

Wednesday November 29, 2017 IR Technology Seminar Presentation Outline

Note: This is an English Translation from the original summary in Japanese.

■ P2 "Providing Value"

- Our company's Technology Sector has various initiatives for the "Housing," "Automotive," and "Energy" business fields. Today, we will explain our major activities in the areas of "IoT/Robotics" and "Energy."

■ P3 "Creating 'A Better Life, A Better World' with the Technology 10-Year Vision"

- We created the "Technology 10-Year Vision" around 2000 and revised it 2 years ago. This vision was created in consideration of the necessity of advancing ongoing technology development while thinking about how the world will have changed in 10 years' time.
- Over the next 10 years, our company will focus on "IoT/Robotics" and "Energy." In this regard, we have seven leading themes based on which we are advancing projects, intensifying technology development, and promoting human resource development.

■ P4 "IoT/Robotics"

- For this area, our company must go beyond merely developing IoT/AI products. We must quickly change the company's business process as a whole to meet the needs of the IoT age.

■ P5 "Society 5.0: Super Smart Society"

- Our company developed substantially and achieved solid results in Society 3.0, in other words, the industrial society. Today, the world is shifting from Society 4.0 to 5.0 and our toughest competitors are mostly Society 5.0 companies. In this context, learning to do business in Society 5.0 is a matter of the highest urgency for our company.

■ P7 "Direct communication with customers"

- Technology development has also shifted its focus from mass-production/selling to design thinking. This makes it possible to create what customers want in a timely manner by actively communicating with them in the prototyping/commercialization stage. We consider this process to be essential in order to keep pace in this IoT age.

■ P8 "Restructuring Corporate R&D to promote innovation on April, 2017"

- To promote these things, the Head Quarter Technology Sector was reorganized into the Innovation Promotion Section in April 2017 as an organization in charge of business process alteration as a whole in response to technological changes. Further, the Business Innovation Division, which was established simultaneously, disseminates new business methods from the Head Quarter in cooperation with existing organizations.

■ P10 "Business Digitalization*1"

- Today, we will explain three things. First, "Construction of Digital Native*2 Business." Second, "Establishment of Panasonic β ," which will be explained for the first time. Third, "Optimization in Innovation Promotion Division."

*1 The term business digitalization describes digitalization of every corner of a value chain, including products, services, the planning/development/manufacturing process, sales/distribution/marketing operations, and even consumer experiences.

*2 The term digital native describes the generation of people who were raised with the Internet and personal computers around them or it is used to describe how that generation thinks.

■ P11 "Construction of Digital Native Business"

- HomeX is an initiative to go beyond simply changing existing business models and construct digital native business from a clean slate without being controlled by conventional thinking.
- Even in Japan only, it is estimated that there are over 50 million Daily Active Users (DAU: People who use our company's products, such as home appliances and housing-related products, every day in some form). But, this fact has not led to creation of new business models and customer values. The Platform Company will be in charge of creating a platform to enable this.
- In the Digital Ecosystem, instead of companies scrambling for shares, which is typical of manufacturers, each company achieves its own growth by taking advantage of the growth of other companies. Instead of competing against others, digital companies come together and progress together.
- "Software Designed Hardware" is a business model in which our company will continue to be a hardware company, but we will promote the hardware business making use of software. Compared to the hardware cycle, this expedites offering of customer values and enables us to keep connected with customers after selling a product.
- In the HomeX project, software developers work with people whom they have never met (freelance workers, etc.) over the Internet. The days when a company has to have excellent in-house software developers to do business are gone.

■ P12 "Software Driven Type Living Space Hardware"

- Let's first look at the right side. There is a concern that the growth of HomeX might negatively affect sales performance of the existing housing, housing equipment, and home appliance businesses. However, we believe it is possible to restore growth of the existing businesses by once again putting together housing, housing equipment, and home appliances, shifting from our traditional approach, and launching new things into the market.
- Please look at the left side. The aim of HomeX is to have an impact on the outside by creating a platform for housing, housing equipment, and home appliances and thereby making digital connection with customers. A feature of the digital native business model is that it does not only emphasize defense but promotes going on the offense.

■ P13 "Panasonic β"

- To accelerate these initiatives, Panasonic β was established by making Silicon Valley its base. This is the mother factory to realize cross-value innovation from the Horizontal Panasonic approach and it promotes mass production of innovation.
- This factory provides a digital native company's characteristics, in terms of whole new workstyle, conception, process, system, and space, and beyond the borders of the existing business departments and functions, operates HomeX and other projects within "Panasonic β," which is viewed as one digital company.

■ P14 "Panasonic β Involves the whole company"

- Primarily, young generations in various functions from Companies and the Head Quarter gather under one organization called "Panasonic β" and operate in a swift manner.
- The "β" of "Panasonic β" indicates an antithesis to the perfection-focused culture. It is an organization that conducts many trials of incomplete items by eliminating excess quality/inter-departmental adjustments.

■ P15 "Restructuring Business Process by Innovation Promotion Division"

- While the Business Innovation Division, as the administrative organization, prepared the structure, most activities are conducted by Panasonic Group employees outside the Business Innovation Division.
- The next challenge is to bring concrete products/merchandise of appropriate quality to market and speed up this commercialization process. The commercialization process is addressed as an activity of the entire Innovation Promotion Division, including the Manufacturing Technology and Engineering Division and Advanced Research Division.

■ P16 "Panasonic β that leads next 100 years"

- Taken together, "Panasonic β" will promote construction of digital native business. Practically, while constructing digital native business, we will also consider how the mainstream business should be changed. These two activities will be promoted simultaneously.

■ P18 "Show Faster"

- By utilizing various manufacturing technologies accumulated over the years for prototype creation, swiftly create a tangible form embodying the designer's concept and deliver it to the customer - this is what we want to do by rapid prototyping to swiftly embody ideas.

■ P19 "Manufacturing that realizes rapid prototyping"

- The "Measuring" process in which a design is speedily modeled through CAD data linkage and converted into digital data. The "Printing" process in which a prototype is built based on digital data in a short time with the use of an additive manufacturing process, such as 3D printing. The "Decorating" process in which decorative printing is applied to the prototype so that the customer may realistically experience the quality, color, texture, etc. of the

product to be custom-designed.

- By combining and speedily operating these 3 processes, it is possible to create data, make a tangible form, and add the finishing touches in a short time to build a high-quality prototype.

■ P20 "Connect to the Business Faster"

- For agile development, what's important is to create 100 or even 1,000 units, promptly deliver them to the customer, have the customer experience values, and receive feedback. In this process, mold creation is a bottleneck to L/T reduction.
- With the use of metal 3D printer technology, our company can reduce L/T for mold creation down to 1 week from the normal 1 month and make a metal mold enabling creation of 100 or 1,000 prototype units. In this way, we can have the customer promptly experience the designer's ideas and customer values.

■ P21 "Digitalization of Mass Production"

- Mass production is one of our company's specialties. Through digitalization, we can optimize production in response to the customer's various orders and changing demand. Even for mass-produced products, we can utilize digitalization to reduce L/T.

■ P23 "Rechargeable battery is key device to reduce fossil fuel"

- Looking toward to 2050, our company aims to contribute to creation of a society that is not dependent on fossil fuels.
- The most familiar fossil fuel is gasoline for cars. To facilitate electrification of cars, we focus on the further development of rechargeable batteries. Now, we will explain our cutting-edge technology and upfront manufacturing of rechargeable batteries.

■ P26 "Importance of Materials for Battery Performance"

- In R&D of next-generation batteries, such as all solid state battery and new principle battery, development of new materials is vital. To this end, it is important to understand lithium-ion behavior in a battery in use through an atomic/molecular-level analysis.

■ P27 "Shortening of New Material Development"

- In developing new materials, taking too much time on the trial and error process which emphasizes experience has been the problem. Our company promotes "Materials Informatics," which is a new material searching means using AI and data science.
- Our company is working to eventually cut the new material development time in half by taking advantage of in-house battery-expert material researchers and information technologists who can utilize AI and making predictions about materials synthesis and such.

■ P28 "Data-driven Material Search"

- What's crucial in "Materials Informatics" is volume/quality of data essential for AI. In collaboration with external institutes, our company is constructing a massive database of data reported in literatures and material data. At the same time, we make maximum use of

data accumulated through over 50 years of our company's battery research. Thus, we promote development of new materials and next-generation batteries.

■ **P29 "Elaborate Analysis and Evaluation"**

- To develop new materials, it is extremely important to understand the behavior of materials at the atomic/molecular level and lithium-ion movement in a battery in use.
- By the combined use of an electron microscope capable of material observation at the atomic level and a unique method of analysis, our company has successfully visualized lithium-ion behavior in an all solid state battery in use for the first time in the world.
- Thus, by using the world's most advanced analysis technology and the "Materials Informatics" technology, we will lead the development of next-generation rechargeable batteries.

■ **P30 "Quick Launch Products into Markets"**

- In R&D of next-generation rechargeable batteries, in addition to developing new materials, it is extremely important to pursue new manufacturing and customer values for batteries. By promoting rapid prototyping in collaboration with the Manufacturing Technology and Engineering Division, we will lead the industry through the development of next-generation rechargeable batteries.

■ **P32 "Pursuit of Security & Safety in Manufacturing"**

- Quality is vital for a battery. Not only in the upfront development stage but also in the mass-production stage, we actively monitor in-process physical properties and processing state, which could not be seen before, in real time.
- In addition to material processing, also for coating, drying, joining, and cutting, we work to develop equipment and lines with the aim of assuring 100% quality without generating any defects in mass-production. In this connection, we make facilities capable of sensing physical properties and characteristics.

■ **P33 "Evolution of Traceability by Visualization of Factory"**

- We are working to ensure quality traceability through visualization of all in-factory information.
- On-site information is digitized; data is rapidly processed/accumulated so that it can be handled in a database; necessary information is taken out; and process quality is visualized/analyzed in real time. We are aiming to shift from simply "controlling quality" to "ensuring zero defects," specifically, conducting process management capable of preventing defects from being generated through management of signs using AI and acquisition of data used for maintenance.