INTELLECTIVE AI

A.I. DEVELOPMENT PLATFORM

White Paper v1.0

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Executive Summary

Intellective AI offers adaptive, real-time, and forensic capabilities to provide operational intelligence for any data-intensive application. There are various competitors depending on the industry or sensor types, but most players providing real-time intelligence are industry-specific players due to their technical limitations.

Intellective AI enables Proactive, Predictive and Preventative Capabilities through its unsupervised continuous-learning-based multi-sensor analytics platform, Foundation®. Intellective AI's competitive advantage is its breakthrough approach to Machine Learning, Cognitive-Neuro Analytics™, which utilizes online training[MS1], no predefined behaviors and no rules. Therefore, Foundation is the most scalable solution to identify anomalies and information within customer-generated data – across industry types.

The company estimates its current Market Opportunity at $2.1 billion. Intellective AI's go-to-market strategy is currently focused on Blockchain applications, InfoSec, VCA, and Financial Technology markets. The company's customers will include banks, oil and gas companies, and transportation and municipal authorities of many of the largest metropolitan areas in the US. Intellective AI targets include critical infrastructures such as oil and gas, utilities, building management, and transportation.

The 4th Industrial Revolution: IoT, Big Data, and Artificial Intelligence

The 4th Industrial Revolution is upon us. By 2025 there will be 75 billion IoT devices[1] streaming zettabytes or yottabytes of data[2] from smartphones, tablets, sensors, consumer wearables, and other internet-connected devices used throughout every industry. When viewed from the context of the current global population, this translates into roughly 10 IoT devices per human being. Everything we do, say, and eventually, think or feel will swiftly be digitized, stored, and analyzed.

Add to this that video, audio, textual, and sensor data are frequently wrought with inconsistencies and other complexities, and it's clear that this is far too much data for humans to parse through, and derive insight from, on their own. Thus, it's not altogether

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[1] Statista Research Department. (2016). *Internet of Things (IoT) connected devices installed base worldwide from 2015 to 2025 (in billions).* Available at: https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/

[2] Petrov, Chris. (2019). *Big Data Statistics 2019.* Available at: https://techjury.net/stats-about/big-data-statistics/

surprising that the artificial intelligence market is expected to produce a compound annual growth rate (CAGR) of approximately 57% through 2025.[3] Other more conservative estimates place the AI industry CAGR at 37%,[4] and its potential value creation between $3.5T and $5.8T -- most of which will be centered on marketing, sales, supply chain management, and manufacturing.[5]

However, the initial push of AI being utilized to generate product sales (i.e., retail, marketing, etc.) is only the start of the AI revolution. Both the concept and application of AI continue along a trajectory of innovative emergence. Although we can trace the history of AI back to the 1950s, and possibly long before the mid 20th century, its manifestation and full potential have only recently come about due to a substantial increase in machine computational capacity and our intense reliance on the internet (e.g., cloud computing, social media, SaaS, IaaS, etc.).

That being stated, the more serious, and by extension life altering, applications of AI within the health, oil and gas, utilities, and public safety sectors is on a substantial uptick. This isn't to say that the retail industry isn't impactful on our daily lives. But, when compared to allowing AI to full navigate an 80,000 lbs. truck without a driver, or detecting the early onset of a fatal disease, mass selling of Amazon products is rarely as life altering if AI (or the humans training AI) make an error. As such, the retail sector is, and has been, a fertile testing ground for reliably expanding AI into other industries.

But, as with all innovations, AI is not without some initial confusion.

Cognitive Intelligence vs. Artificial Intelligence, Machine Learning, and Deep Learning

As previously indicated, the AI market is on a staggering upswing. The downside to this is that the marketing push for overusing AI as an SEO keyword has created obfuscation as to what AI actually is and how it contrasts with deploying machine learning or deep learning algorithms. Unfortunately, even the major tech companies are guilty of jumping on the buzzword bandwagon. To be fair, however, the technology is still evolving. But,

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[3] Grand View Research. (2017). *AI market size worth $35,870 Million by 2025 | CAGR: 57.2%.* Available at: https://www.grandviewresearch.com/press-release/global-artificial-intelligence-ai-market

[4] Columbus, Louis. (2019). *Roundup of machine learning forecasts and market estimates for 2019.* Forbes. Available at: https://www.forbes.com/sites/louiscolumbus/2019/03/27/roundup-of-machine-learning-forecasts-and-market-estimates-2019/#6ed0bcb97695
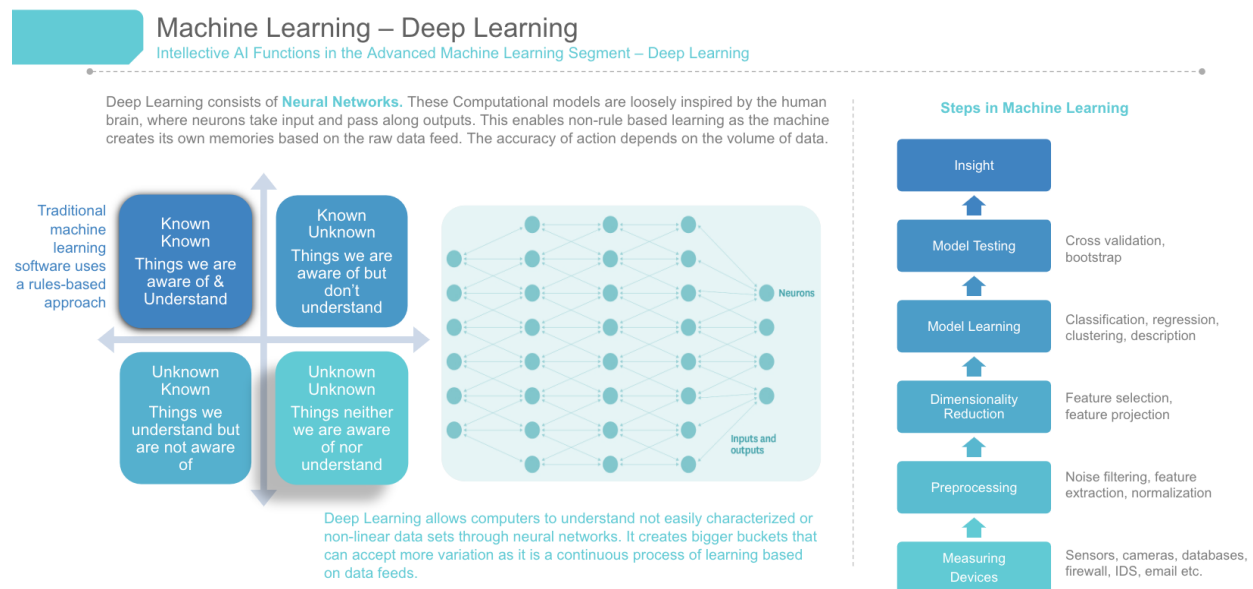
[5] McKinsey Global Institute. (2018). *Visualizing the uses and potential impact of AI and other analytics.* Available at: https://www.mckinsey.com/featured-insights/artificial-intelligence/visualizing-the-uses-and-potential-impact-of-ai-and-other-analytics

consumers should be aware of what they're purchasing when any enterprise claims that they are "AI-powered."

While ML and DL are considered to be the subsets to and the foundations of AI. Clearly defining the boundaries between each is more than a mere academic exercise. Each has a specialized function that either moves us towards or away from an objective, whether it be the full development of a smart car that lessens rather than increases the likelihood of death or injury, or early detection of cancerous cells -- which also carries a life or death imperative.

Certainly, AI, ML, and DL can be used in conjunction (and they are frequent bedfellows) to create specialized and automated systems for data ingestion, storage, retrieval, and analysis. But, using AI for every problem is akin to using a bulldozer to hammer a nail into a wall. Furthermore, at this time, AI implementation is neither inexpensive nor easy. Those who are in the process of building AI systems must have several essential components intact, including (but not limited to) a completely digital infrastructure and massive amounts of relevant data: garbage in, garbage out. Subject matter experts are also necessary as part of determining the definition of "relevant data."

So, while it's easy to make claims about being "AI-driven", constructing and deploying such a system is far more involved. In terms of the technical aspect of AI, an AI infrastructure usually begins with machine learning and deep learning.

Machine Learning – Deep Learning
Intellective AI Functions in the Advanced Machine Learning Segment – Deep Learning

Deep Learning consists of **Neural Networks.** These Computational models are loosely inspired by the human brain, where neurons take input and pass along outputs. This enables non-rule based learning as the machine creates its own memories based on the raw data feed. The accuracy of action depends on the volume of data.

Traditional machine learning software uses a rules-based approach

Known Known	Known Unknown
Things we are aware of & Understand	Things we are aware of but don't understand
Unknown Known	Unknown Unknown
Things we understand but are not aware of	Things neither we are aware of nor understand

Neurons

Inputs and outputs

Deep Learning allows computers to understand not easily characterized or non-linear data sets through neural networks. It creates bigger buckets that can accept more variation as it is a continuous process of learning based on data feeds.

Steps in Machine Learning

Step	Description
Insight	
Model Testing	Cross validation, bootstrap
Model Learning	Classification, regression, clustering, description
Dimensionality Reduction	Feature selection, feature projection
Preprocessing	Noise filtering, feature extraction, normalization
Measuring Devices	Sensors, cameras, databases, firewall, IDS, email etc.

Machine Learning

Although machines are fundamentally different constructs when compared to humans, they "learn" via similar methods. They are, after all, human inventions and we, being the self referencing beings that we are, tend to anthropomorphize everything around us. With this in mind, we can map the essentials of machine learning, i.e., supervised, unsupervised, and reinforcement learning, to our very own learning stages.

Supervised learning: This machine learning approach is representative of an elementary school level of learning where the machine matches an image, or other construct, to another labeled image. If we think of this in terms of traditional classroom instruction, the teacher shows the students a picture of an apple with a label, thereby identifying it as an "apple", and then shows a picture of an apple that is unlabeled. The goal is for the learner, our machine, to correctly label the unlabeled picture as an apple. Simplistic, but correctly illustrative of the basics of supervised learning.

Unsupervised learning: This is the next level of learning where abstraction begins to take place. There are no labels, the learner is to classify or categorize "things" on their own, without the aid of prompts. It's generative learning where the algorithm (within the human context, this would be our schema) works on its own to sort pictures of dogs vs. cats, or identify different population segments who are likely to purchase certain items (using retail as an example).

Reinforcement learning: We experience reinforcement learning on a daily basis. Our interactions with the environment produce signals (although not always clearly) that either encourage or discourage our behaviors. Reinforcement learning for machines operates in a parallel way. The engineer sets a framework for the rules of the game, including "penalty" and "reward" parameters, then the machine determines the optimal methods for achieving more "rewards" than "penalties."

Although AI is also trained through the above techniques, it has a different extensible output than machine learning. Both technologies involve producing accurate predictions and learning to improve those predictions through adjustments to their models (i.e. algorithms). But, in comparison to AI, machine learning doesn't attempt to create meaning from the patterns; if it does, then it's in the AI realm. Machine learning's expertise is in identifying and classifying or categorizing those patterns amidst the morass of big data being fed into its algorithmic architecture. Intellective AI utilizes machine learning in addition to its AI and deep learning counterparts as it's an essential tool for offloading cognitive tasks within our AI ecosystem.

Deep Learning

Being able to "think" is more complex than we realize. Much of the thinking we do each day is automatic as we've had millions of years of evolution in the development of our neural networks and in relation to the environment. Deep learning attempts to model -- albeit loosely -- the functions of our own hardwiring within the brain. For most of us, recognizing facial expressions, determining their meaning, and discerning voices on audio or in-person are easy tasks. For machines, not so much; they're new to our world.

Processing these types of inputs, visual and audio, require additional layers between the input and output. This is true for our brains as well. So, deep learning architecture may have one or more hidden layers, each with a node that carries a weighted function. Again, our brains are already hardwired to do this. We constantly assess distance, proximity, and the amount of variation of an object has in relation to other objects inside or external to a classification schema.

Intellective AI deep learning is an imperative technology within our AI ecosystem as ingesting and analyzing video and audio data from a variety of IoT and other inputs is one of the platform's core functionalities.

Artificial Intelligence and Cognitive Intelligence

AI incorporates the if-then rules of machine learning along with the deep learning workflow to a human-like level of reasoning, perception, and decision making. When presented with a problem, AI sets out to solve it without human interaction or interception. But, AI can be of a weak or strong variety, and also be used as a collaborative intelligence, where it provides the best decisional pathways while leaving the action to its human collaborators. In general, AI is a system comprised of the above mentioned tools with the added capability of creating

Cognitive Intelligence (CI) manifests through even more advanced functionalities such as understanding the meaningfulness of what it's analyzing. Rather than merely returning an individualized treatment protocol for a cancer patient, and then automatically enacting that treatment, it can comprehend -- as much as a machine is able to without direct human experience -- the emotions of the cancer patient. From there, it can provide emotional assistance via video, voice, or a combination for both. For example, perhaps the patient is a child who is comforted by kitten videos. CI would converse with the child (auditory soothing) while also showing them their favorite images of kittens.

Intellective AI's cognitive system is the basis for this technology. As will be discussed in the Intellective AI Platform section, we've created the essential infrastructure that

combines sensory input with analytical and memory functions that pattern how humans process auditory, visual, textual, and emotional information.

AI Market Overview

The total revenue generated from the AI software market is projected to exceed $100 billion by 2025.[6] Other reports estimate that AI's total value creation, throughout all industries, will reach $3.9 trillion over the next two years.[7] Suffice to say that AI and machine learning will continue to maintain a high rate of investment and ROI potential in both the long and short term.

However, in addition to financial value creation, AI has an ever-broadening public service capability including, but not limited to, personalized medicine, increased safety for emergency personnel, improving individual and collective financial health, and boosting the efficiency of energy consumption and production. At first glance, AI's impact may seem to be miniscule, there are far reaching positive effects that will be discussed in the ensuing sections.

Intellective AI for Financial Services

Trillions of dollars flow through the global financial network each day.[8] While it's difficult to precisely account for and value every single asset, whether fungible or not, in existence -- and intangible assets such as intellectual property are notoriously difficult for valuation purposes -- asset exchange is a process fraught with challenges. Not only are there numerous regulatory requirements[9] [10] and a growing number of data protection regulations,[11] but there also exists the continuous and increasing threat of data breaches.[12]

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[6] Statista. (2019). *Revenues from the artificial intelligence (AI) software market worldwide from 2018 to 2025.* Available at: https://www.statista.com/statistics/607716/worldwide-artificial-intelligence-market-revenues/

[7] Columbus, Louis. (2019). *Roundup of machine learning forecasts and market estimates for 2019.* Avaliable at: https://www.forbes.com/sites/louiscolumbus/2019/03/27/roundup-of-machine-learning-forecasts-and-market-estimates-2019/#3d4bd1a47695

[8] Scutt, David. (2016). *Here's how much currency is traded every day.* Business Insider. Available at: https://www.businessinsider.com/heres-how-much-currency-is-traded-every-day-2016-9

[9] Schmidt, Michael. (2019). *Financial regulators: Who they are and what they do.* Investopedia. Available at: https://www.investopedia.com/articles/economics/09/financial-regulatory-body.asp

[10] Columbia Business School. (2016). *List of national regulatory authorities.* The Columbia Institute for Tele-Information. Available at: https://dfsobservatory.com/content/list-national-regulatory-authorities

[11] DLA Piper. (2019). *Data protection laws of the world: Compare data protection laws around the world.* Available at: https://www.dlapiperdataprotection.com/

[12] Breach Level Index. (2019). *Data breach statistics.* Available at: https://breachlevelindex.com/

Case in point, in July of 2019, over 100 million Capital One customers were likely affected by a data breach whereby a woman from Seattle, Washington may have accessed "140,000 Social Security numbers and 80,000 linked bank accounts."[13] While the perpetrator was subsequently apprehended, the ensuing damage was already done. The root of the vulnerability was, as reported by Capital One, a "misconfigured firewall", an error that may cost them upwards of $150 million in the short term.[14] Adding salt to this preventable wound is the potential long-term and deleterious impact on the individual consumers and the ensuing loss in consumer confidence.

In terms of consumer demand, the digital generations place individualized products and services, along with robust security, at the top of their financial services list. Per PWC's "Financial Services 2020 and Beyond" report, 33% of Millennials stated that they believe they will "not even need a bank in the future."[15] While the regulatory mechanisms in place at this time aren't yet supporting a future without banks, and it's not clear what the Millennials surveyed had in mind as a possible replacement, the underlying message is this: harnessing and maintaining customer trust and loyalty will take more conscientious investment on the part of the financial services industry.

One additional component of the aforementioned conscientious investment is in creating and securing multiple digital channels for consumer access. Undeniably, we're in an age of instant gratification reinforced by all things digital. Despite the heavily regulated environment, which tends to be an obstacle for establishing new financial services offerings, Fintech companies such as Stripe, Coinbase, Acorns, Credit Karma, and many others,[16] are attracting the attention (and money) of the digital generation. They make it as easy as possible for customers to transact with their system and provide multiple pathways for doing so, including well designed and frustration free mobile apps.

However, they too are vulnerable to nefarious agents infiltrating their data channels.

For long established financial institutions and Fintech startups, AI implementation will help to resolve the tension between maintaining regulatory compliance, protecting customer

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[13] Allen, Karma; Barr, Luke; Hoyos, Joshua. (2019). *Woman arrested in massive Capital One data breach, impacting over 100 million people.* ABC News. Available at: https://abcnews.go.com/US/woman-arrested-massive-capital-data-breach-impacting-100/story?id=64644733

[14] Siegel, Rachel. (2019). *Capital One looked to the cloud for security. But its own firewall couldn't stop a hacker.* Available at: https://www.washingtonpost.com/technology/2019/07/30/capital-one-looked-cloud-security-its-own-firewall-couldnt-stop-hacker/

[15] PWC. (2016). *Financial services technology 2020 and beyond: Embracing disruption.* Available at: https://www.pwc.com/gx/en/financial-services/assets/pdf/technology2020-and-beyond.pdf

[16] Editors Pick. (2019). *The most innovative Fintech companies in 2019.* Forbes. Available at: https://www.forbes.com/fintech/2019/#1b58fa62b4c6

information, and implementing innovative ways of attracting and retaining a "want it now" generation of consumers.

AI for Regulatory Compliance

Regulations are voluminous and frequently convoluted; this is particularly true for financial services companies operating within an international context. AI tools such as Optical Character Recognition (OCR), Natural Language Processing (NLP), Natural Language Understanding (NLU), and Natural Language Generation (NLG), can assist in streamlining assurance that all systems and processes comply with numerous regulatory documents.

Through the use of OCR, AI can quickly recognize and classify document types, e.g., PDFs, emails, and text in non-digital format, thereby extracting metadata from the "reading" of the text. AI can then automatically shuttle the document to the appropriate storage and/or pull relevant data into a database for future review or analysis. In concert with NLP, NLU, and NLG, AI can also "read" and then "summarize" the content, thus generating a written summary of regulatory changes as they are released by the local, national or international regulation agencies.

As such, actionable insights are near immediate as AI can also alert the requisite stakeholders as to any systemic deficiencies that do not comply with the most recent regulations. For example, when changes are made to either California's[17] or Colorado's[18] data privacy laws, AI can promptly review your data collection pipelines to correctly tag the type of information being collected (e.g., biometric, behavioral, etc.), which U.S. state that data is collected from, and then either auto adjust collection procedures or notify stakeholders that there is an impending change that will place the business out of compliance.

Better Security with AI

As is obvious, hackers exploit even the slightest vulnerabilities within a digital system. But, for those financial institutions that still maintain a brick and mortar establishment, danger still exists for more violent criminals. AI is poised to help improve the detection, prevention, and -- if necessary -- apprehending those who threaten the financial and physical security of law abiding citizens.

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[17] Stoltz, Brenda. (2019). *A new California privacy law could affect every U.S. business—Will you be ready?* Forbes. Available at: https://www.forbes.com/sites/allbusiness/2019/09/07/california-consumer-privacy-act-could-affect-your-business/#1696694f36ac

[18] Weiser, Phil. (2019). *Colorado's Consumer Data Protection Laws: FAQs for businesses and government agencies.* Colorado Attorney General. Available at: https://coag.gov/resources/data-protection-laws/

With regard to digital security, AI can be used for proactive security practices rather than enacting the frequently too little too late reactive approach. Event and systemic monitoring are the key to prevention. AI doesn't solely rely on statistical analysis of past events, though this is a component of predicting future probabilities of a cyber attack. It constantly monitors massive amounts of data -- both internally as well as externally -- and actively seeks and tests digital channel vulnerabilities.

AI behavioral analysis can be extended to customer behaviors as well. We are creatures of habit. What we buy, the devices we use, the stores we frequent are relatively predictable -- with a few exceptions along the way. Due to its ability to aggregate and analyze multiple data points from far more sources than humans are able, AI can detect when an actual variance of customer behavior has occurred vs. a false positive, e.g., they've temporarily used a relative's phone to log on to their account. From there, AI can decide whether to simply alert the customer and make a note in the customer's account, or temporarily freeze the account until the customer verifies their identity (which can be biometrically or another form of multifactor authentication).

As for brick and mortar scenarios, AI can continually observe and audit customer behavior in and around the building. Emotion detection and facial recognition will soon be essential sensor based capabilities that will act as both multifactor authentication for withdrawing money at an ATM (and via a human bank teller), and quickly assessing a potential security threat.

AI Personalized Financial Services

Without customers, there is no business. Whether insurance or mortgages, the digital generation wants an interactive experience that mirrors Amazon, Google, Apple, and Facebook.[19] Simultaneously, they want a variation in the bundling of service types from a single financial services enterprise.[20] However, regardless of the generation, consumers are individuals that cannot be conveniently (or accurately) lumped in with a broader consumer segment. Financial institutions must have greater granularity, but with one exception: the persistent consumer Zeitgeist is for digital services.

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[19] Accenture. (2017). *Financial providers: Transforming distribution models for the evolving consumer.* Available at: https://www.accenture.com/_acnmedia/Accenture/next-gen-3/DandM-Global-Research-Study/Accenture-Financial-Services-Global-Distribution-Marketing-Consumer-Study.pdfla=en#zoom=50

[20] Accenture. (2019). *2019 Global Financial Services Consumer Study.* Available at: https://www.accenture.com/us-en/insights/financial-services/consumer-trends-financial-services-consumer-study-2019

In addition to the AI behavioral analysis for security purposes, it can also be used to tailor offerings on a per customer basis. Of course, regulatory compliance requirements still apply, meaning if only a single customer wants to bundle several services and one isn't currently offered due to needing bureaucratic approval, then it might not be immediately feasible.

But, as stated above, AI can assist with swift compliance alignment and product development and delivery to meet the "all-in-one" requests of products such as a "property-buying solution that bundles a mortgage, insurance coverage, security equipment and an additional loan for furnishings."[21]

Intellective AI's Cognitive Operating System (COS) is specifically designed for use within the financial services industry. Driven by an algorithmic and digital architecture that models human cognitive processes, the COS is in a perpetual state of multichannel observation, learning, and -- if needed -- immediate and multiplicative responses throughout all touchpoints.

Intellective AI for Healthcare

Per Accenture, the size of the health AI market will likely balloon to \$6.6 billion by 2021.[22] Intertwined within AI for healthcare is the global wearable medical devices market (also known as smart medical devices), e.g., Fitbits, Apple Watches, ECG monitors, biosensors, etc., which will continue to flood the healthcare system with medical data. Indeed, by 2026 the medical wearables market is "projected to surpass \$29 billion by 2026."[23]

Individualized Medicine

For the first time in human history, individuals can track and monitor most facets of their daily health: sleep patterns, daily caloric and nutrient intake (at the macro and micro levels), heart rate, blood pressure, water intake, etc. This information not only helps the individual improve their self care and curtail the onset of diseases associated with lifestyle choices, such as diabetes, hypertension, and heart disease,[24] but can also aid their physicians in providing individualized treatment.

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[21] Ibid.

[22] Accenture. (2017). *Artificial Intelligence: Healthcare's new nervous system.* Available at: https://www.accenture.com/_acnmedia/PDF-49/Accenture-Health-Artificial-Intelligence.pdf#zoom=50

[23] Slachta, Anicka. (2019). *Medical wearables market projected to surpass \$29B by 2026.* Available at: https://www.cardiovascularbusiness.com/topics/healthcare-economics/medical-wearables-market-surpass-29b-2026

[24] Medicine.net. (2019). *Medical definition of lifestyle disease.* Available at: https://www.medicinenet.com/script/main/art.asp?articlekey=38316

Since the health sensor data is readily available, and per the patient's permission can be shared with their physician, there is increased efficiency and speed in predicting and attending to the patient's physical condition. Depending on the patient's condition (whether or not they need intense medical intervention or it can be self-managed), and with AI assisting in the growth of Telemedicine, the patient may not even need to make the trek to the physician's office, thereby saving time and costs for both the patient and physician.

Smart Hospital Rooms

At the hospital level of care, there is a steady push for implementing smart patient rooms that can modulate the ambient environment based on the patient's physical and emotional reactions, e.g., changing the lighting, temperature, auto-releasing precise medicinal dosages, and even something as simple as changing the television channel or adjusting the hospital bed (as opposed to calling a nurse to do this). All of this, and more, is achieved via sensors, which are the "eyes" and "ears" of AI.

Furthermore, AI applications such as automated image diagnosis, robot-assisted surgery, and administrative workflow assistance will provide a significant reduction in health and medical care costs.[25]

The future of health and medical care is a collaboration between the individual patient and their physician and the Intellective AI platform is on the leading edge of bridging the gap between the medical industrial complex and the individual patient. Through the use of the Intellective AI platform, the aforementioned health data, both real-time streaming and historical, can be quickly transformed into life saving insight that has the added benefit of streamlining medical decision-making through more precise diagnoses and treatment protocols.

Intellective AI for the Energy Sector

Everything that supports human life in the 21st century is predicated on the energy sector, including the utilities and oil and gas market. By 2022, the oil and gas AI market is expected to rise to $2.85 billion by 2022.[26] Combined with the utilities market, the total

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[25] Forbes Insights Team. (2019). *AI and healthcare: A giant opportunity.* Available at: https://www.forbes.com/sites/insights-intelai/2019/02/11/ai-and-healthcare-a-giant-opportunity/#6d7819f54c68

[26] PR Newswire (2018). *AI in Oil and Gas Market Worth 2.85 billion USD by 2022*. Available at: https://www.prnewswire.com/news-releases/ai-in-oil-amp-gas-market-worth-2-85-billion-usd-by-2022-808671798.html

market valuation is estimate to reach $7.78 billion in 2024.[27] This expansion centers on several components including a focus on cost reduction, employee safety, and pressure from both citizens and governments to reduce carbon emissions.

Employee Safety and Machine Efficiency

The oil and gas industry, specifically, is a volatile one for employees. Per the U.S. Bureau of Labor and Statistics, "accidents during oil drilling and exploration activities account for 40% of all workplace deaths in the industry."[28] Wherever there is heavy machinery that needs to be constantly maintained (particularly in dangerous conditions), there also exists a need for accurate sensors being used in conjunction with AI.

In addition to increasing machinery efficiency by predicting maintenance and the potential for malfunction (thus, reducing the costs of replacing the equipment), the AI-sensor integration can promptly alert employees as to increased safety risks before, during, and after the equipment's usage. Notably, AI is capable of automatically rolling back or completely shutting down machinery based on its continual learning of the various environments in which the equipment operates.

AI can also be used to for employee training simulations through Augmented or Virtual Reality, whereby historical or real-time sensor data is utilized to create varying scenarios that range in experiential conditions, e.g., everyday "business as usual" to what to do in the event of machinery malfunction. Thus, AI has the capacity to help save lives, improve working conditions, and lower capital equipment costs.

Renewable Energy Transition

For the time being, the world still relies on oil and gas extraction as its primary energy source. Renewable sources continue to be technological refined so that they are a. not increasing environmental damage; b. competitively priced since systemic transition to renewable sources will require a global infrastructural shift; and c. sustainable in the long term -- both physically and financially.

The first trajectory for AI's assistance in this transition is its ability to analyze varied and massive datasets, including utility usage data. Then, it can identify patterns at increasing

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[27] BIS Research. (2019). *Global Artificial Intelligence (AI) in Energy Market.* Available at: https://bisresearch.com/industry-report/artificial-intelligence-energy-market.html

[28] Market Watch. (2019). *Oil & gas sensors market -- 2019 size, share, trends, growth, competitive regional analysis with global industry forecast to 2023.* Available at: https://www.marketwatch.com/press-release/oil-gas-sensors-market-2019-size-share-trends-growth-competitive-regional-analysis-with-global-industry-forecast-to-2023-2019-08-08?mod=mw_quote_news

granular levels and make tailored recommendations about appliance degradation (e.g., if the 10-year old refrigerator should be replaced for a more energy efficient one, or there's a "green smart" appliance on the market). Or AI can auto power down lights when it senses no one is in the room.

Likewise, AI is proving to be beneficial in improving the broader benefits of renewable energy technologies. NextEra Energy is currently using machine learning and AI to monitor its wind farm equipment.[29] Using AI's powerful predictive analytics capabilities, NextEra can "boost the functionality of wind turbines and reduce maintenance costs."[30]

Moreover, whether for renewable or non-renewable resource extraction and usage, AI can monitor and predict the environmental impact of the equipment prior to installation. For example, if placing wind turbines in a particular region would likely cause an intolerable disruption of the local ecosystem, AI can raise an alert and recommend an alternative approach.

The Intellective AI platform provides the computational and cognitive power needed to ingest, decipher, and learn from extensive utilities and oil and gas datasets.

Intellective AI for Public Safety

Public safety is a common good for individual and social welfare. Whether emergency responders are trying to rescue victims of an earthquake or flood, or they're fighting to quench a fire that's gone wildly out of control, they're placing their lives at great risk. Fortunately, AI is increasingly able to help in early detection and containment of public safety risks.

Video and Crime Detection

There's a constant and high probability that we're either being filmed or will be filmed going about our daily business. Parking lots, stores, just about any public area in the U.S. has a camera somewhere, even it's just a camera on a smart phone. Together with the body worn cameras that a multitude of police departments have mandated their officers wear and the litany of home surveillance devices now available (e.g., Ring, SimpliSafe, etc.), U.S. law enforcement is saturated with video data. Added to this are the various dash cams and would-be citizen journalists ready to film an incident and post it on social media.

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[29] Bharadwaj, Raghav. (2019). *Artificial Intelligence in public utilities -- comparing applications at 4 top US firms.* Available at: https://emerj.com/ai-application-comparisons/artificial-intelligence-in-public-utilities-comparison/

[30] Ibid.

Unfortunately, not all of the video is clear. And manually sifting through numerous videos consumes vital law enforcement resources. Image detection and analysis is where AI can be particularly useful to law enforcement. More specifically, AI's facial recognition capability can be used for criminal identification or to help locate missing persons.[31] For example, through video cameras, AI can scan a public place and deploy facial recognition that's compared to a database of missing or endangered persons. If recognized, AI will contact local law enforcement and notify them of the person's most recent location while also coordinating the arrival of the closest officer available to respond on scene.

This identification process can also be achieved through AI's faster automated review of video. As video from body worn cameras or citizens reporting crimes through video recordings is uploaded to the law enforcement system, AI can search the video, produce a transcript of any conversations, and identify the video's participants. The information is then sent to the appropriate personnel for further investigation.

Natural Disasters and Emergency Medical Services

The 2020 Australian fires have devastated millions of acres of flora and fauna. Eight firefighters lost their lives in addition to the 25 civilians who perished as a result of the disaster. Firefighters need to collaborate in an unfamiliar environment. Even if they know the layout of the land or building, the high stress situation along with the all consuming blaze creates a disorienting chaos. Efficient coordination of both firefighters and their resources reduces the risk of death or injury and increases the probability of quickly containing the fires.

NASA is currently developing the Assistant for Understanding Data through Reasoning, Extraction, and Synthesis (AUDREY), an AI-powered system that has the ability to "track an entire team of firefighters" and sends "relevant signals" with collaboration and resource recommendations.[32] Sensors attached to the firefighters' gear will be able to determine their "GPS location, heat in other rooms, the presence of dangerous chemicals and gases" and communication "satellite imagery of the location."[33]

Such tools aren't limited to firefighters, however. Law enforcement, military personnel, and emergency medical responders could also benefit from an AI-sensor integrated technology. If combined with health and medical wearables, and the data is easily shareable through an emergency medical services app emergency medical responders

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[31] Cognilytica. (2019). *AI Today podcast #89: AI in law enforcment -- use case series.* [Podcast]. Available at: https://www.cognilytica.com/2019/05/15/ai-today-podcast-88-ai-in-law-enforcement/
[32] NASA. (2019). *A.I. could be a firefighter's guardian angel.* Available at: https://technology.nasa.gov/features/audrey.html
[33] Ibid.

can more quickly identify what they need to administer to a patient in an emergency. Or as the caller reports the symptoms to emergency services (e.g., short of breath, indication of pain in the chest, etc.), AI can analyze the reported symptoms and immediately send recommended emergency protocols along with the likely cause of the symptoms to the emergency technicians.

Given the multiple beneficial uses for AI, it's not at all surprising that it's tangible and intangible value will continue to rise. With this in mind, we've developed the Intellective AI Foundation Platform, a first of its kind cognitive and linguistic AI system that mirrors the plasticity of human cognitive-sensory architecture.

The Intellective AI Foundation Platform

The Intellective AI Foundation Platform (Foundation Platform) system adapts to environmental changes by continuously learning and adjusting the model. As it learns what is normal, it creates a hierarchical set of abstract memories that describe the associated events corresponding to normal activity. It then uses these memories to evaluate future events to determine whether they fit within the normal range or are abnormal and need special attention. As these abnormal events are detected in real time, the system issues alerts that identify the concerns.
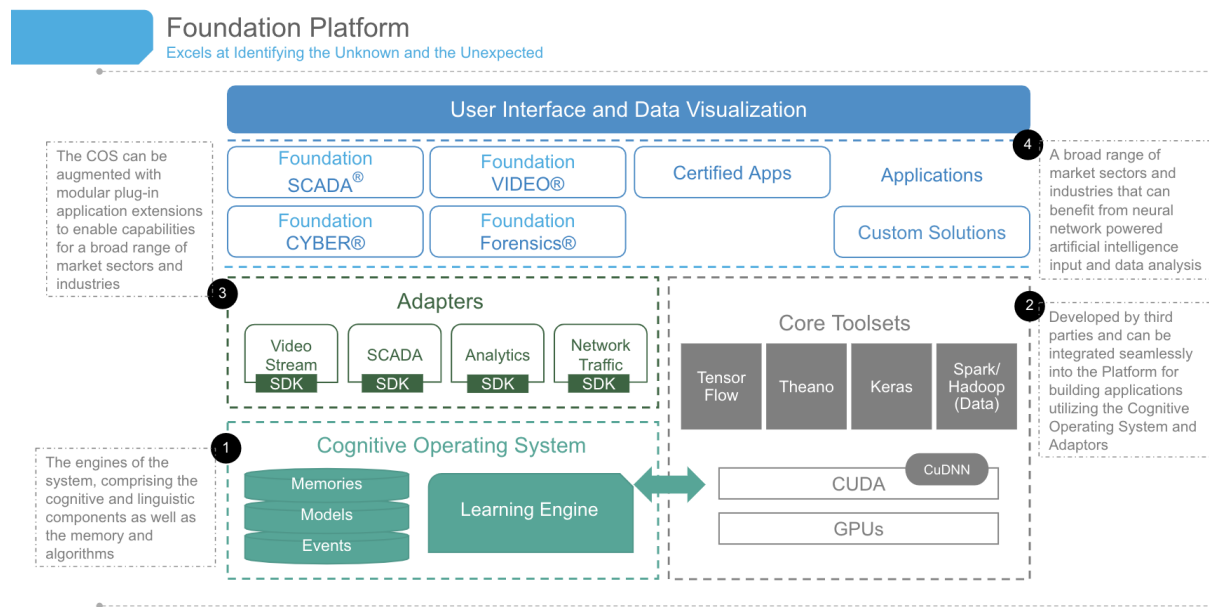

Objects and events seen in the incoming data stream are abstracted into a hieratical collection of descriptors that characterize the input data. The lower-level, more primitive

elements are defined as alpha symbols. Collections of alphas are grouped into beta symbols as higher levels of abstraction are defined. Finally, collections of betas are grouped into gamma symbols. This approach dynamically generates a lexicon.

Essential Architecture

The core of the Foundation Platform's Cognitive Operating System (COS) is the Learning Engine (LE), which consists of a Linguistic Engine and a Cognitive Engine. The FOUNDATION Platform Learning Engine uses the input data received to create a dynamic model of normal events for a system or environment.

The statistical model is multi-dimensional, and the Learning Engine constructs a cognitive syntax to describe the environment it is modeling

Distributed Architecture
A Highly Scalable, Multi-Input Machine Learning System
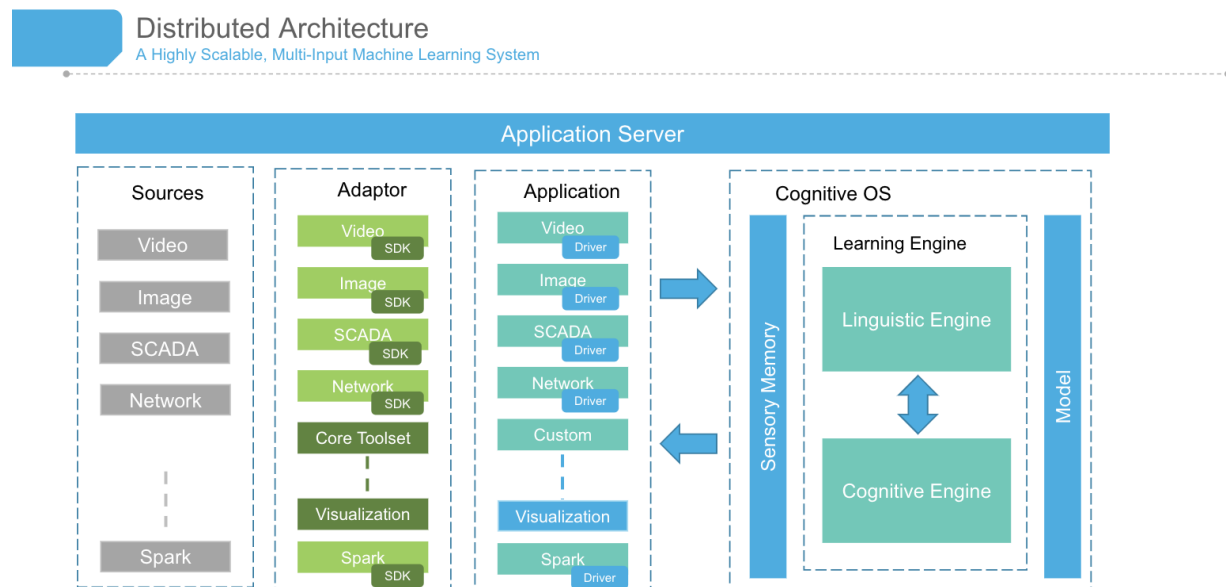
The Foundation Platform trains itself through observation via unsupervised learning to establish a running baseline of normal events in a sensor. The LE's Cognitive Model is used to analyze the resulting syntax from the collection of alpha, beta, and gammas symbols to establish a Score for each new data point received. This score describes the range of normality or rarity and the odds of occurrence for that item.

Products and Services

Intellective AI provides comprehensive, multi-sensor solution in the Foundation Platform with a number of broad-based applications across a number of business lines. At this time, Intellective AI provides four software products options in addition to professional consulting and implementation:
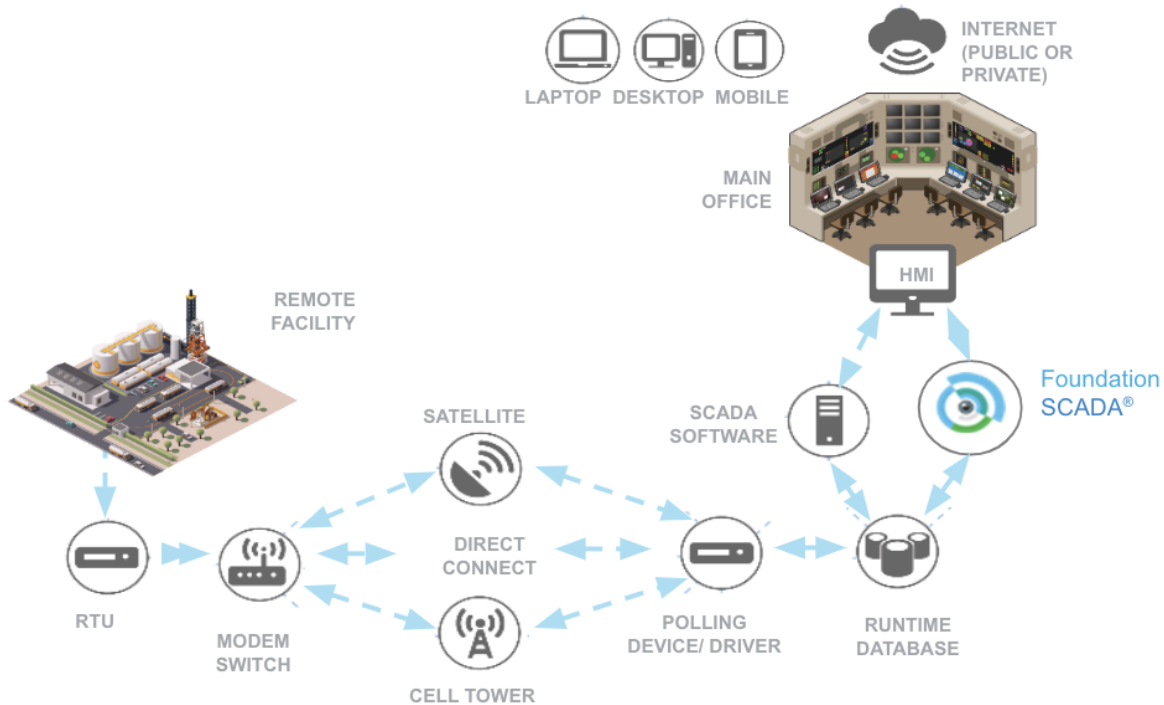
- Foundation SCADA®
- Foundation Cyber®
- Foundation Video®
- Foundation Forensics®

The products are flexible and can be deployed via various combinations. All licenses are perpetual.

Foundation SCADA®

Foundation SCADA®, also known as Foundation-S, provides real-time monitoring of the industrial environment, and offers operational intelligence to help prevent loss issues, enhance safety issues as well as identify opportunities for increased operational uptime.

Foundation-S brings new levels of intelligence to Supervisory Control and Data Acquisition (SCADA) industrial operations by providing direct insight into rapidly changing conditions as they develop and before alarm thresholds are reached. Real time monitoring provides operational intelligence that can help prevent safety and loss issues and identify opportunities for increased operational uptime.
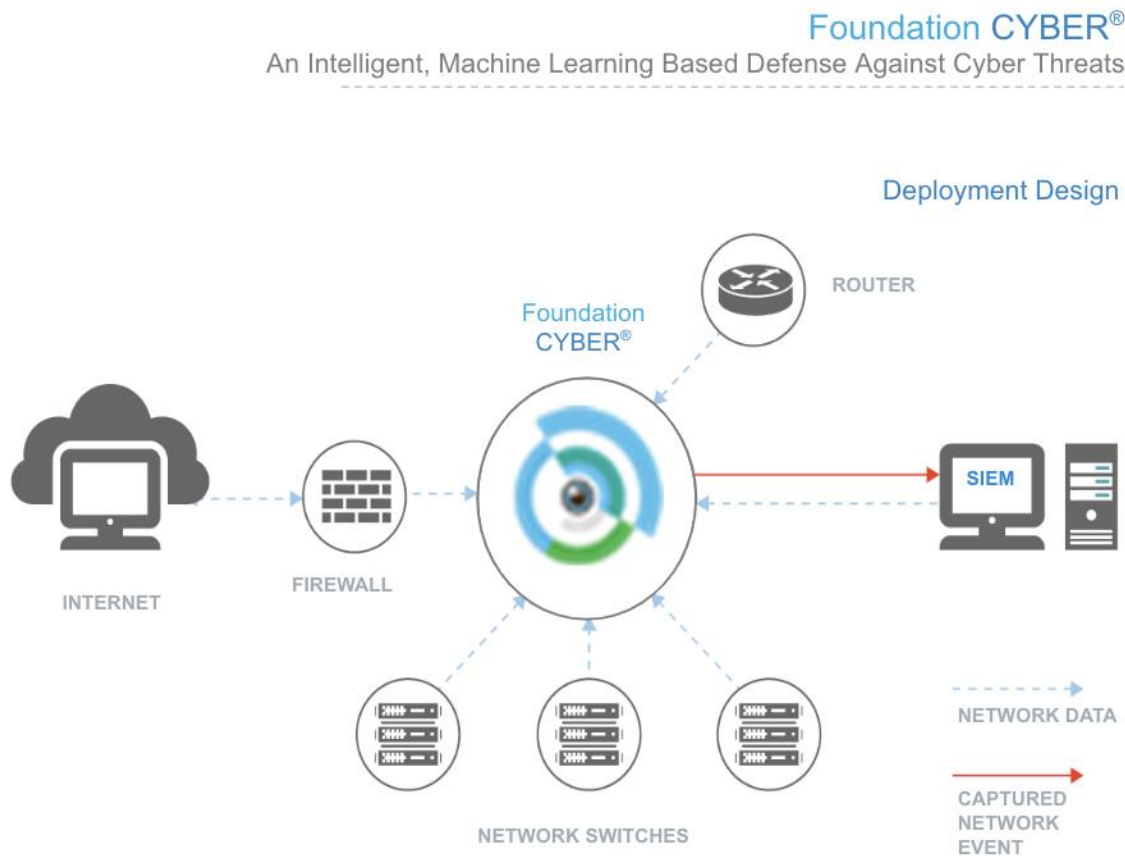
Benefits

- Proactive integrity management
- Real-time precursor alerts
- Forensic enabler
- Superior enhancement to condition-based maintenance
- Optimized production management
- Expanded operator visibility

Foundation-S is available in both real-time and historical analysis modes to meet an organization's unique needs. An on-site installation provides 24/7 real-time analysis and alerting that scales to tens of thousands of sensors across remote and geographically

dispersed locations. A Software Development Kit (SDK) is also available for integration with an organization's existing HMI.

Foundation Cyber®

Foundation-C is a true behavior recognition based defense for network security, this machine learning, real time solution adapts and learns network behavior automatically, allowing it to signal anomalies to help protect computers, networks, programs and data from unauthorized access, change or destruction.
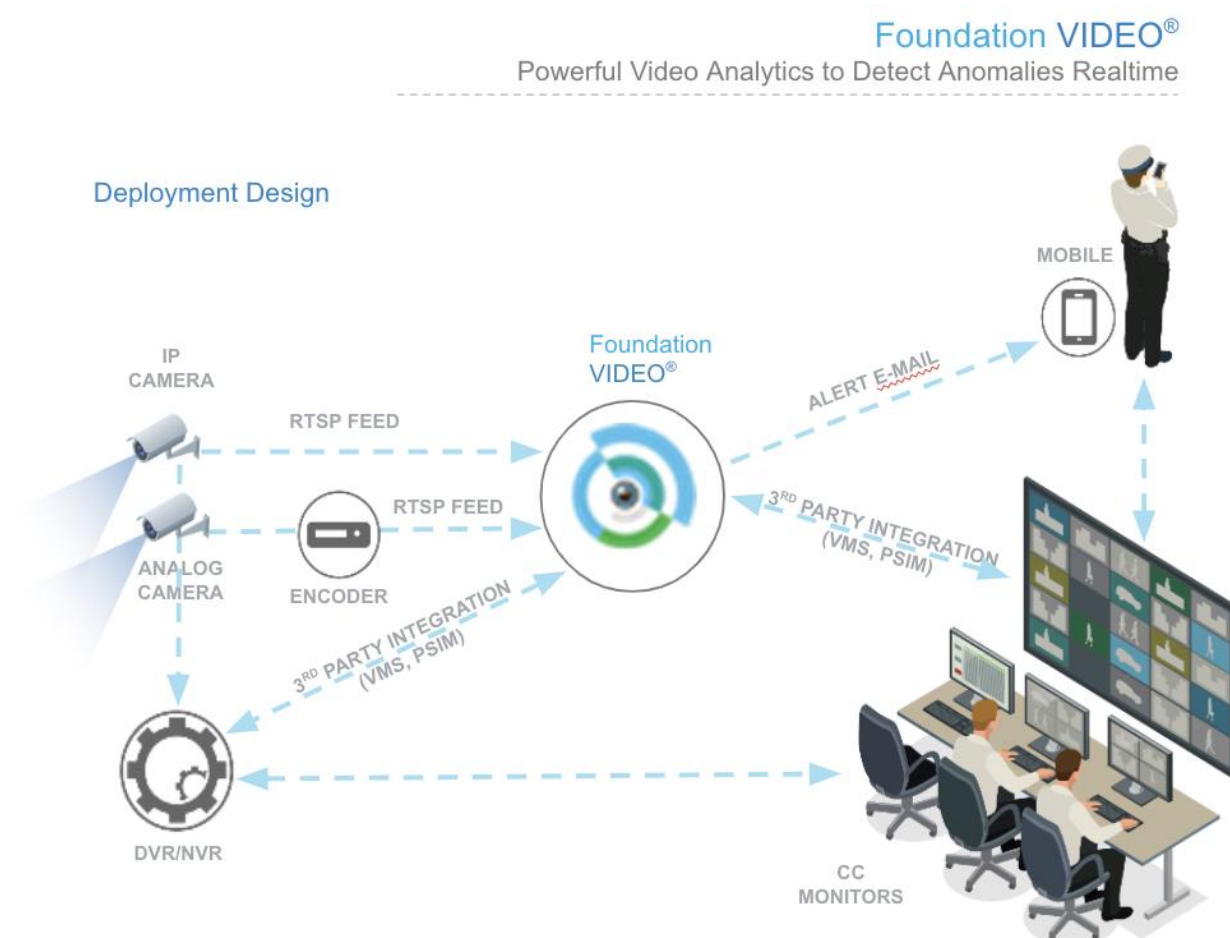

Benefits

- Proactive information security
- Unknown threat discovery
- Real-time system alerts
- Evolving network intelligence
- Preemptive anomaly detection

Utilizing a robust API-based architecture, Foundation-C integrates into all existing operational and IT infrastructures. It collects data regardless of format or protocol, including structured, semi structured or unstructured data. Foundation-C performs a deep review on all data, identifying patterns, establishing normal behavior and ranges and subsequently alerting to anomalous behavior. Depending on the customer workflow, these anomalies can be presented as alerts in the Intellective AI interface or directly integrated into existing dashboards or alerting infrastructure.

Foundation Video®

Foundation-V for Video is a highly scalable solution that gives organizations the ability to effectively monitor thousands of cameras at once. The technology learns normal vs. anomalous behavior within data streams and issues real time insights that enable security personnel to hone in on potential threats. Essentially, Foundation-V autonomously learns what constitutes normal behavior within a video camera's field of view.

Benefits

- Proactive Anomaly Detection

- Easily Scalable Solutions
- Works Within Existing Security Infrastructure
- Real Time Alerts
- Continuous, Adaptive Learning

Foundation-V's open systems design is highly scalable and can integrate seamlessly with a wide range of VMS and PSIM solutions, including but not limited to:

- Cisco VSM
- VidSys
- Milestone XProtect
- Lenel OnGuard
- OnSSI Ocularis
- Genetec Security Center
- Guetebruck GeViScope
- CNL IP Security Center

Foundation Forensics®

Foundation-F for SCADA for Forensic historical data analysis brings new levels of intelligence to Supervisory Control and Data Acquisition (SCADA) data scientists and analysts by providing fast, direct insight into SCADA data anomalies before alarm thresholds are reached. Foundation recognizes the subtle and often overlooked blips in the data stream that serve as early indicators to pending upset conditions.

Report Snapshot
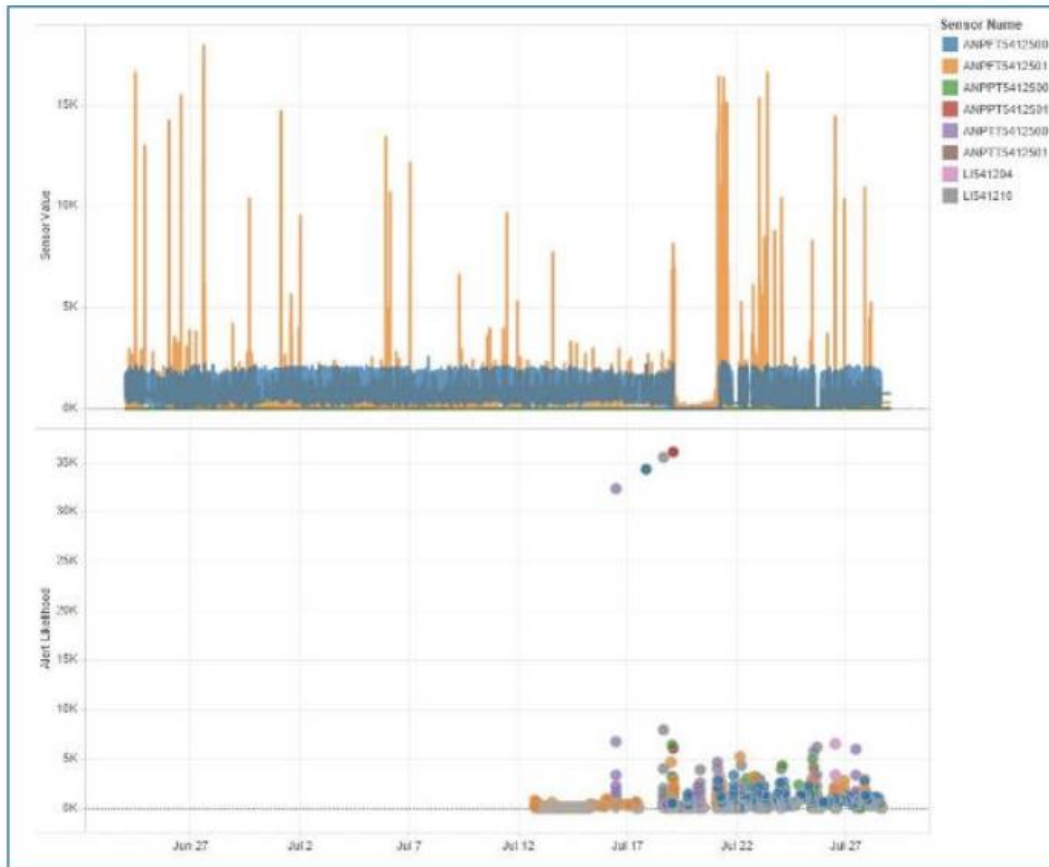
Benefits

- Historical view of anomalies
- Anomaly pattern recognition and trending
- Correlation of composite sensor anomalies
- Guidance to most anomalies activities
- Operational optimization to alert threshold monitoring

Foundation-F is a professional service offering where customer provided historical data is processed through the Foundation platform to produce charts of behavior anomaly likelihood, trends and patterns. Reports provide data scientists, analysts, and other end-

users with a quick view of anomalies and insight to help them further drive operational efficiency, risk mitigation or system process improvements.

Professional Services

Intellective AI offers a full suite of consulting and implementation services to help define, align, and deliver a licensing strategy that meets the business objectives and operational processes unique to client organization. The typical implementation process time is about four months.

Solution Lifecycle and Over System Implementation Approach
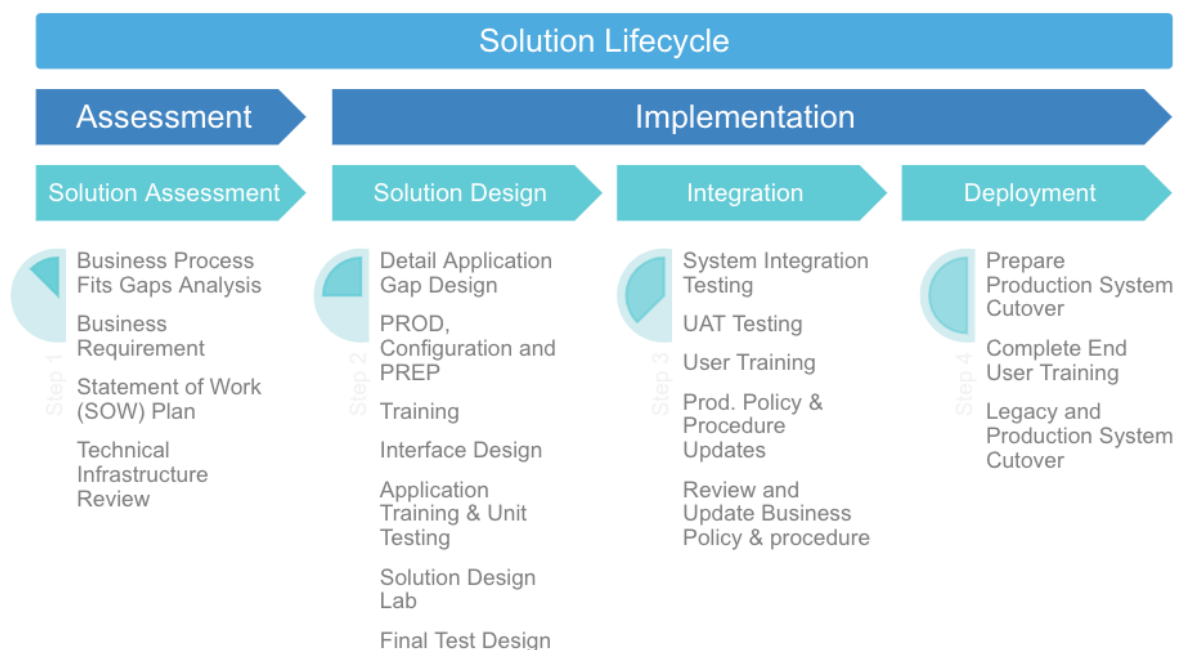
With each license sold, the company provides an implementation team of highly qualified software licensing consultants to define, design, and deliver some of the industry's most sophisticated licensing ecosystems. The consultant(s) will use the business goals defined by the client organization to design an end-to-end license system architecture that addresses one or more of the aspects noted below:

- End-to-end fulfillment processes
- Back office design, Customer experience
- Sales impact
- Business intelligence, Business Agility
- Security

- Product design, License models
- Use case definition
- Detailed user workflows
- Data migration planning

Our Customers

Foundation is a non-industry specific, multi-sensor analytic platform and the addressable market is significant. The company however is initially targeting the oil and gas, financial services, defense, public safety, health care, transportation, healthcare, and cybersecurity markets as these sectors generate significant raw non-linear sensor data which require deep learning algorithms to analyze and derive meaningful insights.

Competitive Advantage

Unlike the traditional, rule-based system, Foundation is the reason-based system that enables a machine to learn what is abnormal, without human pre-programing. By decreasing the number of alerts, it helps security officers to perceive more threats in real-time. Foundation permanently learns and registers when some changes occur, so any ongoing programing is not necessary

The Foundation analyzes the total field of view through each video camera in closed-circuit television system, despite certain difficulties, types of equipment or specific conditions on a scene. It is the "open standards" system which enables it to cooperate easily with different infrastructures, both the existing ones and the new ones.

The system has minimum requirements for the complete hardware and software installation, regardless of the number of cameras that need to be connected into the system and without any changes on the client's site.

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