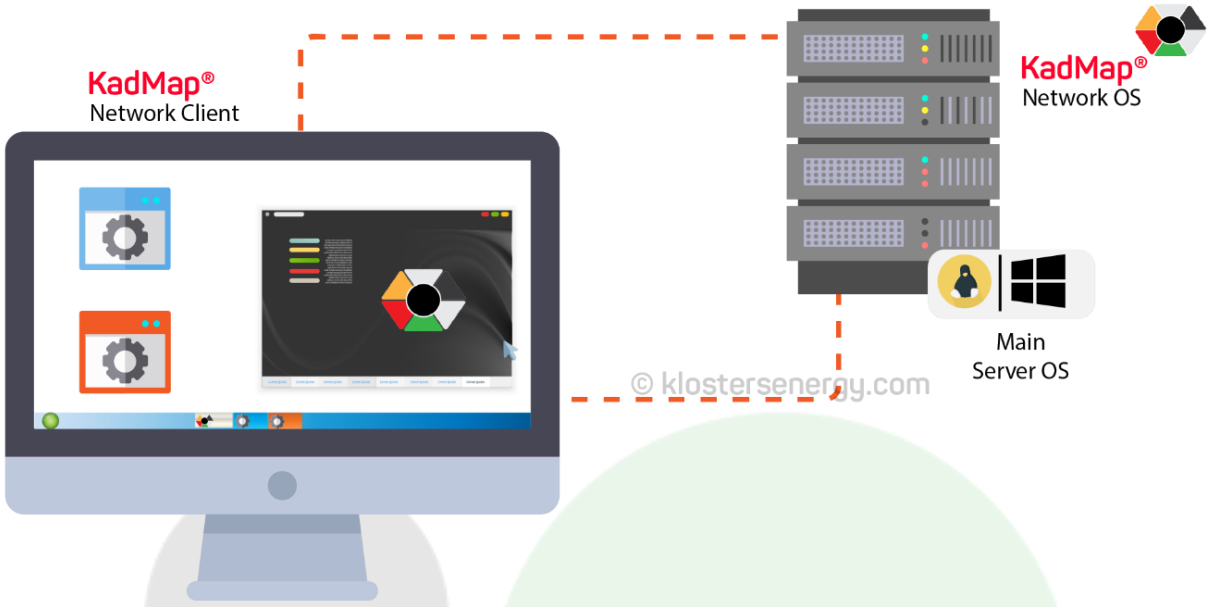


KadMap OS Architecture

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[7]) 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*[8])

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.

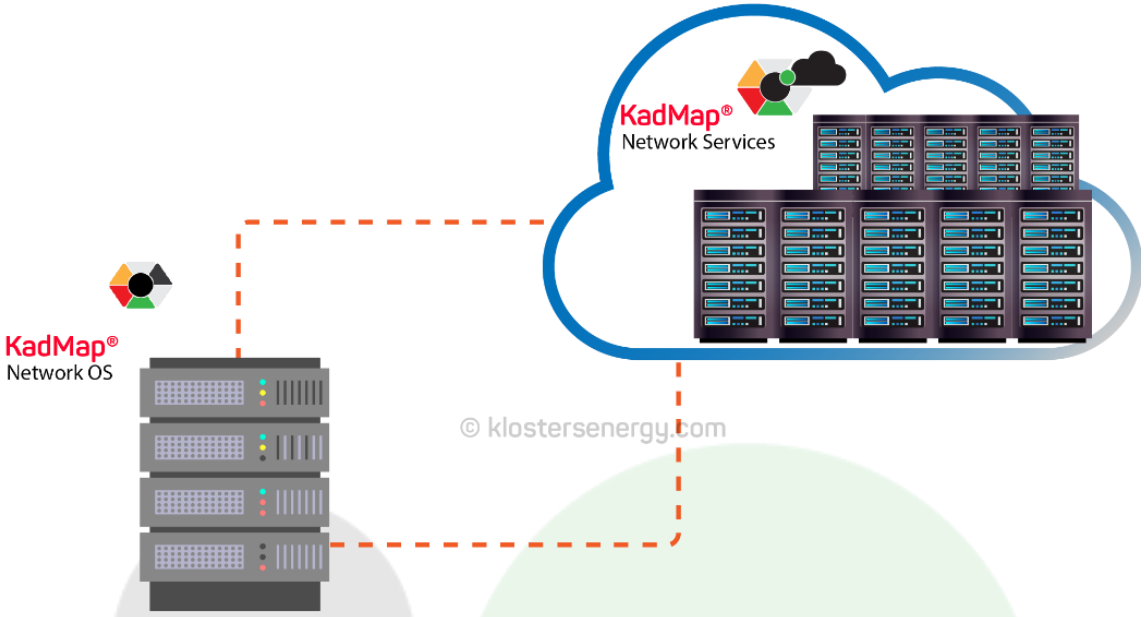
KadMap® OS architecture very importantly, allows for a high level of security and privacy whilst delivering significant benefits to the EE enterprise.

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).

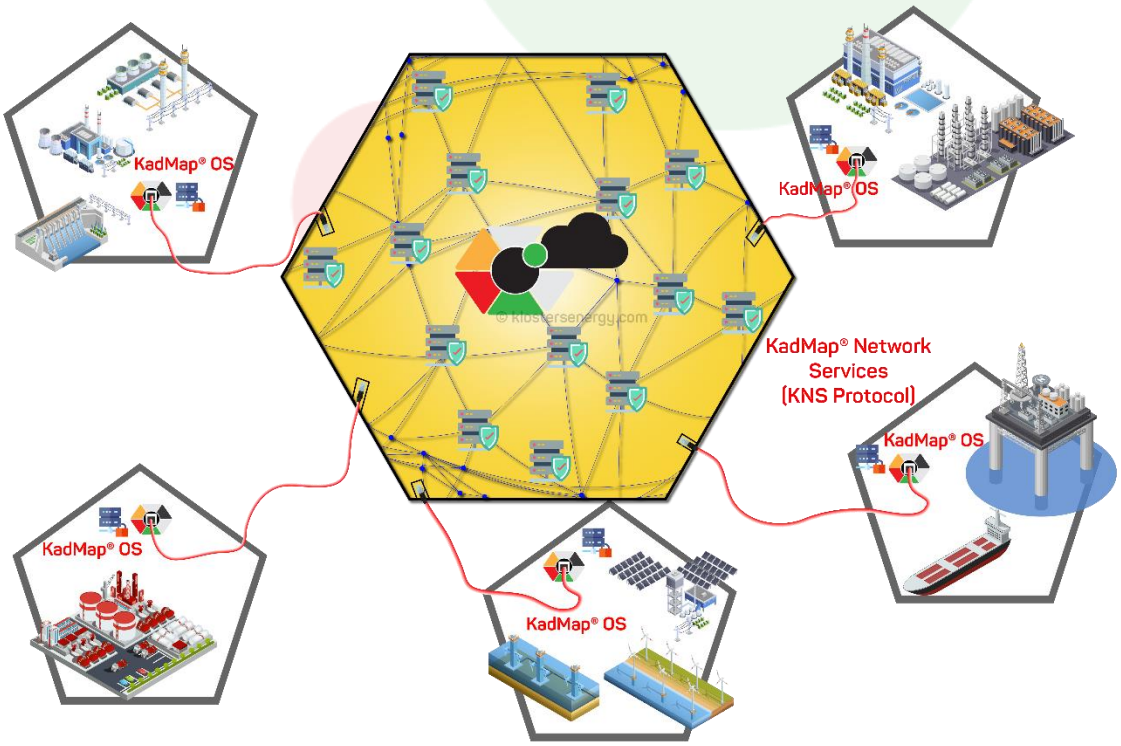
KNS also serves as machine nexus (see: *The Engineered Future – A Likely Preview*[9]) by storing data in a way that is machine readable and programmable without human interference.

[7] 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*)
[8] Visit http://bit.ly/SvSDigitEngMod-KES
[9] 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.



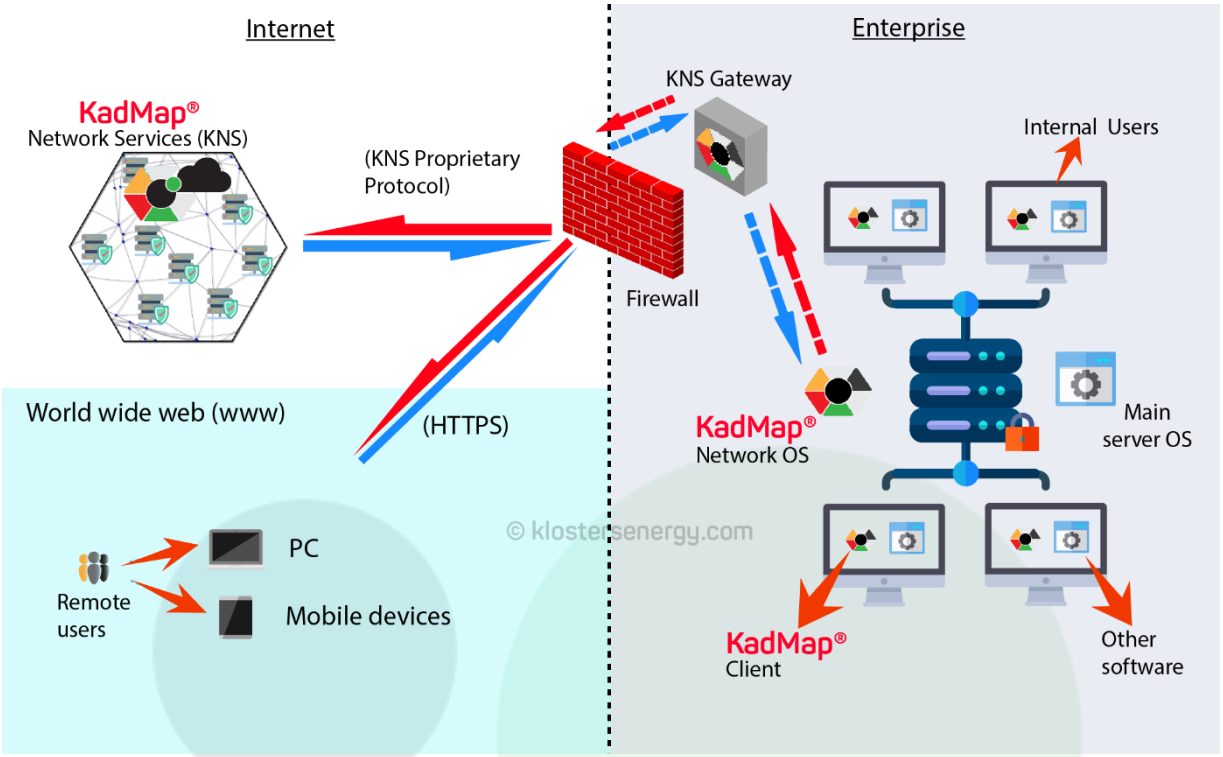
KNS – IIoT resources

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.

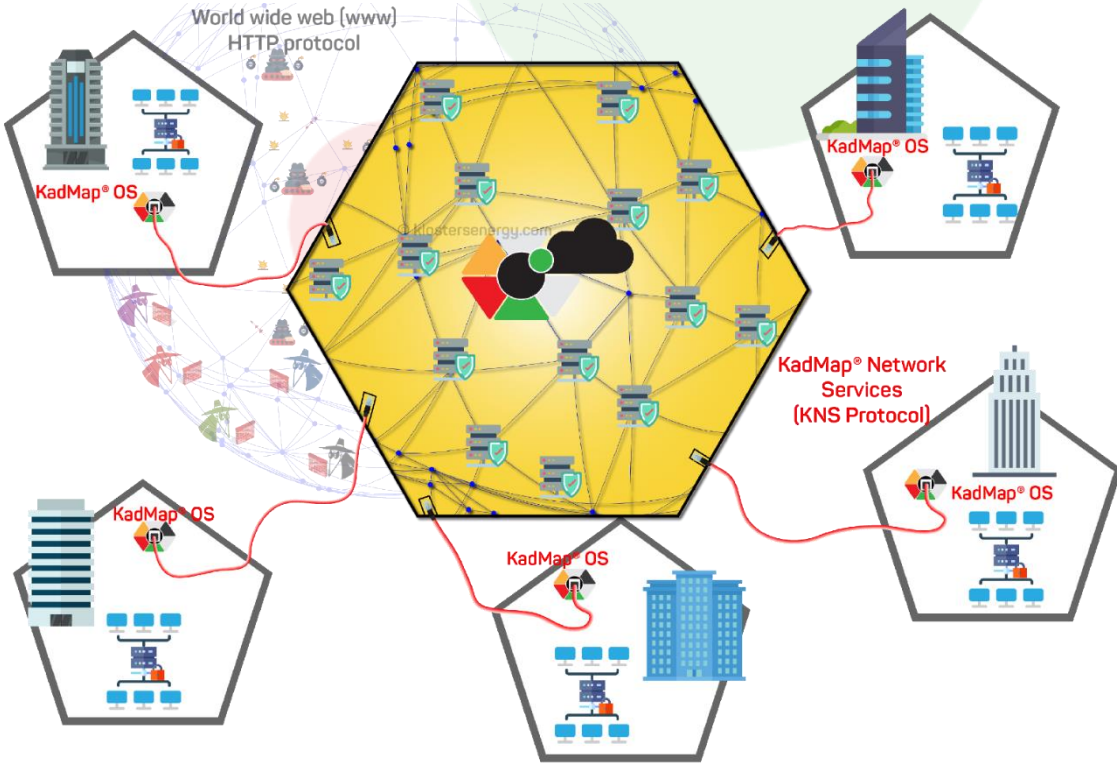
With KNS the EE industry will have a massive niche in cyberspace which is completely exclusive and accessible only by KadMap® authenticated EE enterprises. The hardware (supercomputers and high data storage servers) are high performance machines designed to deliver the heavy machine resources that are 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

For more in-depth insight on KadMap® OS and KNS, see: *A Big Platform for the Engineering and Energy Enterprise – What Is It and Why Do We Need It?*[10].

The KadMap® Development Project

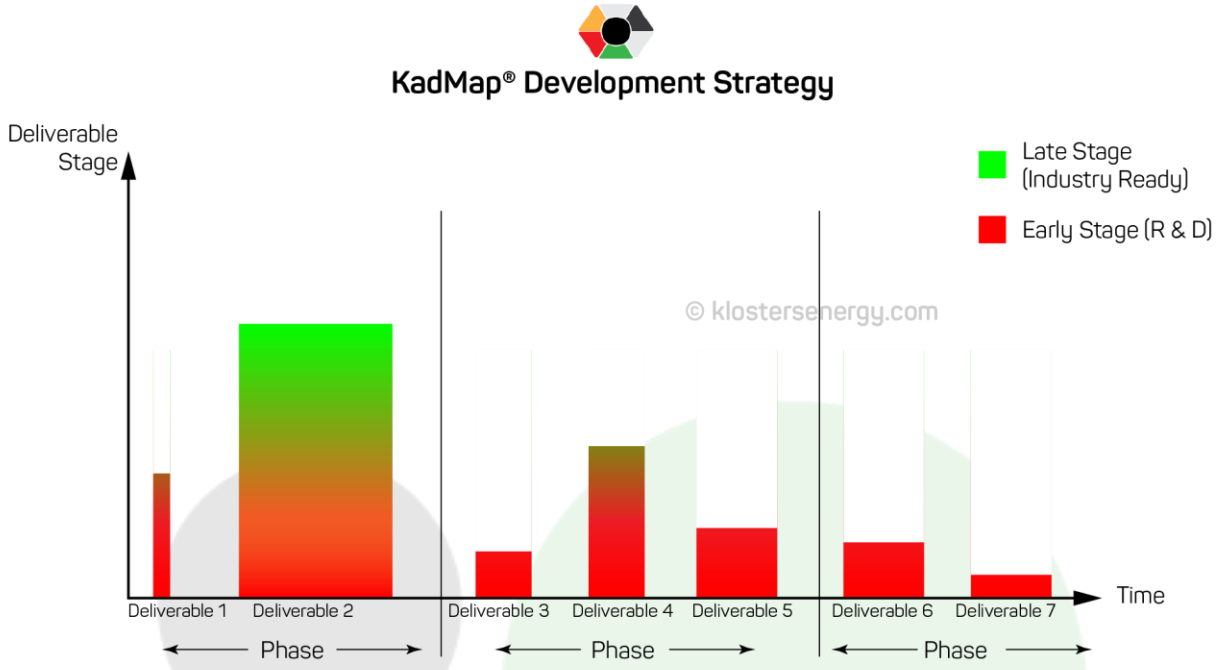
The end-to-end integrated scope of KadMap® is a huge challenge. KES' strategy to surmount this challenge has been the adoption of a project-based approach. This involved the creation of an integrated project dubbed "KadMap® Development Project" which is currently in execution. The goal of this project 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.

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



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*[11] *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*	7A. *Industry Consultation*	7B. *Product specification*

[11] Research and Development

production

8A. *Industry engagement*

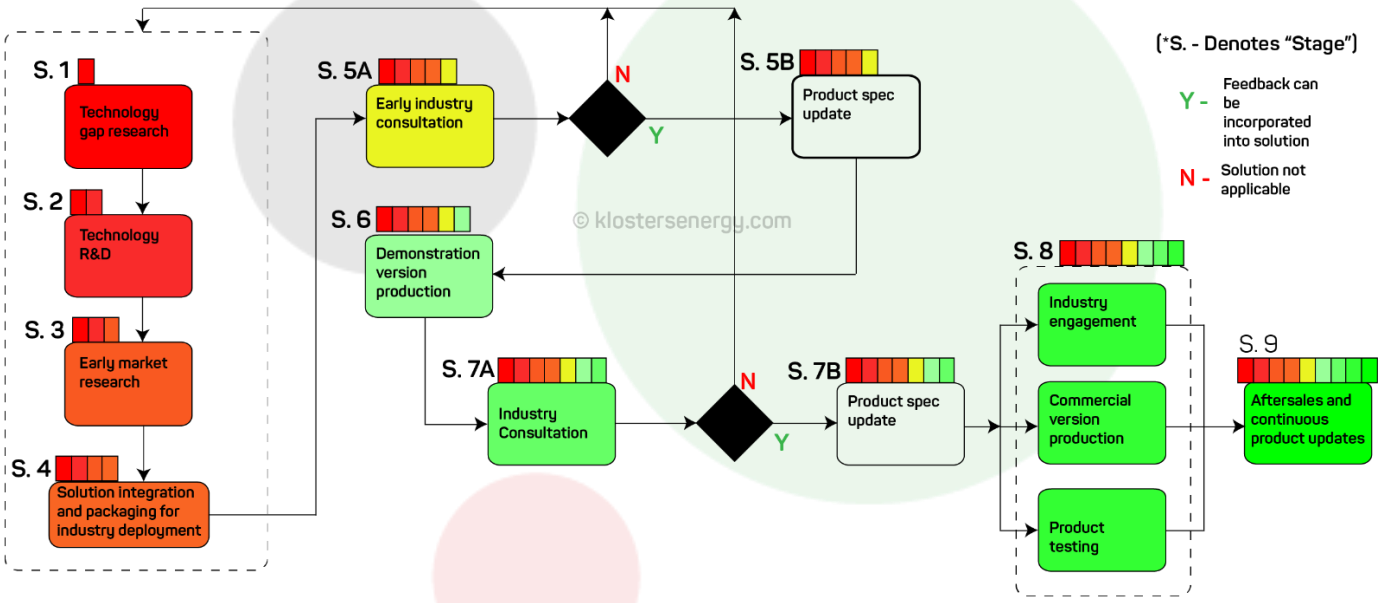
8B. *Commercial version production*

update

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.



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.

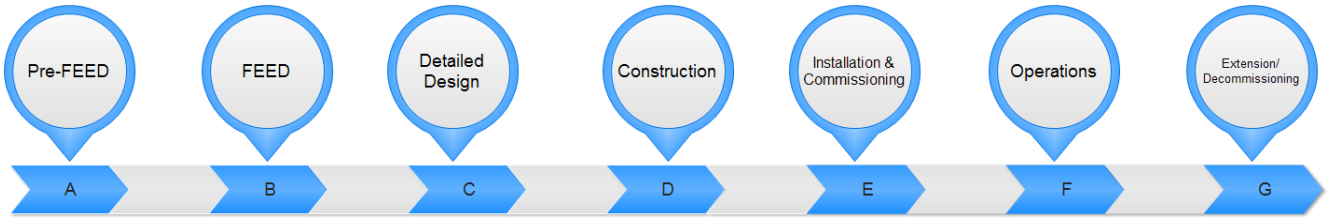
From its early beginnings in 2007, KadMap® has evolved into a very potent asset to facilitate and lead the world's fourth industrial revolution – the digital revolution. KadMap® has been through two development phases and is currently on the third.

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 solutions for EE industry	2014-2018	• KadMap® web interface application (WIA) • *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.

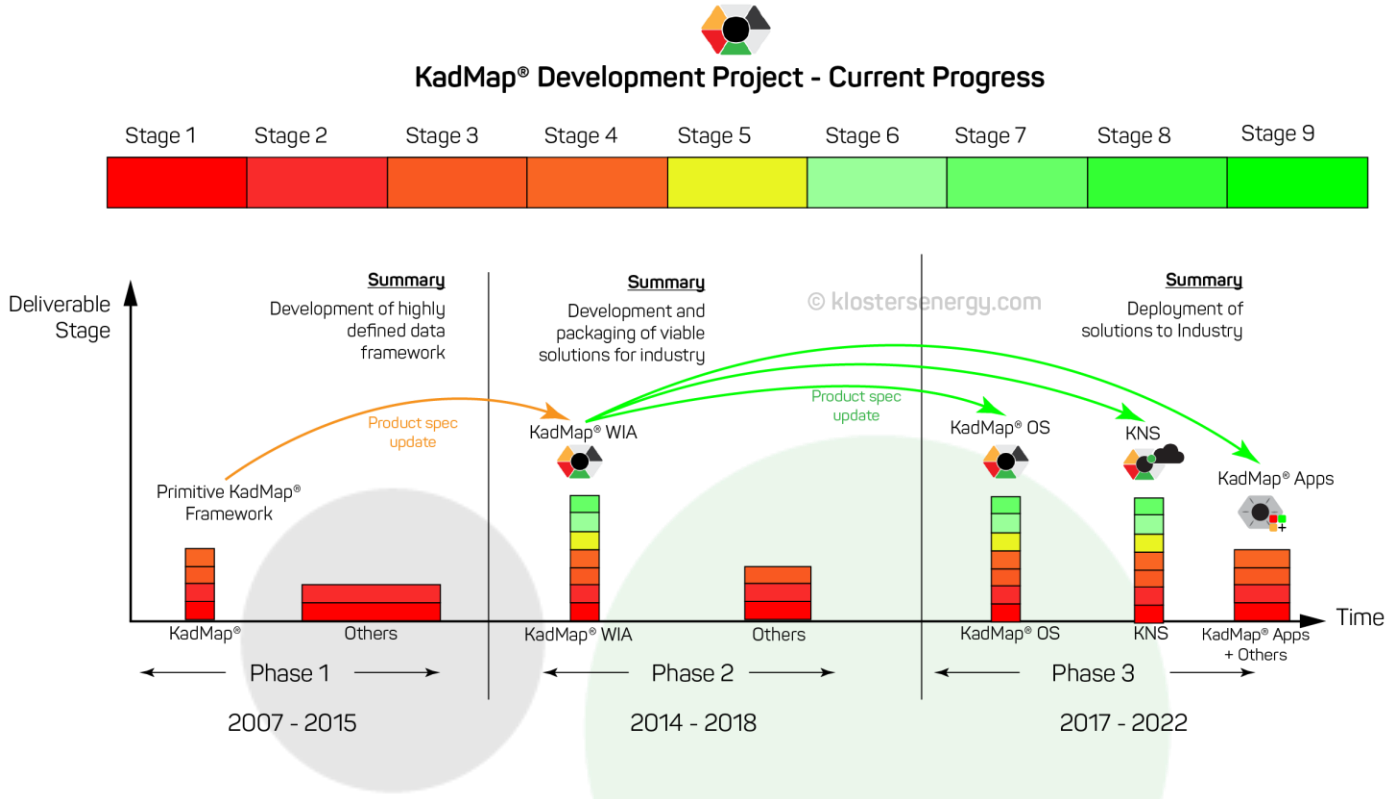
Sufficient definitions/specifications of the infrastructure, abstraction, data operations and technology marked the beginning of phase 2.

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*[12]).

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.

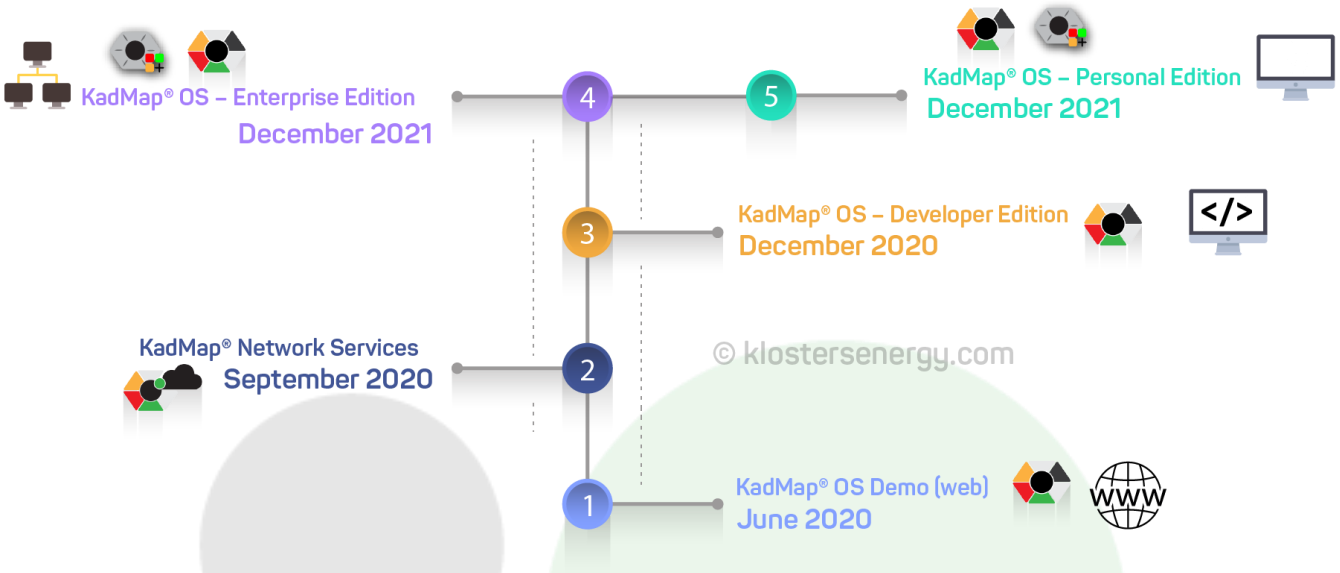
The final product specifications update (stage 7A of KadMap® deliverable development process) manifested as evolution of the user interface, critical details of our R-AIM service and eventually the KadMap® WIA architecture. The KadMap® WIA architecture evolved and split to give rise to 3 subsequent deliverables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

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



KadMap® Evolution

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.

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.

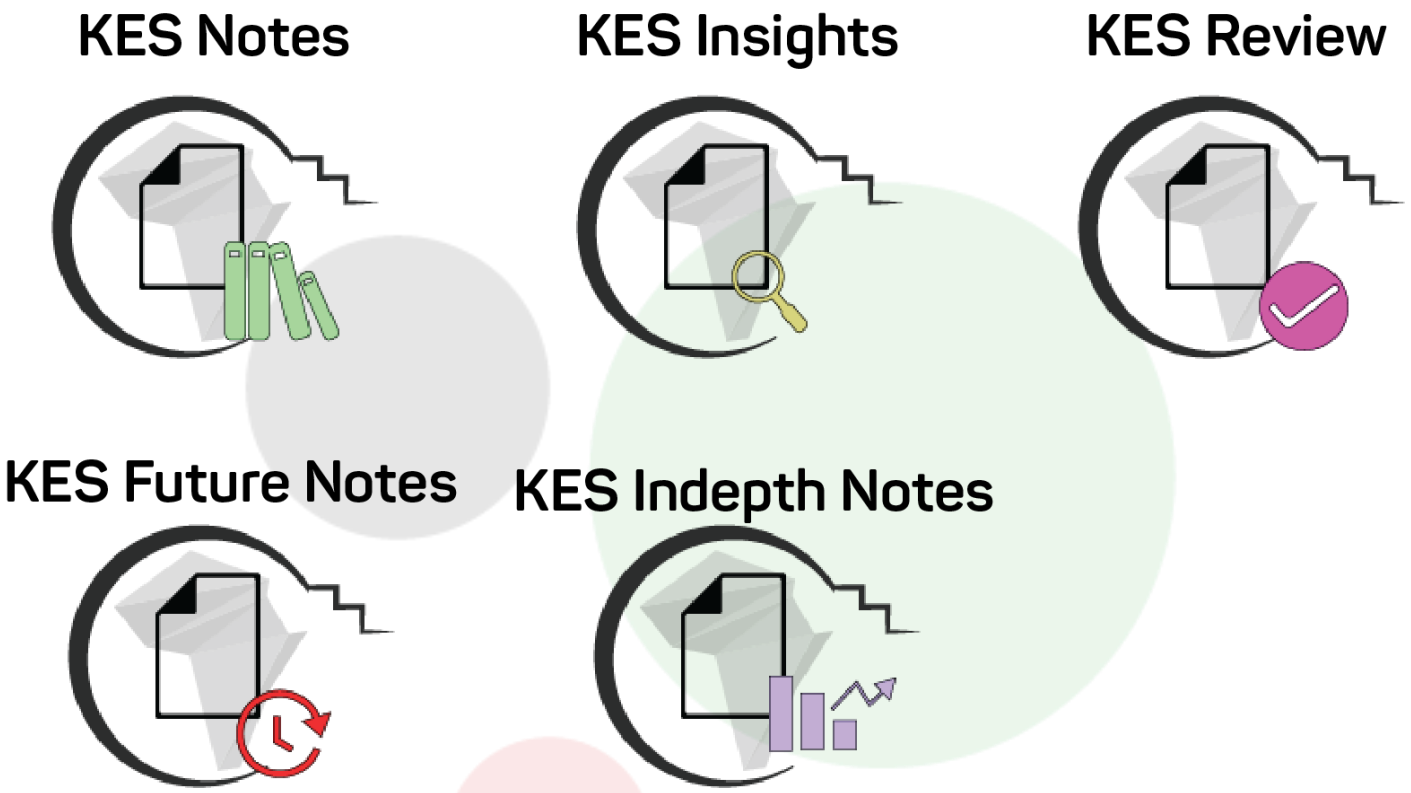
Industry papers uses a unique referencing system and a peer review system populated by our network of academicians and experienced industry professionals. Reviewers of publications can be viewed by the URL provided at the "Reviewers" section of each publication.

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



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Klosters Energy Services Limited

15B Mamman Kontagora Crescent,

Katampe Extension

Abuja, FCT

www.klostersenergy.com