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DIGITAL GREECE: THE PATH TO GROWTH

NATURAL RESOURCES INDUSTRY DIGITAL STATE

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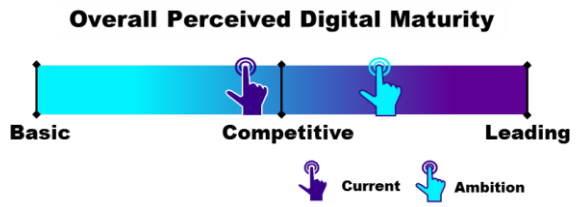
1 Identifying the perceived digital maturity of the Greek Natural Resources Industry

The digital environment in which Natural Resources companies operate appears challenging[1]. Leaders in the Natural Resources industry have placed digital at the center of their transformations, adopting technological capabilities throughout the supply chain. Similarly, their Greek counterparts who were surveyed by Accenture, also acknowledge the importance of digital and have recognized its value-creation potential, but have yet to take any bold steps with regards to their digitalization[2].

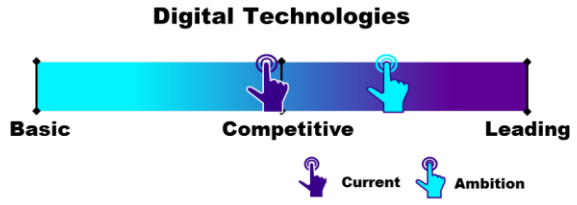


Source: Questionnaire of Perceived Digital Maturity, Accenture Analysis

Figure 1: Overall Perceived Digital Maturity – Natural Resources Industry (Current State – Ambition)

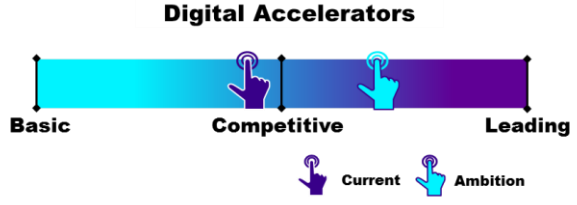
Source: Questionnaire of Perceived Digital Maturity, Accenture Analysis

Figure 2: Perceived Digital Skills Maturity – Natural Resources Industry (Current State - Ambition)



Source: Questionnaire of Perceived Digital Maturity, Accenture Analysis

Figure 3: Perceived Digital Technologies Maturity - Natural Resources Industry (Current State - Ambition)



Source: Questionnaire of Perceived Digital Maturity, Accenture Analysis

Figure 4: Perceived Digital Accelerators Maturity - Natural Resources Industry (Current State - Ambition)

Focusing on the Natural Resources industry, companies perceive to be executing their digital transformation at a slower pace than their industry's global market (Figure 1). However, they appear ambitious to increase their digital maturity in the future by prioritizing digitalization of their operations and production.

Breaking down the digital maturity score into its levers we get a better understanding of the key drivers of the overall maturity and the effort that must be applied for the digitalization of the Natural Resources industry. Regarding the ***digital skills*** maturity of the sample, surveyed executives consider themselves to perform notably below the market-competitive level (Figure 2). Nonetheless, they have already planned for major changes in the next five years in their Organization and Collaboration capabilities, which are expected to have a positive impact on their skills maturity.

With regards to the ***digital technologies*** lever, Natural Resources executives claim to have made some efforts towards digital rotation (Figure 3), with increased sensitivity showed across their Information & Insights capability area since they aim to use data as a driver for productivity, as mentioned during our respective workshop.

Finally, as indicated by data, the Greek companies view their maturity related to the industry's ***digital accelerators*** to be performing below international competitors (Figure 4). This

[1] According to NACE (2nd revision), the Natural Resources industry contains the following sectors: manufacture of other non-metallic mineral products, manufacture of paper and paper products, manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials

[2] The performed analysis and the respective conclusions were based on data recorded through the "Questionnaire of Perceived Digital Maturity", launched on December 19, 2016 and remained open until January 30, 2017

indicates that the survey participants consider the environment to not be conducive and favorable towards their industry's digitalization.

1.1 Evaluating the Greek Natural Resources Industry's digital maturity

Moving one step further from our initial analysis, we cross-examined and analyzed secondary data against the executives' opinions, in order to extract additional insights. To evaluate the Greek Natural Resources industry's digital maturity and identify the primary factors that can drive economic growth in their digital economic output, we have applied the Digital Economic Opportunity Index (DEOI) for the Natural Resources industry.

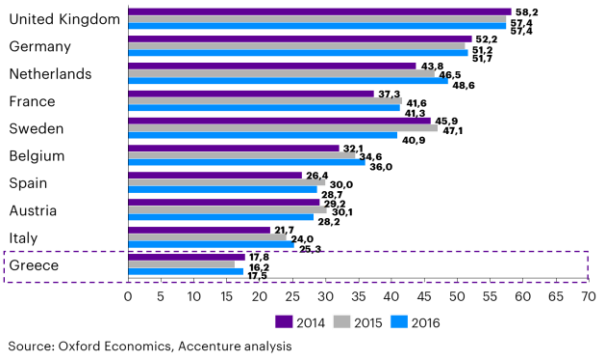


Figure 5: Natural Resources Digital Economic Opportunity Index from 2014 to 2016

Our analysis for the Greek Natural Resources companies with regards to their digital maturity suggests that the Greek companies are situated at the lowest end of the European list over the last three years (Figure 5). In fact, since 2014 the Greek Natural Resources industry's digitalization seems to have remained stagnant. This indicates that the pace of digitalization is much slower than their European peers.

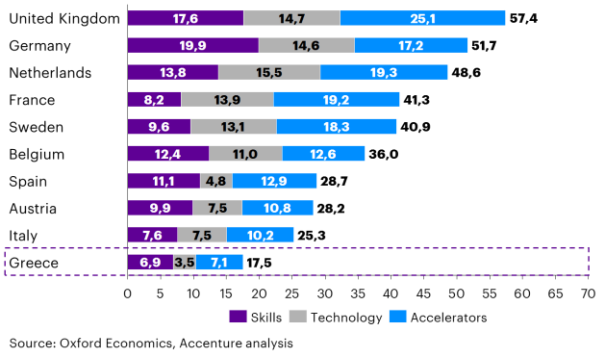


Figure 6: Natural Resources Digital Economic Opportunity scores by country

The dissection into the three levers that make up the Digital Economic Opportunity Index, namely, digital skills, digital technologies and digital accelerators is represented in the following graph (Figure 6).

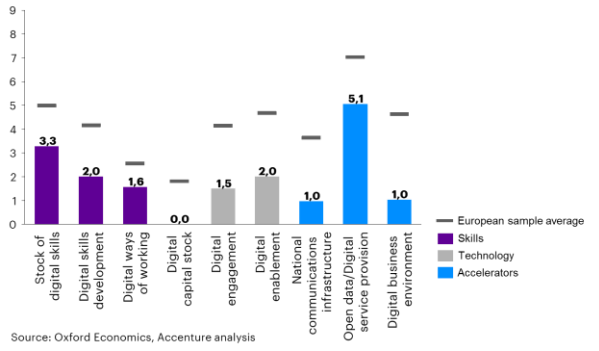


Figure 7: Natural Resources Industry - Digital Economic Opportunity Index Components Breakdown

To further comprehend the key drivers of the Digital Economic Opportunity Index, we then zoom into the nine underlying components to get a more detailed view of the factors that contribute to the very poor performance of the Greek Natural Resources industry (Figure 7). It is apparent that the gap from the European average varies across the Digital Economic Opportunity Index components.

By closely examining the ***digital skills*** lever, the Greek Natural Resources industry appears to be scoring behind its European peers. Although the "stock of digital skills" pillar is below European average, it contributes the most to the overall score. The "digital skills development" component also scores below average and in fact has the biggest gap from European average, signaling that Greek companies need to focus on significantly improving the digital skills of their workforce. The low score in "digital ways of working", reflects a limited expenditure on innovation and internal R&D, and an absence of a knowledge-sharing culture, with a distance of 1 point from average.

The low score with regards to the ***digital technologies*** lever suggests that although Greek Natural Resources companies have made some digital investments, they need to speed up their efforts and invest more effectively in hardware and software to boost their "digital capital stock" component. Moreover, the Greek companies' customer engagement and internal company collaboration methods are not fully utilizing digital capabilities as this is indicated by an almost 3 point gap in the "digital engagement" component. The Greek companies seem to have yet to fully adopt enabling technologies like Internet of Things and big data analytics to unlock digital productivity gains and score 2 points below their European peers in the "digital enablement" component.

Finally, zooming into the ***digital accelerators*** lever, it is evident that Greek Natural Resources companies are lagging their European peers, signifying that the business environment in Greece today is not favoring their digitalization and presents various obstacles along the way. Factors such as the inflexible regulatory framework, that have not yet changed make it increasingly harder for Greek companies to rotate to digital.

1.2 Defining the contribution of digital to the Natural Resources industry's economic output

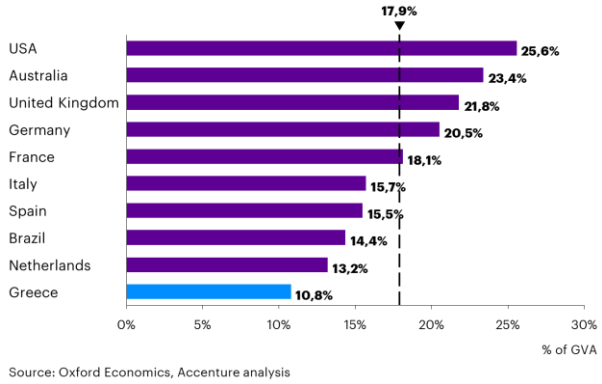


Figure 8: Percentage Contribution of Digital to Natural Resources Industry's GVA

The Greek Natural Resources industry's low digital maturity appears to be further validated by the moderate contribution of digital to the industry's economic value. Our analysis with regards to digital contribution of the Natural Resources industry to the Greek economy, indicates that the overall digital inputs contribute to 10,8 percent of the industry's Gross Value Added (GVA)[3] and are equal to €108 million. The Greek Natural Resources industry's score is 7,1 percentage points below the sample average, positioning the industry at the lower end against the European peers that we examined (Figure 8).

At the other end of the specturm is the US Natural Resources industry, which currently exhibits the highest contribution of digital to its GVA, with a digital output estimated to cover 25,6 percent of

[3] Gross value added (GVA) is a productivity metric that measures the contribution to an economy, producer, sector or region. Gross value added provides a dollar value for the amount of goods and services that have been produced, less the cost of all inputs and raw materials that are directly attributable to that production. The relationship between GVA and GDP is defined as:
GVA + taxes on products - subsidies on products = GDP, or restated as:
GVA = GDP + subsidies - (direct, sales) taxes

the industry's GVA. In Europe, it appears that the UK and Germany are at the top, scoring at a 21,8 percent and 20,5 percent of their digital potential.

2 Natural Resources Industry - Rotation to Digital

There is wide-spread evidence that all industries are impacted by digital. In fact, as per Accenture research, "every business is a digital business". However, as each industry is also unique, its digital rotation puts the emphasis on different parts of the value chain, which we refer to as "digital pivot points".

What are the digital pivot points?

Companies organize their business activities against value chains that typically consists of strategy, production, sales and customer services and operations. There is widespread evidence that all industries are impacted by digital. However, as each industry is also quite unique, its respective digital rotation places emphasis on different areas of the value chain. These areas are referred to as digital pivot points.

This below mentioned value chain (see Figure 9) will be used as our framework to identify the digital "pivot point(s)" of the Greek industries.

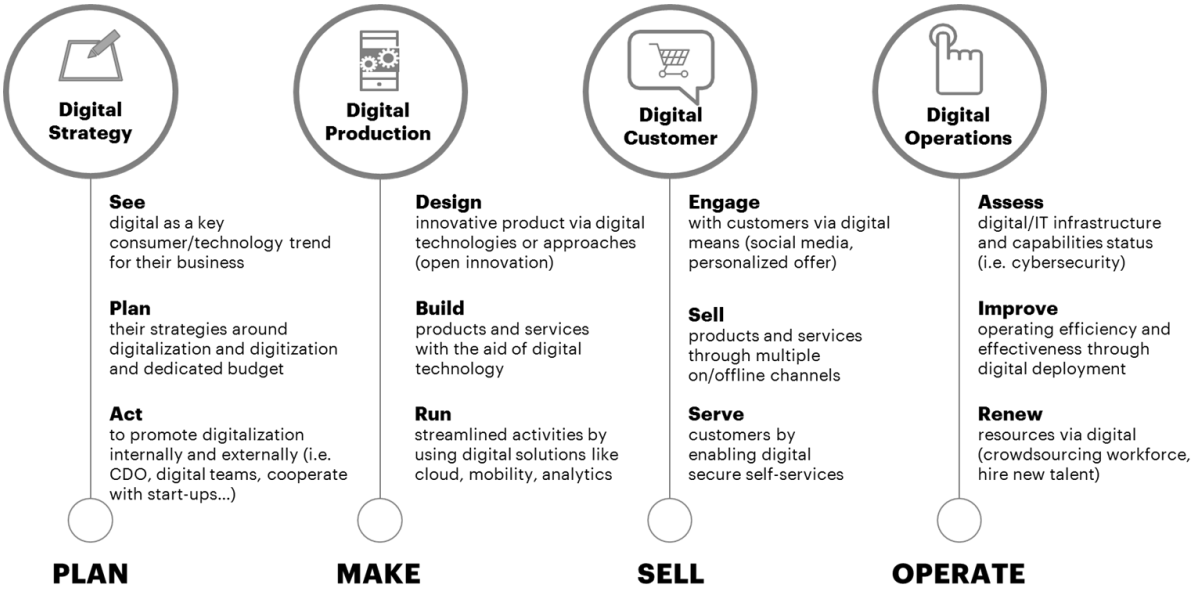


Figure 9: The typical Value Chain

2.1 Industry Clustering

According to our analysis on how digital impacts the Greek industries' value chain, we have placed the Greek Natural Resources industry within the first group of the Greek industries, the "traditional" industries (see Figure 10).

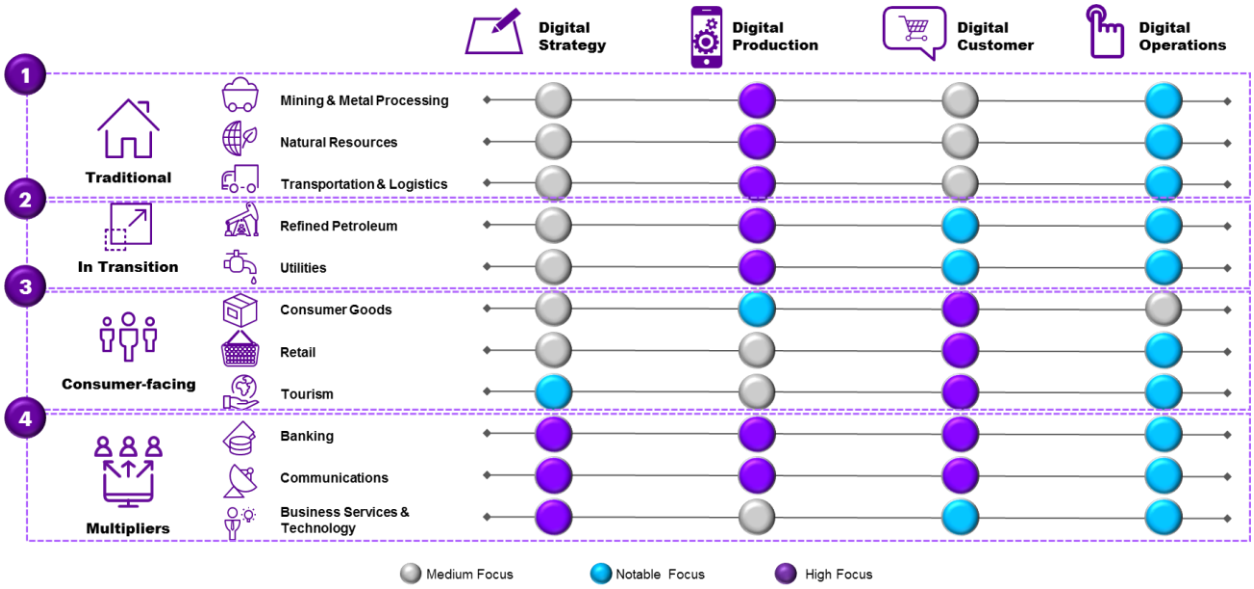


Figure 10: The Clustering of the Greek industries

Enterprises that belong to this group, are typically asset-heavy organizations, require large amounts of capital to establish and operate and their production is dependent on heavy industrial machinery. Their workforce demonstrates a different composition and set of characteristics from that across the other industry groups. Their production and operations are heavily dependent on a large number of field workers. The focus of their digitalization is primarily targeting production and operations. Six digital themes influence the "traditional" industries as presented in the Figure 11 below. The description of the digital themes is presented in Figure 13.

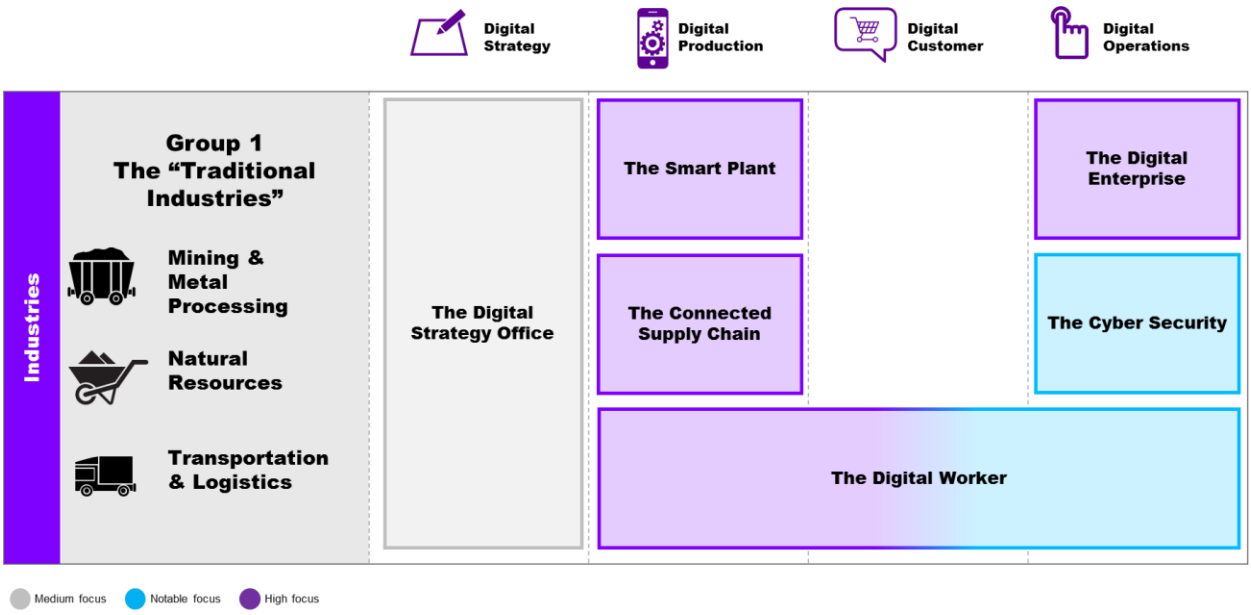


Figure 11: The "Traditional" industries

International best practices suggest that, at the core of their digital rotation, Natural Resources companies have embraced digital to primarily automate their operations, augment their workforce's capabilities and drive better decision-making across their production with the application of next generation technologies. Figure 12 illustrates elements of the above.

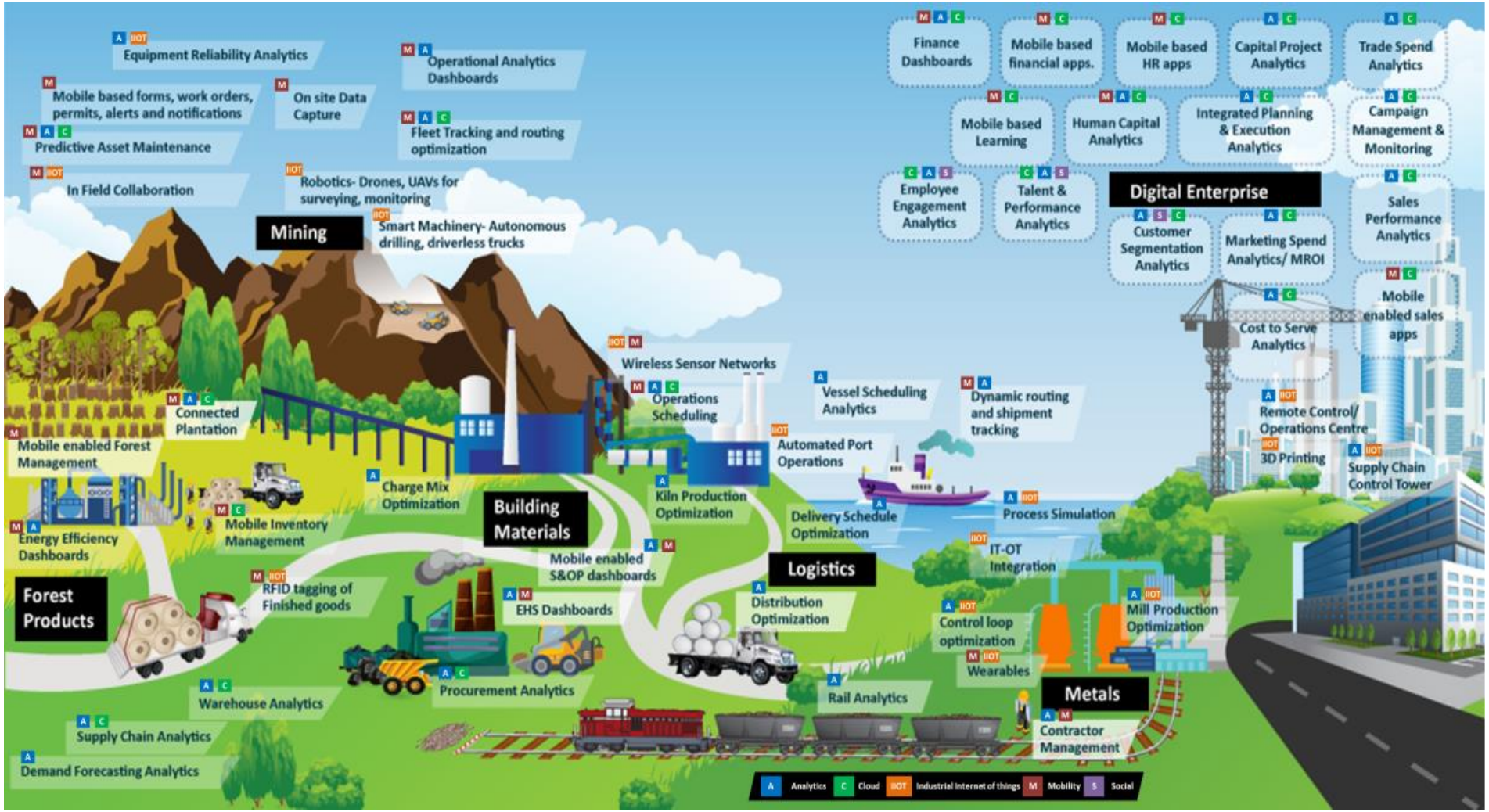


Figure 12: Digital Natural Resources

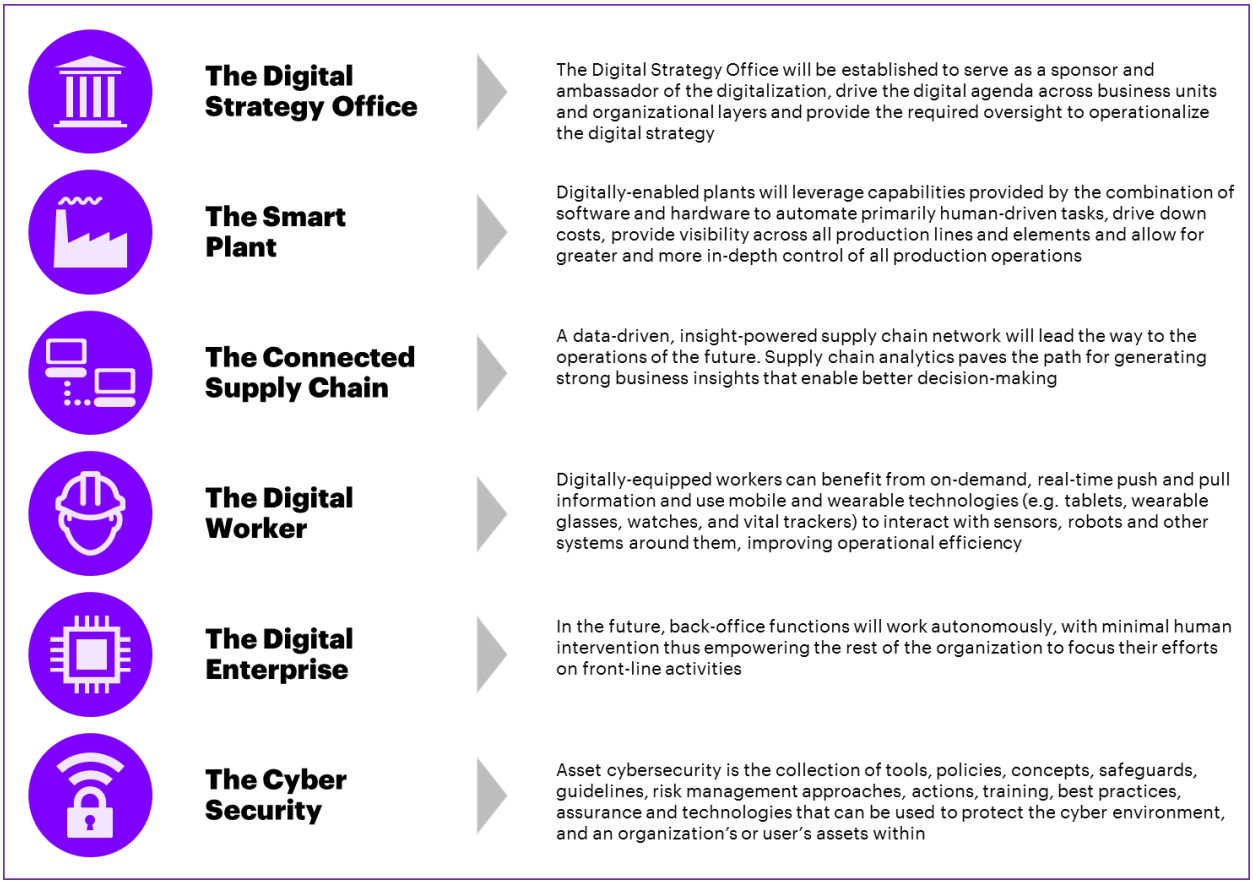


Figure 13: Digital Themes

2.2 Digital Pivot Points

Contextualizing these observations with industry's executives, we have identified the deployment of big data analytics to efficiently integrated their value chains and make sense of their data as the primary area for digital attention. In addition, they aim to improve worker health and safety through the use of digital capabilities. Figure 14 illustrates the emphasis on the different pivot points for the Natural Resources industry.

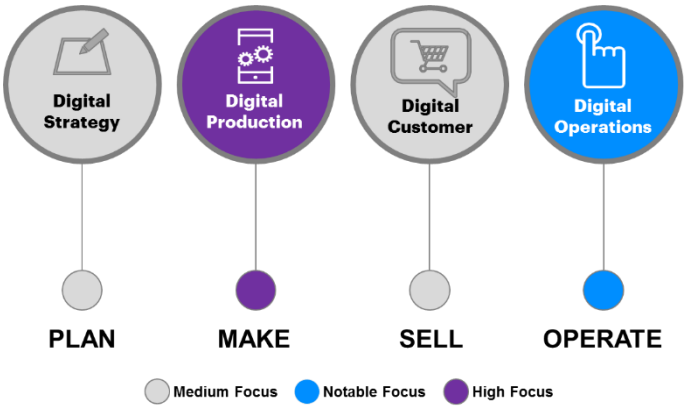


Figure 14: Natural Resources Industry - Digital Pivot Points

2.3 Initiating the digital transformation

With global best practices as our reference point, we propose a set of initiatives that will accelerate the industry's digital rotation. It is evident that not all initiatives may be applicable for all organizations within this industry; indeed, digital initiatives are recommended to be selected in accordance to the different strategy, business model, size, available budget and most importantly, each company's own digital aspirations and vision. The initiatives that follow, are broken down into tactical, which we call "**tactical moves**" and disruptive, which we call "**cut new ground**". In addition, they are linked to the digital themes presented previously that influence the specific group of industries. The classification of the identified initiatives is depicted in Figure 15.

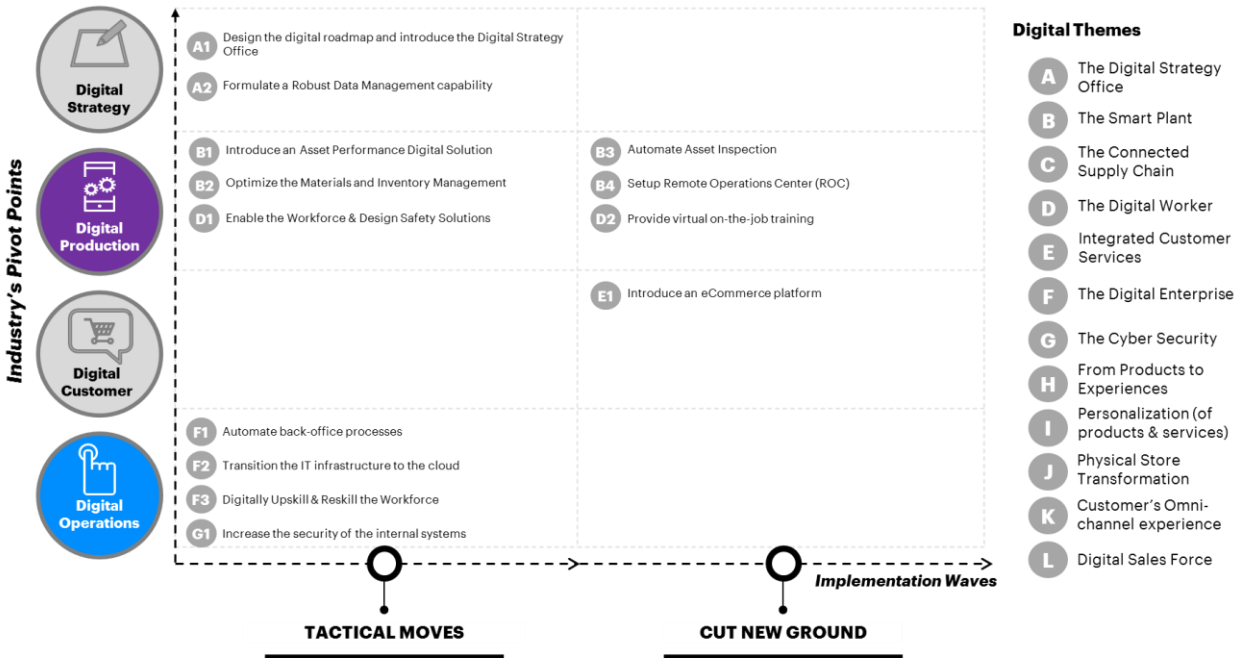


Figure 15: Classification of Suggested Initiatives Across Three Dimensions

A description of the proposed initiatives is presented in the table below:

#	Digital Initiative	Description	Value Chain Area
A1	Design the digital roadmap and introduce the Digital Strategy Office	Design and implement a digital roadmap that will incorporate all digital initiatives to be undertaken by the organization and set up the Digital Strategy Office that will be responsible for the effective operationalization of the digital roadmap	Digital Strategy
A2	Formulate a Robust Data Management capability	Formulate a robust data management capability will involve a set of initiatives around building of an effective data architecture, data quality management, as well as data security	Digital Strategy
B1	Introduce an Asset Performance Digital Solution	Develop an integrated solution for Asset Performance Management which supports organizations to define effective asset strategies and improve them over time. The solution will leverage consolidated asset data and predictive analytics to perform asset strategy & performance tasks, i.e. Equipment Criticality analysis, Maintenance Strategy Development (RCM), Mechanical Integrity / Risk Based Inspection and will provide a common data repository to enhance optimization efforts	Digital Production
B2	Optimize the Materials and Inventory Management	Design a solution to improve spare parts forecasting and inventory deployment to achieve target service levels with lowest inventory investment. Codify spare parts to classify them and aid in leveraging associated inventory optimization	Digital Production
B3	Automate Asset Inspection	Introduce unmanned aerial systems (i.e. drones) to monitor and inspect infrastructure assets with no human intervention	Digital Production
B4	Setup a Remote Operations Center (ROC)	Setup a Remote Operations Center (ROC) that will integrate the supply chain processes and tools across silos. Continuously monitor the execution of operations activities and provide visibility to performance metrics, perform 'what if' analysis, and dynamically respond to changes. The Remote Operations Center (ROC) brings together capabilities such as Events & KPI Management, Analytics and Execution to enhance outcomes such as Operational Excellence and Overall Equipment Effectiveness	Digital Production
D1	Enable the Workforce & Design Safety Solutions	Leverage wearable solutions and analytics solutions to capture, analyze, communicate critical manufacturing information to and from workers, and improve operational performance by supporting fact-based decisions in near real-time. Remotely monitor and manage safety across manufacturing sites	Digital Production
D2	Provide virtual on-the-job training	Implement VR/AR technologies to enhance and modernize the on-the-job training	Digital Production
E1	Introduce an eCommerce platform	Design and introduce an eCommerce platform, where the client can place and manage orders online, has access to real-time, searchable inventories, tracks shipments and manages their financial reports	Digital Customer
F1	Automate back-office processes	Digitalize and automate end-to-end internal processes (i.e. finance, sourcing & procurement)	Digital Operations

#	Digital Initiative	Description	Value Chain Area
		powered by artificial intelligence (robotics) and big data analytics	
F2	Transition the IT infrastructure to the cloud	Move the IT infrastructure to the cloud, in order to simplify the process of integrating supply chain data with multiple standards, formats and communications channels and improve the supply chain efficiency. The cloud will also enable the organization to easily connect with an ecosystem of external partners (i.e. suppliers, etc.) and facilitate transactions such as uploading orders or checking order status, booking or downloading invoices	Digital Operations
F3	Digitally Upskill & Reskill the Workforce	Design training sessions through leveraging digital solutions to effectively build digital workforce talent and skills	Digital Operations
G1	Increase the security of the internal systems	Strengthen internal systems and incorporate increased security measures such as multilayered authentication and internal control processes to strengthen security and comply with increased regulations	Digital Operations

2.4 Global Leading Practices

- **Case Study – CEMEX Decision Support Platform for Managing Manufacturing**

CEMEX first installed the Performance Improvement (PI) System in 1995 and has been evolving the scope, breadth, and application of the PI System ever since. At the 2014 OSIsoft Users Conference in San Francisco, Raul Roel presented CEMEX's latest advancement, the Cement Production Model (CPM) to improve quality, energy utilization, emissions, and reduce failures.

While still in development, the aim is to create a robust, corporate-wide platform for managing all aspects of cement manufacturing. Leveraging state of the art technologies the platform is able to provide real-time decision making within all the hierarchies/levels of the company.

Prior to CPM, plant personnel manually managed a lot of data and there was no standard criteria applied to production or process. The first step in the CPM project was to define a corporate-wide standard for production and process. "We established the common names and common references to define the same meanings for all the information across the plants," says Raul Roel, Processes Center of Excellence Advisor for CEMEX. "This allows us to make comparisons and benchmarks among our plants." This new standard relies heavily on the Asset Framework (AF) functionality of the PI Server to add context and consistency. Users can define easily the production plant parameters like the sequence of operations for the production line and the products produced by the equipment. This information is then sent to the Asset Framework where the AF model and corresponding data feeds are automatically created.

With the beginnings of the CPM solution in place, CEMEX has seen many benefits. CEMEX administrators can now easily manage users, countries, plants, material families, etc. to ensure consistency of all master data and maintain data integrity. The new solution is providing reliable, validated, information for real-time decision making while "standardization enables personnel to work the same way in all company sites so future inventory corrections are avoided," says Roel. This data is being fed to standardized reports and KPIs which provide equipment operation, fuel consumption, KWH consumption, and inventory information to the company. These reports are used by the plants each morning to review daily results and determine action items for the plant. Implementing CPM has also helped CEMEX reduce obsolete and high maintenance tools throughout its operations which is lowering its total cost of ownership.

Source: www.osisoft.com/customer-stories/Cemex-UC2014-customer-story.pdf

- Case Study – LafargeHolcim 3D concrete printing

LafargeHolcim has entered into a partnership with the French start-up XtreeE, which specializes in the development of large-scale 3D printing systems. This alliance has made it possible, for the first time in Europe, to market a concrete structural element created using a 3D printer. Bringing the digital revolution to the construction industry, 3D printing allows complex geometric structures to be created at a reasonable cost and with shorter production times compared to traditional techniques. LafargeHolcim has identified three potential markets: high value-added architecture, the individual construction of affordable homes, and the robotic construction of prefabricated building elements.

In its R&D center in L'Isle d'Abeau near Lyon, LafargeHolcim teams have leveraged their scientific and technological expertise to design a range of experimental concrete mixes suitable for 3D printing.
LafargeHolcim has developed and provided materials designed specifically for the creation of two different 3D printed structures:

- A load-bearing post printed by XtreeE and assembled by Fehr Architectural, with a height of 4 meters (about 13 feet), being used to support the playground roof of a middle school in Aix-en-Provence in France. This is the first 3D printed structural element to be marketed in Europe
- A pavilion created on behalf of the Ile-de-France regional authority using a revolutionary design, the fruit of a collaborative project bringing together XtreeE, Dassault Systèmes, ABB and LafargeHolcim

These advances underscore LafargeHolcim's commitment to delivering innovative solutions that create value for its customers.

Source: http://www.lafargeholcim.com/lafargeholcim-innovates-with-3D-concrete-printing

2.5 Maximizing the Natural Resources industry's economic output (GVA)

Our econometric analysis suggests that by 2021 the initiation of the digital rotation for the Natural Resources industry is expected to result to a moderate increase in the economic output by 1,87 percentage points equals to approximately €20,1 million[4]. The projected GVA uplift is a product of macroeconomic analysis assuming a 10% increase on the industry's digital maturity (Figure 16).

Source: Oxford Economics, Accenture analysis

Figure 16: Natural Resources GVA Uplift as % of the 2021 GVA baseline, (Million Euros, %)

[4] 2021 Gross Value Added is calculated from Eurostat data using Oxford Economics projected growth rates. The spill-over effect to the economic performance of other industries is not included in this figure.