Rosefinch Industry Research Series:

Start with Technological Innovation, and Blossom with Price-Performance Ratio

Every year, Rosefinch holds strategic reviews on the main industries that we research on. Please find below some thoughts on Advanced Manufacturing industry shared by our Co-CIO and Head of Management Account Investment Department, Mr Zhen Huang:

- There is no good or bad industry, because each industry has its own unique position in its stages of development. Technological innovation is only a starting point of the investment cycle, and what we really seek is the tipping point in its Price-Performance Ratio.
- Looking at the global power generation, photovoltaic power generation accounts for less than 5% of total, therefore the whole industry still has great growth potential.
- Leading companies in all links of the photovoltaic industry chain are expanding their production based on their advantages in technology, cost, capital and distribution channels. This forms a positive feedback loop with the clear Matthew effect, where success begets more success.
- Electrification is only the starting chapter to the transformation of the automobile industry, and the real revolutionary change comes with the emergence of the intelligent car.
- As automobiles become more and more intelligent, they need more and more powerful sensory, decision and execution systems. The overall improvement of automobile's intelligence will increase the value of automobile semiconductors.
- The global commercial aerospace market will enter the second golden development cycle after Apollo landed on the moon in 1970s. The main driving force comes from technological innovation and the improvement in Price-Performance Ratio. In the short term, we will focus on the aerospace manufacturing industry, while in the medium to long term, we will focus on the operational aspects.

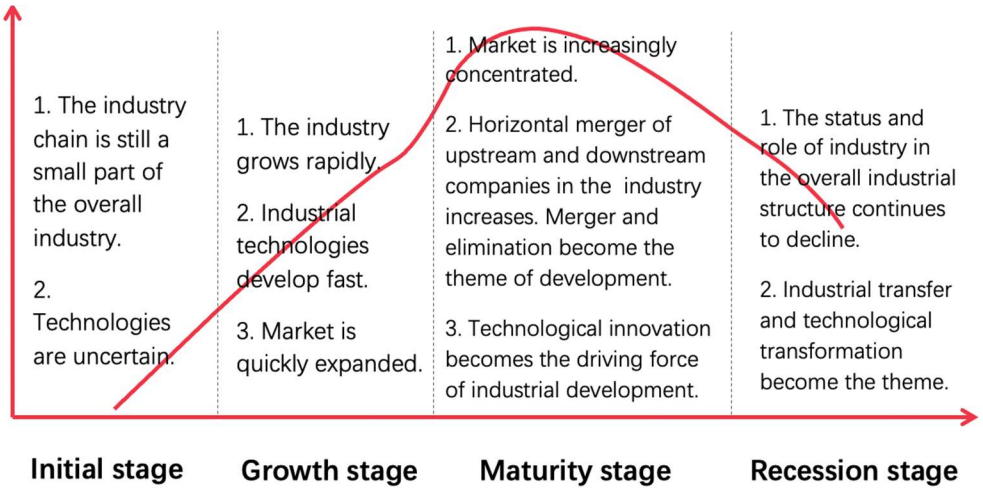
Please find below the transcript of the speech:

Good afternoon, ladies and gentlemen! I'm very glad to share with you my thoughts on investment opportunities in the advanced manufacturing sector. My sharing today mainly includes four parts. When we go on investor roadshows, we are often asked about how Rosefinch discovered so many good industries and companies. So I will share with you our research framework in part 1, followed by 3 key industries with investment opportunities: solar energy and energy storage, automobile intelligence and commercial aerospace.

Part I: How Does Rosefinch Find an Attractive Industry

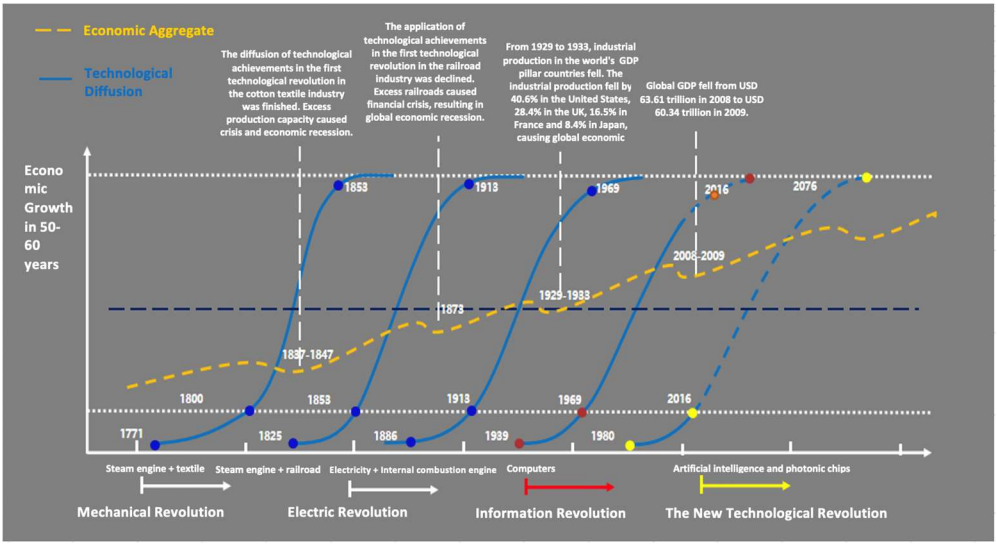
In Rosefinch, there is no good or bad industry. Each industry has its own position in the four stages of development: initial stage, growth stage, mature stage and recession stage. Each stage has different characteristics and drivers. From investment perspective, we focus on the first three stages and look at the improvement of penetration rate of the industry in the initial stage of development; the potential winners of the industry's evolving competitive landscape in the growth stage; and the companies that generate stable cash flow in the mature stage.

Division and Characteristics of Industrial Stages



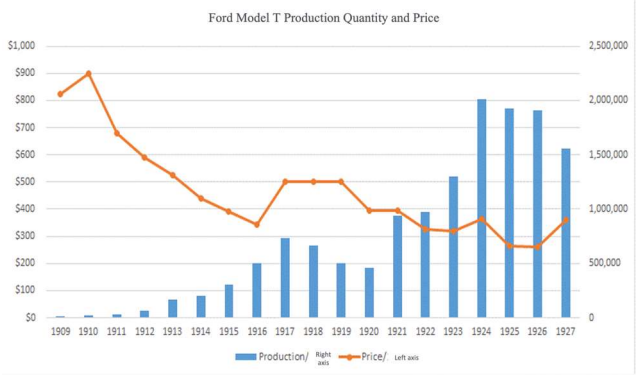
Source: Rosefinch

Historically, every round of technological innovation brought new growth opportunities. For example, in the original industrial revolution, the main transportation mode was transformed from horse cart to railway; the technology of electricity and internal combustion engine brought about the development of fuel vehicle industry; the development of information technology in 1990s brought about the rise of Internet industry; and in recent years, we see the impact of artificial intelligence around us. We divide the investment opportunities brought by technological innovation into two categories: one is "from 0 to 1", and the other is "from 1 to 10." The former is a niche market, while the latter has huge market capacity. Not every technological innovation will grow into the "from 1 to 10" category. For us, we want to find the "from 1 to 10" opportunities, because long-term large-cap companies are more likely to emerge in this category.



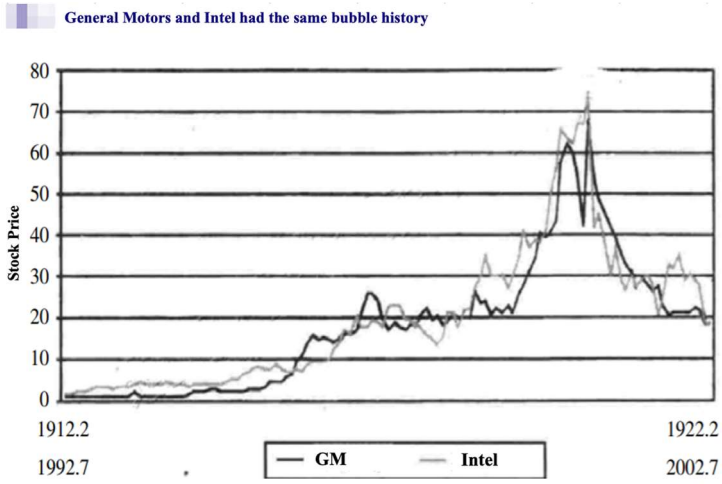
Source: KCTII-GBA

How do we look for opportunities in "from 1 to 10?" Take automobiles as an example, Tesla's Model 3 is the world's first electric vehicle that became best-seller, whereas the world's first best-selling fuel vehicle is Ford's Model T. Before Ford launched its Model T, the global automobile industry mainly operated in small workshops, which led to low production efficiency and no scale effect, which led to the initial high price of automobiles. At that time, automobiles were "toys for the rich" in the United States. Ford was the first to introduce assembly line production which greatly improved the production efficiency and reduced the automobile assembly time from more than 700 man-hours to a mere1.5 man-hours. After this improvement in production efficiency, the annual production capacity of automobiles increased from 10,000 vehicles to over 2 million vehicles. One benefit of scale effect is the significant reduction of cost. The sticker price of automobiles dropped from USD 4,700 to USD 260, falling by more than 90%, and Ford finally enjoyed the rapid increase of automobile penetration rate in the US market and the growth of its market share (from 9.4% to 48% in 6 years.) Therefore, the automobile market's prosperous development was brought by the significant improvement of its price-performance ratio.



Source: Wiki, Rosefinch

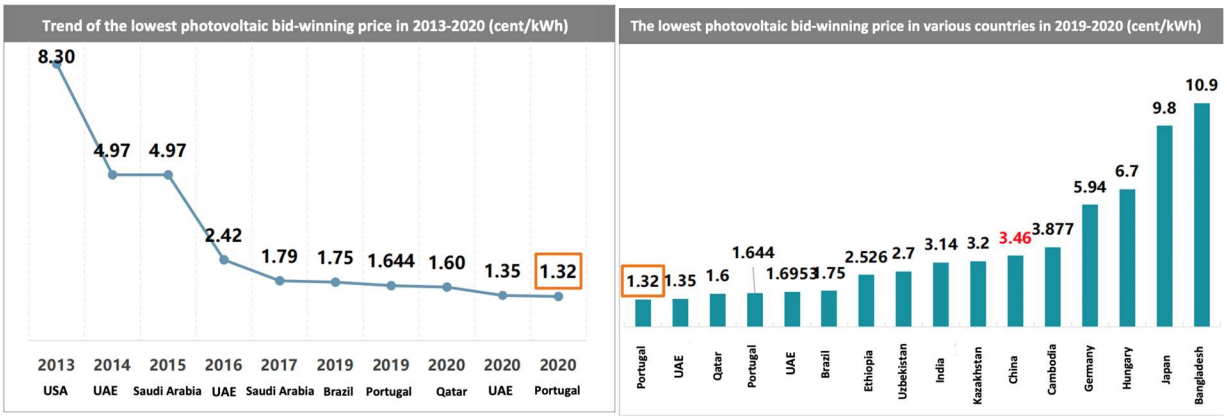
Therefore, when Rosefinch chooses the industry, technological innovation is only a starting point, and what we really want is the tipping point of its Price-Performance Ratio. The chart below is a ten-year stock price trend chart of General Motors and Intel over different periods. When the penetration rate of the whole industry began to increase and the values of companies began to be realized, they both created returns of nearly 100 times for investors in the stage of rapid growth of industries and companies even though they were in different industries. This example gives support to the idea of: there is no good or bad industry, and the key depends on where is the industry in its development cycle.



Source: *The Next Great Bubble Boom* by Harry S. Dent, sorted by Rosefinch

Part II: Solar Energy + Energy Storage: Cost Performance Drives "Clean Energy"

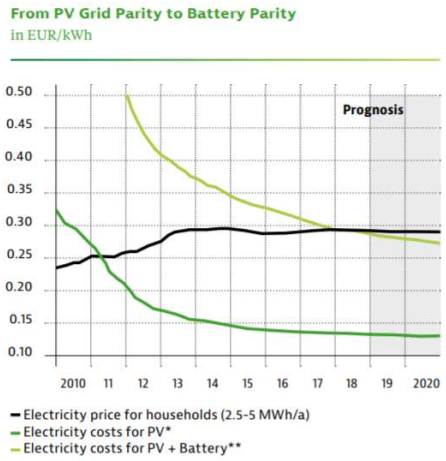
In August 2020, the lowest photovoltaic bid-winning price in Portugal was less than equivalent of RMB 10 cents/kWh. In 2020, the photovoltaic bid-winning price in Qinghai of China was already lower than local generation price of thermal power, thus realizing grid parity. In US, even after Trump took office (the Republican Party traditionally prefers fossil energy), the photovoltaic industry grew further and became the cheapest source for power generation. In 2019, 39% of the newly installed power generators in the United States are photovoltaics, while natural gas generators only accounted for 32%. The photovoltaics has surpassed natural gas in US, and the driving factor is its Price-Performance Ratio. Another driver for photovoltaic demand is from the retirement of traditional generators. According to official statistics in the United States, about 100GW of fossil energy will be retired from 2023 to 2027. If we add thermal power and nuclear power capacity, it will take about 400-500GW of capacity, which is a huge deficit to make up.



Source: CPIA, sorted by Rosefinch

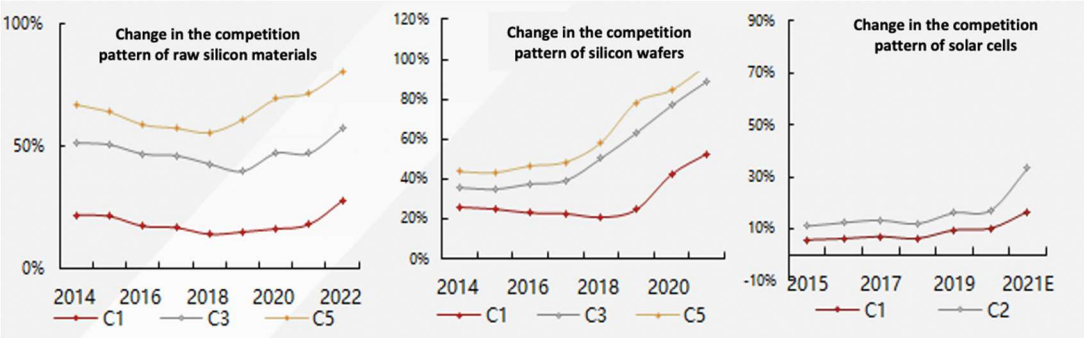
The reduction in power generation cost only solves the cost problem of photovoltaics. In order to make photovoltaic power generation penetrate on a large scale, it is necessary to solve the problem of intermittence: because it can only generate power during the day but not at night, we need energy storage. With the continuous development of pumped-storage hydroelectricity and chemical energy storage such as Lithium batteries - whose cost has been reduced rapidly thanks to the development of lithium battery for electric vehicle industry - the photovoltaic energy storage problem is going to be solved. In Denmark, Germany and Britain, which have high proportions of new energy power generation in Europe, the proportion of new energy power generation is 60%, 35% and 25% respectively. According to the research of international energy experts, the proportion of new energy power generation in total power generation can be up to +90% once we integrate efficient energy storage. In terms of the total volume, photovoltaic power generation accounts for less than 5% in the world today, therefore the whole industry still has great prospect for growth.

Germany is gradually transforming from photovoltaic grid parity to battery parity



Source: GTAI

As far as investment opportunities are concerned, the industry consolidation has increased rapidly in recent years, and the competition pattern in all value links from raw silicon materials to module assemblies has improved. Leading companies are speeding up their production expansion based on their advantages of technology, cost, capital and distribution channel, forming a positive cycle and obvious Matthew effect in the industry.



Source: Wind, sorted by Rosefinch

Taking the modules as an example, people previously thought that the technical barriers were low and the industry was highly dispersed. Today, we're seeing the pattern of vertical integration from silicon wafers to solar cells to modules. The technological innovations lead to tighter integration and higher barrier to entry. In addition, as the industry enters the era of pricing parity, the power station owners and operators will look for stable and robust assembly manufacturer for the duration of the 20-year life cycle of the solar assemblies. We believe that the industry will definitely become more concentrated in future, and the industry-leaders will capture vast majority of the profits.

Part III: Automobile Intelligence - An Unprecedented Transformation in a Century

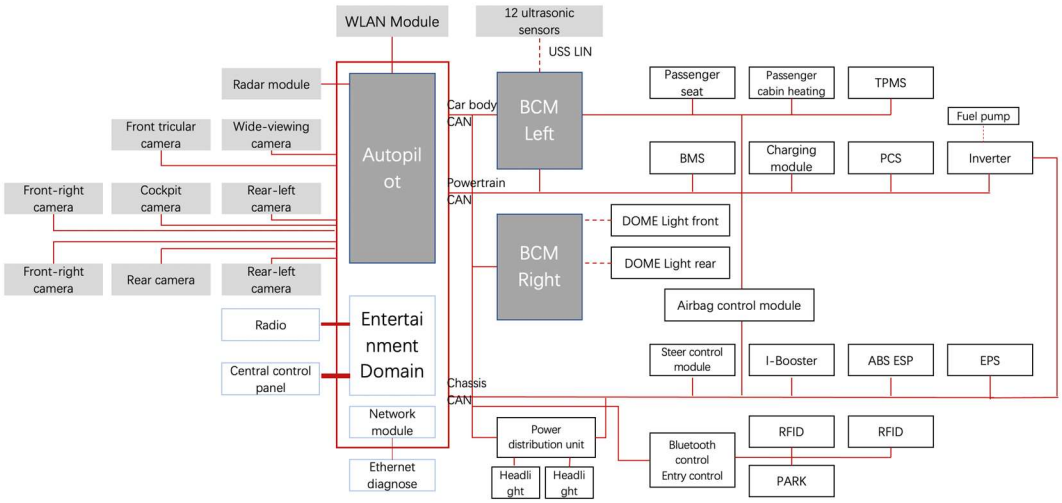
Electrification is only the starting chapter to the transformation of the automobile industry, the real revolutionary change comes with the emergence of the intelligent car.

The price of a made-in-China Model 3 Tesla can be as low as RMB 250,000, with the net profit of about RMB 25,000 assuming Tesla's profitability is stronger than that of traditional automakers. At the same time, the price of an Autopilot installation package of Tesla's driver assistance system is RMB 60,000. The profitability of the seemingly invisible software systems is much higher than that of hardware! The evolution of the Intelligent Car will be the game-changer in the automobile industry's profit model.

What is Tesla's intelligence? According to Mr Zhen Huang, Tesla is different from traditional cars. The performance of the finished traditional vehicle is basically fixed from the moment it leaves the factory, while the delivery of Model 3 is only the beginning of iterative update of its functionality. With a simple upgrade of the software, Tesla can achieve the improvement of 0-100 acceleration capability, the heating option of rear

seats in winter requires, and the improved endurance mileage. For traditional cars, the cars have to be physically driven back to their dealerships; while Tesla only needs OTA online upgrade, similar to the software update in smart phones.

Why do traditional and new automakers differ so greatly? The essential reason lies in the automobile architecture where their creative frameworks are completely different. Tesla adopts a brand-new electronic and electrical architecture with domain controller to realize iterative update of hardware functionalities. It also develops its own software control algorithm for core components. The combination of software and hardware transformed the vehicle's control function from "localized" to "centralized". If you check the electronic and electrical architecture of Tesla Model 3, you can see only three core domain controllers: left body, right body and AP controller integrated with the intelligent cockpit. Different from traditional automakers' hundreds of ECU (Electronic Control Unit) that operate independently, Tesla's EE architecture is simple, efficient, and fortified by the self-developed control algorithm with OTA (Over-The-Air download technology).



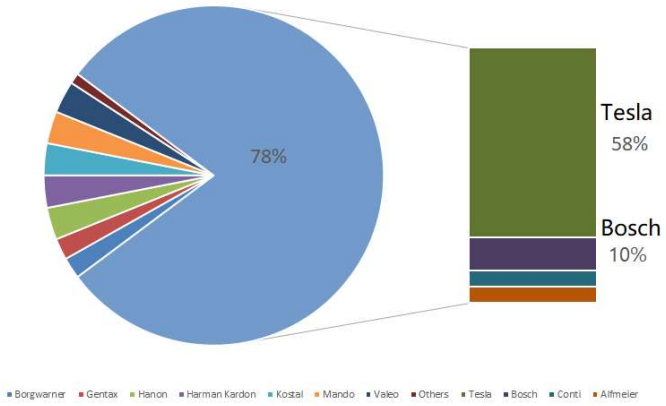
Source: Rosefinch

Sounds good so far, but what impact does this have on investment decisions in automobile value chain?

When we analyze whether a new model can become a best-seller, the car intelligence is a necessary and important factor. We therefore first analyze the electronic and electrical architecture of the new model. The second is the decoupling of software and hardware, such as Tesla's adaptation of centralized software control of the core hardware.

By analyzing the controller of Model 3, we found that 45% of the controllers are made or white-labelled by Tesla. The core algorithms of these controllers are all controlled by Tesla. In the past, parts suppliers could provide both hardware and software, but Tesla's current practice means there is decoupling between software and hardware, which will change the profit model of parts suppliers.

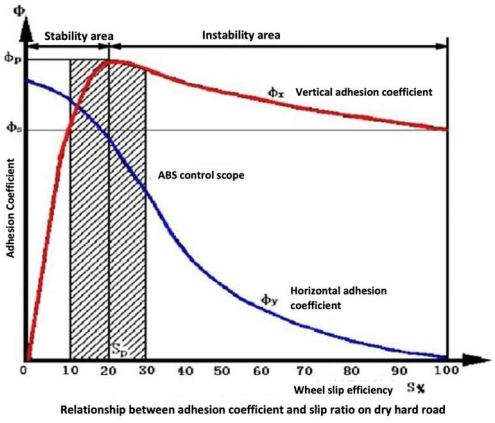
Statistics of Model 3 controller suppliers



Source: 42How, sorted by Rosefinch

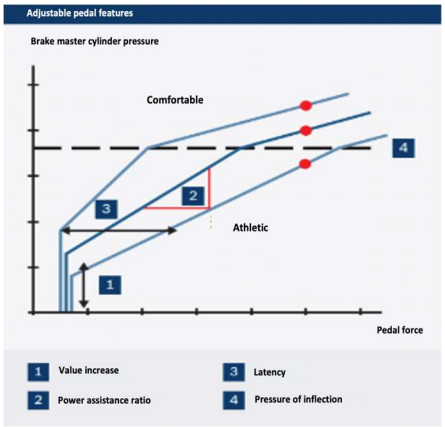
Which companies will benefit from this? Let's take an example: in 2018, one overseas mainstream media rated "not recommended" when evaluating a batch of Model 3 because the braking distance of Model 3 at 100km/h was 46 meters, while other cars was able to brake within 40 meters. If traditional automakers encounter this issue, they will have to do a global recall of all the sold cars to dealerships for hardware upgrading and testing. Not Tesla: Tesla released OTA upgrade package within one week, which immediately reduced the braking distance to within 40 meters. How did it manage to do this? We must first understand two concepts, one is slip ratio and the other is iBooster.

Slip ratio curve



Relationship between adhesion coefficient and slip ratio on dry hard road

Adjust the Ibooster mode through software



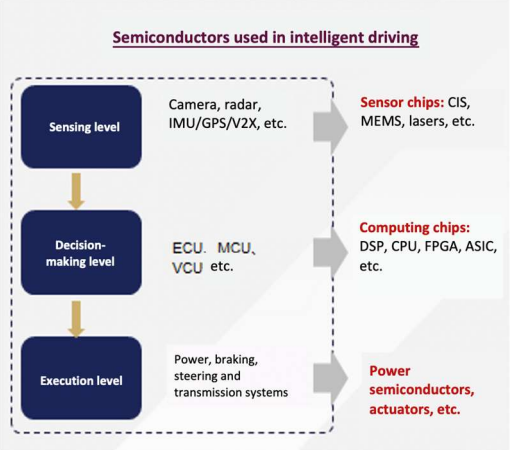
Source: GeekCar

In the process of braking, the ratio of the tire slipping distance on the ground (during sudden brake) to the whole braking distance is called slip ratio. When the slip ratio is within 20%-30%, the friction coefficient between tire and ground is the highest, but people are unable to accurately control the slip ratio by constant tapping on the brake, so the car has a braking system called ABS. In principle, ABS is directly driven by algorithm. Now an ordinary electric or fuel automobile is generally about 2 tons. Without the brake assist system, the driver cannot brake a car running at a high speed. iBooster is driven by algorithm to collect the

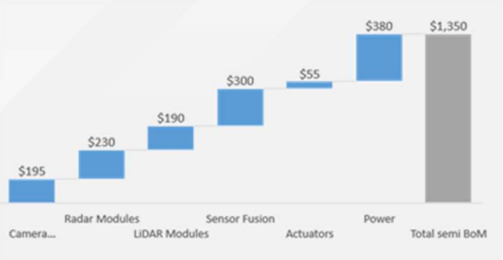
power and speed data through the sensor on the brake pedal and analyze the braking effect you want. The two inputs determine the emergency braking effect of high-speed cars. The iBooster of Model 3 is solely supplied by Bosch, whose software and hardware are very important for Tesla to reduce the braking distance through OTA.

The second trend in the industrial chain is that as automobiles become more and more intelligent, they need more and more powerful sensor systems (camera CIS, radar chips), decision systems (CPU, GPU, DSP, and ASIC) and execution systems (power semiconductors). The improvement of automobile intelligence will bring about an increase in the value of automobile semiconductors. In the future, the upper limit of automobile intelligence will be directly determined by the computing power of chips. Tesla replaced the AP chip from NVIDIA's Drive PX2 with its self-designed FSD, and the core reason is that the computing power of Drive PX2 is not enough to support 5 cameras to collect data at the frequency of 36 frames/second at the same time. If environment sensing is defective or insufficient, it is difficult for the on-board computer to make correct and timely decisions. The image data processing ability of FSD is 21 times that of Drive PX2. Therefore, automobile chip will be the core driving factor for automobile intelligence, similar to PK of current smart phones, most of which comes from cameras and chips.

Semiconductors used in intelligent driving



Usage of automobile semiconductors for L4/L5 level autopilot



Source: Infineon, sorted by Rosefinch

The third trend in the industrial chain is that after the intelligence level is improved, the automobile execution system will change from mechanical hydraulics to electronic wire control. The fourth trend is the

standardization of parts. Intelligent automobiles are similar to smart phones: they have limited volume yet increasingly complex functions, so stronger modularization and integration capabilities are required. In the long term, automobiles are only one application of the automation or artificial intelligence in industries. As automobile intelligence becomes more and more mature, sensory, decision and execution systems may be applied to more complex scenarios such as powerful home service robots, food delivery robots in restaurants or logistics robots. Intelligent robots are expected to become the next frontier in the development of intelligent industries.

Part IV: Commercial Aerospace
A New Chapter of Development beyond Apollo Landing on the Moon

The global commercial aerospace market will enter the second golden development cycle after Apollo landed on the moon in 1970s. The driving factor of the first golden development cycle came from the investment of the American and Soviet governments, where the demands of political competitions were higher than commercial interests. The main driving factor of this golden development cycle comes from the Price-Performance Ratio improvement brought by technological innovation.

	Mercury Age	Gemini Age	Apollo Age	Space Shuttle Age
Year	1959~63	1965~66	1967~72	1972~2011
Background and main purpose	Space race between the United States and the Union of Soviet Socialist Republics. It is aimed to	The preface to the Apollo program. The space technologies and experience needed for the Apollo program, including space walks, orbital rendezvous, spacecraft docking were all learnt from the Gemini program.	The peak confrontation between the United States and the Union of Soviet Socialist Republics in space race after the World War II. The most glorious era in the human aerospace history. It is the first and only aerospace achievement for humans to land on another planet (the Moon).	The most glorious golden age in the history of human space transportation. It is still unreachable today. The space shuttle is the only manned spacecraft to
Launches	20 unmanned launches and 6 manned launches	2 unmanned flights and 10 manned flights	16 successful launches, 11 manned tasks and 6 successful manned lunar landing with 12 astronauts landed on the moon.	5 are in service. Total 135 launches with 134 successful launches and 133 successful returns.
Number of persons	6	16	33	817
Cost	USD 384 million (about USD 3.2 billion in 2019)	USD 5.4 billion (about USD 42.5 billion in 2019)	USD 25.4 billion (about USD 155.3 billion in 2019)	USD 209 billion (about USD 245 billion in 2019)
Average cost per person (USD 100m /person)	5.33	7.87	47.06	3.00
Proportion in GDP	0.012%	0.333%	0.331%	0.064%

Source: Wiki, sorted by Rosefinch

The most representative company in this round of technological innovation is SpaceX. In the past, commercial aerospace could not be used for civil purpose because of the high cost, which was mostly due to the expensive single-use rockets. SpaceX reduced the cost of commercial aerospace in two ways: first, the rocket can be reused. It recovered the first-stage rocket through the self-developed variable thrust engine. In Falcon 9 second-stage rocket, the cost of the first-stage rocket accounted for about 60%, thus most of the cost was recovered. Therefore, the launch cost of SpaceX is less than 40% of that of similar rockets in Europe and the United States. Second, one rocket can carry multiple satellites. Since the cost of a single rocket is fixed, then you can reduce per-satellite cost by developing the technology to carry multiple satellites on a single rocket. The business model of SpaceX to address both rocket and satellite costs in totality allow it to eventually achieve a breakthrough of 60 satellites with one re-usable rocket.

In this golden development cycle of commercial aerospace market, we will focus on aerospace manufacturing in the short term and operation in the medium and long term. For example, we look at impact of commercial aerospace market on 3D printing, intelligent driving and business data mining.

3D printing has been successfully applied extensively in SpaceX program, from spacecraft engines to spacesuits and helmets. In traditional processing, machinary is used to carve out the product, while 3D printing is a way of building using layers of "lego-blocks." 3D print is capable of many different structures like porous, hollow, single form and other complex structures, thus meeting the requirements of commercial aerospace for weight reduction, complex design and short production cycle. We believe that the development of the global commercial aerospace industry will contribute to the further expansion of the 3D printing market.

The second example of technological innovation is intelligent driving. Future unmanned driving needs to combine high-precision maps and high-precision positioning. The tracking error of current commercial navigation system is over 5 meters, whereas it must be reduced to within centimeters for future autonomous driving. The current approach is to establish a ground-based augmentation system and use differential positioning technology to improve the accuracy. The ground-based augmentation system is restricted by the accessibility and cost, thus causing coverage deficiencies. In the future, after the establishment of large-scale LEO satellite systems, we can establish a satellite-based augmentation system. As satellites cover wider areas and are more efficient in transmission, commercial aerospace can accelerate the realization of autonomous driving.

Source: official website of Geely Auto

The third example of technological innovation is the mining of companies' business operation data. As an active research-driven investor, we do a lot of due diligence research on target companies. We notice some

research institutions use satellite data to assess the current business situation of these companies, which is an innovative approach to gather independent data.

Based on the analysis of the above examples, we conclude that when the Price-Performance Ratio of technological innovation crosses the threshold, the potential applications and market opportunities will far exceed our imagination. Thank you!