From Voice of Customer Analysis to Digital Strategy Development: the Digital Challenge of a Leading International Player in the Power Generation Industry

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***Abstract* — Today, the vision of the power generation business is increasingly becoming digital. This is demonstrated by the high investment in innovation that involves multinational energy companies, such as Enel and Engie, and consequently their product and service providers: one of these is Ansaldo Energia Group.**
The proposed paper presents the way in which a leading international player in the power generation industry, as Ansaldo Energia, is facing the digital revolution from analyzing the voice of customer to the implementation and deployment of a digital strategy. The main objective is to increase the value and satisfaction of its clients in a highly dynamic market, which is mature and competitive.

***Index Terms* — Ansaldo Energia Group, customer satisfaction, cyber security, digital transformation, innovation, predictive maintenance, smart product and service, smart factory, smart EPC, voice of customer**

I. INTRODUCTION

An article published by the Harvard Business Review [1] says: "*The gulf between satisfied customers and completely satisfied customers can swallow a business*". In the current market, highly developed and competitive, a positive Customer Satisfaction (CS) level can make a difference. This is the reason why monitoring has become a key strategic element of the most advanced and dynamic companies.
Ansaldo Energia (AE) is a leading international player in the power generation industry.
Ansaldo Energia proposes an integrated model embracing turnkey power plants construction (EPC contractor), power equipment (gas and steam turbines, generators and micro-turbines engineering) [2-5], manufacturing and servicing and nuclear activities. AE is a full service provider with a broad portfolio serving heavy-duty gas turbines: it offers turn-key maintenance [6] solutions to power generation plants, built by itself or other OEMs (Original Equipment Manufacturers).

Due to the fast development of renewable sources, power generation is one of the most competitive markets. In this scenario, AE Group's mission is to deliver innovative, proven, state-of-the-art and flexible solutions aimed at international sector leaders.

II. VOICE OF CUSTOMER ANALYSIS

At Ansaldo Energia, the Voice of Customer (VoC) is a continuously monitored process from the bid phase to the end of contractual commitment. This is made possible by several company tools: from the simple internal and external progress meetings to the realization and tracking of specific Key Performance Indicators (KPIs).

The Customer Satisfaction Survey (CSS) process is one of these tools. It is developed to collect customer feedback in a structured manner during specific phases of the customer buying cycle. AE utilizes the VoC to align its products and services to best serve the market.
The CSS process is led by an independent central function fully aligned with the business stakeholders. It is able to cover the entire AE Group process and product lines:

- product and service lifecycle: construction, maintenance, reconditioning, repair, supervision, etc.;
- client lifecycle: all EPC (Engineering, Procurement, Construction) and LTSA (Long Term Service Agreement) contracts;
- multi-product, multi-contract and multi-region clients.

This is made possible by "face to face" interviews at the customers' site (and/or remote interviews depending on availability) with dedicated CSS Managers. There is a pre-defined questionnaire customized to address the satisfaction level at each phase of the buying cycle: this is a unique structure allowing for elaborate trends and historical comparisons between different types of survey.

The CS survey is divided into 9 macro-factors:

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1. *Effectiveness and promptness of response*
   Capability and promptness to provide key information come up during site activities and to answer technical requests, complaints and urgencies.
2. *Management capability*
   Capability and competence of AE personnel over contract management.
3. *Additional services*
   Availability of monitoring systems (diagnostic center/remote control room) and assessment of services provided by specific AE personnel.
4. *Quality of relationship*
   Reliability, expertise and right-sizing of AE personnel and its capability to communicate proper interfaces and organizational changes to the customer.
5. *Innovation*
   Capability of AE to provide innovative product and service solutions, to continuously improve its production processes and to meet the new requirements of market in a digital way.
6. *Quality of output*
   Quality and promptness of products and services supplied in all aspects: documentation, equipment and parts, and site activities.
7. *Health, Safety and Environment*
   Actions undertaken by AE as regards to Health, Safety and Environment, reliability and expertise of EHS staff at site and its capability to identify and manage EHS risks.
8. *Competitiveness*
   Assessment of products and services competitiveness about quality and reliability.
9. *Flexibility*
   Flexibility of contract management depending on client needs.

The CSS questionnaires ask the client to express its level of satisfaction by giving each question a value from 1 to 10 (where 1 indicates the minimum satisfaction and 10 the maximum). An importance value is also asked for the macro-factor from 1 to 9 (where 1 indicates the minimum importance and 9 the maximum).
Therefore, each macro-factor is associated with:

- a level of satisfaction: average of all the rates assigned to each question in the macro-factor;
- a level of importance: position assigned by the customer to the macro-factor.

The AE CSS process could be considered a "GLocal process": a Global approach with special attention to Local needs. This means not only internal process improvement and product enhancement, but also the arrangement of local actions and follow up for specific contracts or customers. The operational stakeholders involved are as follows: Project Management, Engineering, EHS (Environment, Health and Safety), R&D (Research & Development), Supply Chain, Factory, Field Service and so on.

III. CUSTOMER INVESTMENT IN DIGITAL TRANSFORMATION

In the power generation market, the VoC analysis shows an increasing need for investment in innovation and Digital Transformation (DT), both for EPC contracts and for Long Term Service Agreements (LTSAs).

This trend may also be seen by the growing rank position of *innovation*: from 2016 to 2017, the average importance of this macro factor (assigned by AE customers) has increased from 1.78 to 3.55 [14], as shown in the histogram below.

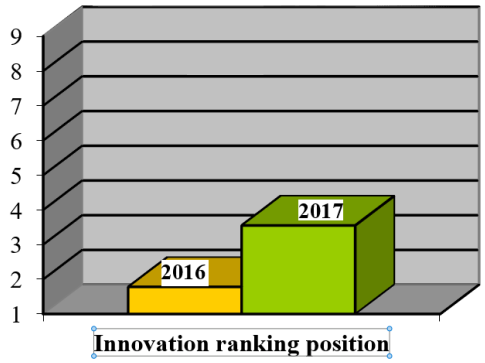

Fig. 1. Average values of importance level assigned to Innovation CSS macro factor by AE customers in 2016 and 2017 [14]

A high investment in digitalization is particularly noticeable with customers considered as AE key clients.
For a leading international company in the power generation industry, the key client is a multi-regional based customer, which may also operate with multi-technology platforms. In particular clients with global power utilities are defined "key".
Two of Ansaldo Energia's key clients are Enel and Engie.
The following paragraphs give a general overview of these international power generation leaders and their digital strategy.

A. *Enel Group*

Enel Group is a multinational energy company and one of the world's leading integrated electricity and gas operators. It has a particular focus on Europe and Latin America.
Enel Group works in more than 30 countries across 5 continents, and distributes electricity and gas across a network spanning about 2.1 million kilometers. With around 64 million end users from around the globe, Enel has the largest customer base among European competitors and may be seen as leading power companies in terms of installed base capacity [3].

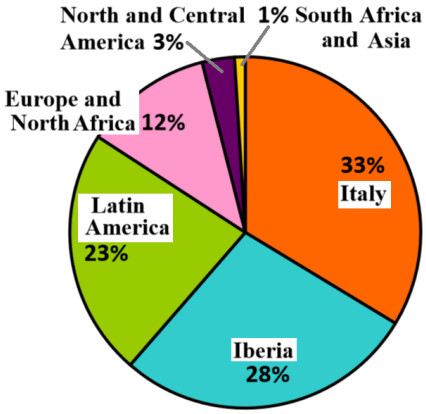

Fig 2. Breakdown of Enel electrical capacity by Region considering a total of 83 GW installed (2016)

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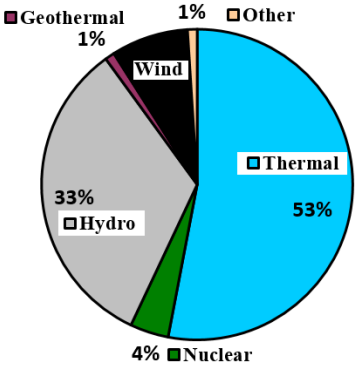

Fig 3. Breakdown of Enel electrical capacity by Source considering a total of 83 GW installed (2016)

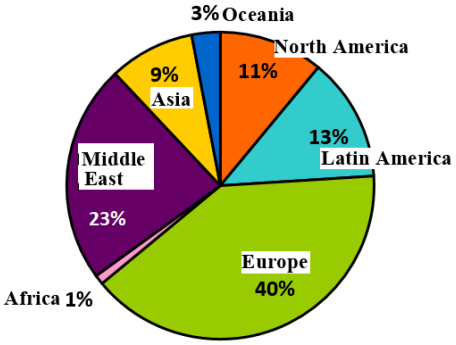

Fig 4. Breakdown of Engie electrical capacity by Region considering a total of 117 GW installed (2016)

Today, Enel is investing €5.3 billion in digitalization CapEx, from 2018 to 2020 [5], to drive efficiency and best-in-class service.
In the shareholder plan 2016 [6], Enel planned 11 GW (30% of whole thermal fleet at 2019) to be digitalized with digital pilots on 5 key areas still running:

1. *Safety*
2. *Security*
3. *Logistics*
4. *Environment*
5. *Operation & Maintenance* (O&M)

This should become possible covering many 4.0 applications, such as [7]:

- communication and data management infrastructure;
- smart sensors;
- material/trucks tracking and management;
- advanced process control;
- wearable, people localization and technologies for safety;
- analytics for predictive diagnostic;
- robots and virtual reality for O&M and training.

B. Engie

Engie, formerly GDF Suez, is a global energy player and an expert operator in the sectors of electricity, natural gas and energy services. The company purchases, produces and markets electricity and natural gas. It transports, stores, distributes, manages and develops major gas infrastructures and offers energy services.
Engie is committed to responsible growth of its businesses in response to the central challenges of the energy transition towards a low-carbon economy. It is providing access to sustainably generated energy and combating climate change by reducing its carbon footprint and making responsible use of natural resources. The Group is developing high-performance, innovative solutions for personal customers, urban authorities and companies by applying its expertise in four key sectors: renewables, energy efficiency, liquefied natural gas and digital technologies [8].

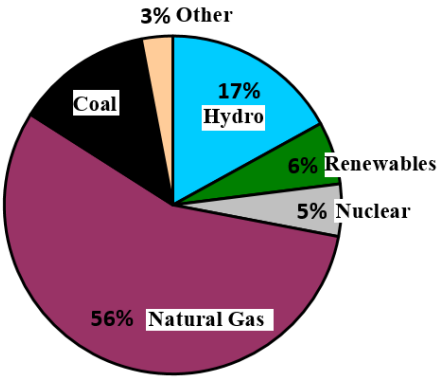

Fig 5. Breakdown of Engie electrical capacity by Source considering a total of 117 GW installed (2016)

Today, Engie has a global and diversified footprint where energy and digital technology are intertwined.
In the shareholder plan 2016 [10], Engie launched a 3-year strategic change investing €1.5 billion to put digital technology at the heart of everything the Group does.
The starting points are 4 dimensions of digital operation [11]:

1. *Augmented Operator*
   Using digital and technology to maximize safety, improve the decision making and performance of field operators and supervisors.
2. *Augmented Assets*
   Using digital and technology to improve asset efficiency reduce OpEx and defer CapEx in order to optimize the asset's position in the merit order.
3. *Global Intelligence*
   Using digital technology for:
   - Semi-autonomous optimization of the overall operation though situational awareness and cognitive systems;
   - Driving Engie strategic transformation through insight & simulations.
4. *Shaping the future ecosystem*
   Sharing digital mindset, inventing digital enablers, establishing new digital standards. Engie will be the "agile digital disruptor" of the worldwide energy market.

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The investment numbers show digital transformation as one of the most significant changes utilities industry must face today. This transformation impacts, not only how the companies operate internally or create value and efficiency, but also the way they interact with their clients.
In order to prepare themselves for this landslide transformation, electricity companies must adapt their practices to facilitate the change [12]. This also impacts product and service providers such as Ansaldo Energia.

IV. DIGITAL TRANSFORMATION VALUE PROPOSITION

What is the value proposition of Ansaldo Energia Group [14]?

In its strategic plan 2016, from 2017 to 2019, Ansaldo Energia issued key goals maximizing the exploitation of digital transformation to support the bottom line (increase of competitiveness) as well as top line (enlargement of offer portfolio).
The AE 4.0 strategy is based on 3 smart processes involving all the business lines from new units to maintenance activities:

1. *Smart Product & Service*
   - Product development for existing and new products: network of R&D centers (in Europe, USA and China), Product Lifetime Management (PLM), integrated 3D modelling from R&D to Service;
   - Service: Remote Diagnostic & Monitoring (RD&M), Predictive Maintenance, integrated Service Hubs all over the world.
2. *Smart Factory*
   Digital technology infrastructure of production processes in all the production and repair centers.
3. *Smart EPC*
   Integrated processes in all the phases, covering more than 13.000 components, from design to commissioning.

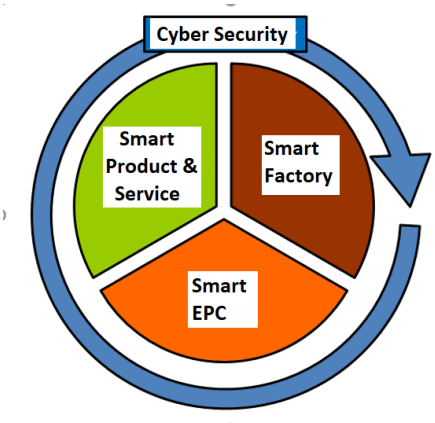

Fig 6. Smart processes for Ansaldo Energia Group digital strategy

In the IoT (Internet of Thing) scope, Cyber Security is a key factor for success. It has to cover and control horizontally (as illustrated in Figure 6) all the smart processes.

AE must be able to implement an integrated and resilient approach to protect its data and digitize customers' critical infrastructures.

The following paragraphs show the key 4.0 application areas to develop the 3 smart processes.

A. *Smart Product & Service development*

The key idea to develop a Smart Product & Service is the transition from the concept of *preventive* to the concept of *predictive maintenance*.

After years of relying on preventive maintenance, the power generation industry is moving into a new phase of maintenance strategy. The powerful predictive maintenance technologies and services are changing the face and the future of the industry. Technology is leading the charge from remote monitoring and diagnostics tools to big data analysis and management.
In the past, the industry focused on preventive maintenance programs, relying on historical performance data to develop set maintenance and specific outage service schedules. The predictive maintenance is based on the current equipment conditions rather than time or age factors. The ability to foresee issues is at the very heart of predictive maintenance. It can achieved through a constant monitoring of the power plant operating parameters, analyzing the data until an optimal planned maintenance outage can be conceived.
This gives to the power producers' real-time transient information and data-driven insights into the risks to be able to bester make decisions to achieve optimal performance. It forecasts when to schedule the next outage and what needs to be done.
Such solutions allow power plant owners to get the most out of their assets by delivering operational visibility into the past, transparency into the present and more clarity about the future. Surprises are expensive and the predictive maintenance is a way to avoid unwanted risks.

For product and service providers, as Ansaldo Energia, the change in philosophy represents a paradigm shift in the way energy industry manages its assets. The value of analytic data must be strengthened through on-site knowledge and experience.
The goal is to combine available data with today's inspection technologies providing a complete predictive maintenance picture. Technology and data help plants run as economically as possible and know when to have an outage.
Looking at specific site performance and customer needs is vital to prepare for the most productive and time-sensitive planned outages. It improves customer value and satisfaction.

How is the way to make all this possible *today*?
The answer is starting from predictive diagnostic tools, through a "corrective maintenance":

1. *Remote Monitoring*
2. *Data Analysis and Diagnostic*
3. *Smart Alerts*
4. *Customized Maintenance*

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All this will lead, *tomorrow*, to a "condition based maintenance" (predictive) in which the key 4.0 applications areas will be :

1. *Neural networks machine learning*
2. *Advanced sensors*
3. *Internet of things and Cyber security*
4. *Plant digital twin*
5. *3D Robotics*
6. *Additive manufacturing*
7. *Augmented reality*
8. *Smart tracking*
9. *Smart safety*

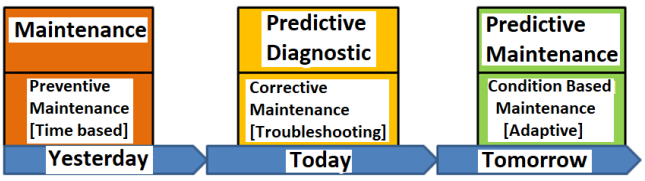

Fig 7. Smart Product & Service apps roadmap

Ansaldo Energia aims to apply such approach to proprietary and not proprietary technologies.

B. *Smart Factory*

The key 4.0 application areas to develop a Smart Factory are:

1. *Big Data*
   Collection and management of quality data from the internal shop floor and, if possible, external manufacturing processes.
2. *Smart Tracking*
   - Logistic traceability of boxes and components from the acceptance to the shipping phase;
   - Technical traceability of equipment through barcode to check, in the processing, the completeness of certifications and testing;
   - Foreign object detection.
3. *Smart Safety*
   - Man-down application;
   - Tracking and monitoring of high-risk areas;
   - Proper use of safety equipment.
4. *Augmented Reality*
   Use of 3D model to product support applications and solutions [7-12]:for
   - Simulation processes of complex mechanical manufactures;
   - Support processes in assembly areas for materials identification and assembly sequences;
   - Training of manufacturing personnel by using virtual rooms.
5. *Additive Manufacturing*
   Development and use of technologies, systems and processes of additive manufacturing for the repair of components.
6. *Predictive Maintenance*
   Study and implementation of models for predictive maintenance of numerical control machinery applying a retro-sitting approach.

C. *Smart EPC development*

The key 4.0 application areas to develop a Smart EPC are:

1. *Big data*
   Collection and management of design data from external suppliers and, if possible, operating data of BOP (Balance of Plant) components.
2. *Smart Tracking*
   - Logistic traceability of boxes and packing lists (PL) from the shipping phase to the incoming activity at site;
   - Technical traceability of main components through barcode to check, during the start-up phase, the completeness of certifications and testing;
3. *Smart Safety*
   - Man-down application;
   - Tracking and monitoring of high-risk areas;
   - Personnel geolocation.
4. *Augmented Reality*
   Use of 3D model to product support applications and solutions for:
   - Support processes at site for materials identification and assembly sequences;
   - Training of manufacturing personnel by using virtual rooms;
   - EComissioning;
5. *Cyber Security*
   Definition of a safe automation system and its management over time.

The 4.0 application areas mentioned above are necessary to implement and to develop the 3 smart processes covering all AE businesses. They represent the digital transformation that is involving Ansaldo Energia Group: from the on-site repairs, inspection fact finding, maintenance operations and design & historical data to the investment in big data analysis and smart tools.
This is an important shift in philosophy that allows to AE Group to be best aligned with the current dynamic market, facing complex challenges with its high-level competitors and aiming to increase the satisfaction of its customers.

V. CONCLUSIONS

Value creation, with flexibility and technology, and "operational" efficiency, with swiftness and competitiveness, are and will be the results of massive investments in innovation and digital transformation by the power generation industry. This is valid both for electricity companies and for their product & service providers.
In this scenario, the CSS process is the foundations for developing the Digital Transformation. This should be made possible by the collaboration with key customers in order to satisfy shared needs and objectives in a synergic manner. The continuous "closed loop" allows further improvement in AE efficiency, competitiveness, and consequently Customer Satisfaction.

In conclusion, the aim of Ansaldo Energia Group is to achieve sustainable growth by providing a flexible and innovative portfolio of solutions that match global energy demand. This

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is made possible through digital transformation and co-development processes with customers.
The strategy positions AE as a high-level competitor in the energy market.

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