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**Analysis and Personal Reflection on the transition to
electrification of Quattro Motors through Innovation**

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Business in Practice: Analysis and Personal Reflection of Quattro Motors' transition to electrification

Abstract

This work project presents an analysis on the transition to electrification of the fictional car company “Quattro Motors” in the business simulation, and a personal reflection on how this experience as the Innovation Director resulted in the questioning my interpersonal skills and performance. The first section is a description of the company and on three corporate functions: Innovation, Operations and Marketing. The second section is a personal reflection on how the experience affected me, focusing on two separate critical incidents: the decision-making on the last Innovation’s investment, and the launch of the micro car.

Keywords: Apply Theory in Practice, Business Simulation, Develop a Business Strategy, Innovation, Electrification, Managing a Business, Reflective Practice, Sustainability and ESG, Team Dynamics, Working in Teams, Integrated and Coordinate Decisions Across Business Functions, Operation Management, Market Research.

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Quattro Motors Analysis

Introduction:

Climate change is driving societal adaptation, particularly in the transport sector, as it is one of the main sectors responsible for the most global emission of Greenhouse Gases (GHGs). Pressured by consumers valuing ESG actions, investors favoring sustainability, regulations promoting eco-friendliness, and EV competition (notably Tesla) (Vance 2015), car manufacturers are shifting to Battery Electric Vehicles (BEVs) for viability (Winkler et al. 2020, 6). Legacy brands such as Volkswagen, Mercedes and BMW already offer BEVs across segments and Start-ups like NIO and Rivian further redefine the market.

This is the environment where our company emerged. Quattro Motors is a legacy car company, focused on the build and sale of internal combustion vehicles until now. The main objective on this 6-year simulation, divided by quarters of decision-making, would be to transition this company to a fully electric car company.

Quattro Motors' mission is to take the lead in driving ESG action within the automotive industry, through focusing on continuous innovation to provide technological luxury. Like the strategies of BMW and Mercedes, Quattro Motors offers high-end cars with above the average technological features. It is also very focused on having the best ESG score available, investing heavily on sustainability in all aspects of the company. In practical terms, our cars would be design in such a way that would have more extras than the rest of the competition, but with the most sustainable choice in engine type and materials without jeopardizing the interest of the consumers (such as in per example for a fast sports car). The objective of this strategy is to develop a brand that relates to success, technology, and sustainability, that would improve customer demand.

This section analyses the company's performance in the simulation, mainly through the analysis of the three corporate functions that had a major influence: Innovation, Operations

and Marketing.

For the sake of simplicity, each department will be called by their name with the first letter in upper form, per example: the operations department will be called Operations, the marketing department will be called Marketing, the human resources department will be called Human Resources or simply HR, and so on.

Innovation Function:

In a company heavily invested in being the most luxurious and high-tech in the market, the innovation department was fundamental for Quattro Motors. It was responsible for mainly two functions: investment in technological projects, that can be divided into three categories (Electric, Connectivity, Autonomous Driving), and the development and launch of new models.

Initial Strategy – Fast electrification and car launches

Quattro motors' focus was to be electric as fast as the market would allow it, not only for our sustainable mission, but also to not pay the CO2 penalties for our fleet. The investment in electric batteries would be fundamental to achieve this goal, as it would enable us to build our first electric car and maintain our electric fleet with updated battery technology so that they can have a competitive battery range in the market. As for the connectivity and autonomous driving investments, those were considered luxuries for our cars to make them more technically seductive. Although less important, investment in such projects is what differentiates a normal car company from a truly luxurious car company that Quattro Motors aspired to be. Even if the market was not interested in such advanced features, the company would prepare for the long term by investing in such investments.

As for the launch of the cars, Quattro motors focused on making high quality and low emissions cars, that were normally more expensive but with more features. In the first quarters, we would launch new hybrid models to completely substitute the purely internal

combustion engine cars that were at the end of their lifecycle and with more potential for short-term profit. By the time we were able to launch BEVs, in quarter 7, we immediately started designing and launching electric cars. From then on, Quattro Motors only launched new electric cars, while still producing hybrid and internal combustion engine cars until their lifecycle ended. But the launch of new cars would be debated to not impact the popularity of older products, that could lead to their discontinuation (Gokarn 2010, 5-6).

The process for the development of an electric car would be as follows.

Firstly, one department would propose that a new model should be developed. This of course depends on each department's needs. The most common examples were: if Operations needs to boost its factories' capacity, if Finance needs to improve profits of a certain segment, or Innovation itself is pitching a new model to improve the CO2 emissions average the company's fleet. In this part, Innovation would choose the segment of car depending on the needs pitched. In the case of the need of a car for economies of scale i.e. that sells a lot and justifies three production slots in a factory, a car in the segment of compact would be ideal, while in the case of a car with larger margins a only occupies one slot, then a SUV or luxurious car would be better.

Secondly, Innovation contacts the Marketing department to jointly do market research. Due to the uncertainty and customer demand for innovations, it was extremely important for Marketing to be integrated into this process (Mohr and Sarin 2009, 88), and in our case it was the most important input. This involves looking at the competitors for the segments in interest, their respective prices and features, and the preferences in each of the three markets (Europe, Americas, and China). This will conclude what features should the car have and what price should our car have. The strategy here would be to have the closest price to the cheapest competitor, with the same design features, but one feature above the competitor, in connectivity, autonomous driving, or battery range, depending on how the average price

of the car would be. In decrescent order, the features that would have the highest effect on the final price would be Battery Range, Autonomous Driving and Connectivity. So different features would be chosen to improve the sales performance of the car.

Now that we have the segment and the features established of the car, Operations would be contacted to know where the new model would be produced. This is especially important as different segments will need a different number of slots in the factory and will be better in certain regions. A compact car would need two slots in a factory or more, while according to the preferences of each market, it would have the most successful sales in China, followed by Europe. This is why every compact car Quattro Motors made was produced or in China or in Europe, using two slots or the maximum three. In this process, HR would be also contacted so that Operations would know if the production of the new car would require hiring or firing of workers, and how would that affect their motivation and satisfaction.

Finally, the car would be fully designed, with the segment and features clearly decided, and the final investment cost would show. Finance would now state if it is able to fund the development of the car. As it is the department that can raise money, they would state if such an investment would be possible, considering all other costs associated and availability of financing with green bonds. Only after their green light, the car would be launched.

This process would allow the involvement of each department for such an important decision, as it would be the new cars that would bring revenue to the company and what would give an identity to Quattro Motors. Even with the involvement of the other departments, Innovation would have the main responsibility for achieving a high-quality electric fleet of cars that would succeed in the market.

Simulation – Sustainability and luxury at all costs

The initial goal for Innovation was to turn the CO2 fines to zero as quickly as possible by reducing the total average emission of our fleet, and to replace all our fleet with electric cars

with good technological features. Innovations was quite strict on its initial strategy to achieve such goal, with the hopes of being as efficient as possible.

In quarter 4, Quattro Motors CO2 fines were a combined total of \$211.69 million (Appendix 1). Innovations started launching hybrid models to substitute the most cars that produced the most and that were also at the end of their life cycle. That was the case for the compact and for the convertible models. From quarter 7, we were able to launch electric cars, as we did that same quarter and never launch another non-electric car. It takes two quarters for electric cars to be available for production, hence it takes 3 quarters for our cars to reach the market. As you can see in Appendix 1, Quattro Motors experienced a great decline on CO2 fines in the quarter when the company's first electric cars came to market, from quarter 9 to 10, for such it was the effect on our average CO2 fleet emission (Appendix 2). By quarter 11, Quattro Motors had zero CO2 penalty fines to pay. In quarter 17, CO2 subsidies were introduced to the simulation that would reward companies with a CO2 fleet emission below the threshold of 70 g/mile. Such subsidies to Quattro Motors, that was already such a low emitter at the time (Appendix 2), received the equivalent of 3.25% of revenues in that quarter in subsidies. By quarter 21, Quattro Motors was a fully electric car company, with zero CO2 fleet emissions, and so the goal of the simulation was reached. The reduction of CO2 emissions and consequent penalties was the most successful feat on the Innovation side.

The investment projects were followed based on our initial scheduling. This was done in collaboration with Finance to manage investment budgets, but also remain ahead in R&D investments compared to the competition. The electrification investments were the most important, and hence they were all invested one after the other. By quarter 11, every investment in Electrification was complete, providing the opportunity to invest in bigger battery packs. For Autonomous Driving and Connectivity, they were sometimes rescheduled as they were not so important. Their only objective was to provide an advantage in extras in comparison with

the competition, and sometimes that did not justify the cost. Giving the example of Autonomous Driving level IV “Secure Infrastructure” (Appendix 3) was rescheduled from quarter 12 to 14, for there was no demand for it at that time.

For the cars made during the simulation, many of them were not completely successful in their objective. This is mostly due for them being too expensive to be produced in high volumes that Operations would have hoped. Strictly following the initial strategy on focusing on good technological features in Connectivity and Autonomous Driving turnout to be a bad for the firm, as it left us with cars more expensive than the competition, that would not sell accordingly, resulting in the accumulation of inventory. Operations’ efficiency in their factories suffered very much from this, so much that it was the main problem of the company throughout the simulation. Our first electric cars Lisbon E and Berlin E were both level I in Connectivity and Autonomous Driving, and both had extra-long batteries packs. The battery feature was chosen because that was the only feature available to differentiate us from the rest of the market. But as a result, they were the most expensive cars in their segment, by far as the battery pack is what would increase the price more. If somewhere in the middle there was some understanding of how such features were hurting our company more than it was helping, a better result would have been reached. Nevertheless, Innovation was successful in developing cars that completed Quattro Motors vision, as they were technologically more advanced than the competition, bringing always an increased interest in our cars.

One final success of Innovation was on its management issues. These unpredictable events gave us a choice on how to move forward and the option that most identified with our vision was always selected. We decided to invest in expensive solid-state batteries for its increased safety and lifespan (Appendix 4 and 5), with the certifications needed to provide the highest satisfaction among customers. We also chose to acquire a car sharing company, as we had the healthy finances to do so, avoiding management problems altogether.

Operations Function:

Operations is considered the lifeline of any company, as it addresses a wide range of business challenges from customer preferences and technological disruption to environmental actions (Slack, Brandon-Jones, and Burgess 2022). But the management of Quattro Motors' operations was the main challenge of the company throughout the simulation. Even with a good initial planning of operations management and a general focus of the company on this department, Operations was full of challenges on the management of inventory and factory capacity.

Initial Strategy – Sustainable and consistent production

Our initial strategy for Operations was focused on sustainable production on our factories and increased efficiency in the management of inventories.

For an increased sustainability in our operations, there were three scopes with available investments for Quattro Motors to improve. Scope 1 is regarding Production Investments, improving emissions from the company's owned or controlled resources, resulting in less waste from our facilities, consequently reducing costs. Scope 2 relates to Energy investments, emissions from the generation of energy used in our facilities, improving the use of green energy and efficient energy management. And Scope 3 represents Supply Chain Investments, emissions not included in the other scopes but indirectly linked to the company's operations, mostly to improve suppliers' emissions. All these scopes needed a sustainable score related to our workers' sustainable related skills to be able to invest in them, and all of them were qualified for green bonds (except the investment to Offset Suppliers CO₂). Hence, our strategy was to invest in them as quickly as possible. HR would improve the sustainable skills of our workforce needed to unlock these investments, and Operations would invest in them with funds financed by the better terms of Green Bonds. This would result in lower production costs and an improved image of sustainable luxury.

For the management of inventories, the company's main goal was to maintain inventories low, generally between 30 to 60 days inventory, and make as few changes as possible regarding production slot changes and worker count in factories. Achieving this would result in high-capacity utilization in our factories, which translates to producing as many cars as are being sold, also known as Just-in-time production (Heizer, Render, and Munson 2017), lowering production costs, and improving the company's flexibility in changing selling prices to manage inventory. For slot management, we would choose the cars relative to how many slots should the car need to better manage inventory and put it in the country which would be more successful regarding preferences of the local population, reducing the effect of tariffs in the price of our cars. Compact cars would be using three slots to obtain economies of scale production and would be produced mainly in China, as it was a desirable car in that market. Sedans and Convertibles would get two slots and would mostly be produced in Europe. SUVs are Luxury vehicles are not sold in great volumes as they are the most expensive, so they would be produced in America for its population with higher willingness to pay, and lower slots available. Regarding Factory expansions, there wouldn't be much, as high-volume production was not the focus of Quattro Motors, but rather low volume production of high-quality cars.

This was the established strategy for Operations, and like Innovations, Quattro Motors was too focused on the strict following of this plan to make necessary adaptations.

Simulation – Sustainable but inconsistent production

Right in the first quarter the investments necessary in HR for the availability of the initial sustainability investments in Operations were made, and in the next quarter (quarter 5), they were invested, further solidifying Quattro Motors vision on committed sustainability. By quarter 11, all available Operations investments were completed, equivalent of \$1 570 million in CAPEX investment financed fully by green bonds.

Even though the sustainable aspect was very successful, the management of inventory proved to be the main challenge of Operations and the company. The main reason for this was that the cars Innovation created had high specs i.e. relatively expensive and did not sell fast enough for Operations to manage inventory as needed. In Appendix 6, you can see a graph representing the days of inventory of every car Quattro Motors made throughout the simulation. Remembering our objective was to keep inventory between 30 and 60 days, one can notice that most cars not only did not maintain in that threshold, but also there were wide movements ranging from 60 to 120 days, in some cases going until more than 200 days, and then going down sharply again. This is due to the initial excess production that accumulated inventory, and then Operations would remove the cars from certain slots or from all slots altogether, selling all available stock until it reached below 60 days, when they would go back to factory to resume production. This happened twice in the case of the Tokyo 75H (Appendix 7). Car price changes by Marketing could only offer a short-term solution to compensate for the operational problems (Shalender and Singh 2015, 255) but the cars were so expensive that it was never a sufficient decrease. Consequently, the norm for Operations was constant slot change of almost every car to manage inventory.

This was mostly due to the desire to have economics of scale for our compact cars, and later for our Micro car Sado E. The main purpose of our compacts was to be our “cash cows”, that is, not our best cars in terms of profit margin, but with high volumes of sales that would result in a steady source of revenue. They achieved a high number of sales, but not high enough to justify the 3 factory slots needed for Operations to achieve its economics of scale. Looking at the chart of the production volume of our compact and micro cars in Appendix 8, one can noticed that there was a time for each car that it was present in 3 slots (equivalent of a quarterly production of 45K units) just for it to fail, as we had to reduce it once again. It also helps to see in Appendix 9, how the inventory accumulated until the decision was

made to reduce production.

One exception for this trend is Porto E, which by that time we knew that 3 slots wouldn't work. We kept two, still with a serious debate on these decisions, but thankfully we learned from our past experience: that our cars were not able to sustain 3 factory slots production. Quattro Motors would have been better off just producing conservatively and continuously, using no more than two slots.

Regarding the other cars' production, the constant change in production of the compact cars affected the others production, due to the limited slots available, leaving one slot empty was not an option due to the costs associated without the future revenue to justify it. Still, there were some models that were a success in inventory management (Appendix 10), that were the SUV (Kyoto E) and the two Luxury model cars (Berlin E and Berlin GTX). Since these were expensive cars, there was never a point where they would sell in such high volume that would justify more than one slot, so we kept it accordingly, mostly in our American factory with only two slots available, reserved to produce our most expensive cars. Berlin E had to be put in two slots at one time to fill a vacant slot, because of the before mentioned problems in slot management caused by the compact cars, and Berlin GTX was our pilot super car with the highest available extras that Quattro Motors had available, so it was more of an experiment to capture the highest price range market. Those are the causes for the single spikes for each one of the Berlin cars, present in Appendix 10. But Kyoto E did not suffer such a problem and continuously produced sustainable volumes, making it the most successful example of inventory management of Quattro Motors.

Every single car in Quattro Motors should have been produced like the Kyoto E, with conservative production. The compact cars should have been produced in only 2 slots, so that inventories would not accumulate. The failure of our strategy was such as Michael Porter (1996) states "Strategy is about making choices... and choosing what not to do."

But in the final quarters (see Appendix 6), inventories stabilize. The company learned from the past and Operations was able to adapt to its current car portfolio, having no slot changes in the final year of the simulation.

Marketing Function:

Marketing is a key function in ensuring the success of any business, as its main focus is on attracting and retaining customers (Drucker 1954). The Marketing department played a pivotal role in Quattro Motors, a pattern common to most businesses. All other departments relied heavily on Marketing's consistent flow of information for an efficient decision-making process. Not only it was the department able to collect most information about the world outside the company, but it also possessed information about the cars themselves, with the ability of providing a more detailed description of the sales performance of each vehicle. These factors made it the most influential department within the company.

Initial strategy – Market research and price manipulation

This department's goals for the company were to manage marketing expenses of the company, to manipulate car marketing expenses and prices with the purpose of controlling profit margins and inventory numbers for each car, and lastly to offer any department the information requested in the most efficient way possible.

Starting with the marketing expenses of the company, as Quattro Motors was aspiring to be a luxury brand, an effective marketing campaign would be fundamental to spread that image. The strategy would be to spend heavily on print and TV campaigns, on customer promotions and on training and service, following the examples of luxury brands such as Mercedes and BMW. There was also the possibility to adjust prices differently among the markets of America, Europe, and Asia. Since Quattro Motors aspired to be a global luxury brand, our initial strategy was not to focus on one specific region, and hence there would be no adjustments between the markets.

Since Operations was responsible for making the production of cars as smooth as possible, Marketing was responsible to manipulate the price and marketing expenses whenever it was needed. If a car was selling very well and consuming all its inventory, Marketing would increase its price and decrease the marketing expenses to improve profit margins on a successful product. If inventories were accumulating, then Marketing would decrease price to make the car more competitive and sell better as well as increase marketing expenses to attract more customers.

Market research offered by Marketing was fundamental, interpreting the most valuable information outside the company. There was a lot of data that Marketing could access, but we focused more on the following points.

It was able to information about Quattro Motors market share in each market, as well as its competitors. Quattro Motors was approximately equal as two biggest competitors out of the three in the market. Our strategy was not to be a high-volume sale company, so it was not on our best interest to be the one with the most market share, but it was important to maintain it constant among all the markets. Hence, we concluded to focus on maintaining market share as one of the highest, but not aspire for the greatest market share, as that would probably not happen with our initial strategy at hand. Still, Marketing would report quarterly the advances in our market share, as well as the competitor's.

Next, the analysis of the list of sales per product, ordered by revenue, of all cars in the globe was one of our great focuses. As a technologically advanced luxury brand, Quattro Motors aspired to be at the top of this list since our cars would be mostly luxurious high profit margin cars.

Lastly, Marketing was able see the preferences of type of car in each market, as well as the average income of its citizens. This would massively influence our decision on in what region the car would be build. A certain type of car would be produced where its preference

would be the highest in the list since no tariffs would be added for the most promising market. Tariffs were something that worried us, as it would increase the price of the car in question with no return for the company.

Simulation – Great communication, but ineffective action

Marketing's performance was exemplary, but due to the problems on car production from Operations and the car development strategy from Innovation, it made the efforts from Marketing largely ineffective in resolving the issues mentioned in the other function's sections. From the start of the simulation, Marketing started by increasing marketing expenses of the company overall (TV and print campaigns, Training and Service, Customer Promotion/POS), until it reached the maximum possible by quarter 6. Throughout the simulation Marketing helped to provide information to all departments in an efficient way. Its most important input was in Market research, that dictated what car would be produced in what factory. We could obtain the highest possible profit margins producing and selling compact and micro cars in Asia, Sedans in Europe, and SUVs and Luxury vehicles in America. As we prepared to introduce our first electric cars on the market, it was Marketing that pointed out that electric was still not in much demand. Hence, we became more conservative in our transition to electric, as we could obtain the revenue from internal combustion engines to finance further electrification projects.

Its ineffectiveness came from influencing the car sales. Because of the more expensive cars that Innovation developed, and the problems in efficient management on factory slots from Operations, the influence of marketing improvement and price adjustments had very little effect on sales. Because the cars were so expensive, there was a relatively high bottom limit that the price of cars could be reached. Every time we would decrease the said price of a specific type of vehicle, we would start a price war with the competitors, similar to what happened to GM when it pursued a four-year price discounting strategy, also to face poor sales (Jobber and

Chadwick 2020, 804). But since our competitors had cars with less features because our car development policy would be to have always one feature better than the competition, the competitors could always decrease the price of their cars more than we could. Moreover, marketing campaigns for specific cars proved to be ineffective in influencing sales. The market did not seem to respond to our marketing campaigns in the slightest, and the same is true for marketing campaigns of the overall company. In quarter 14, we noticed such reality and Marketing decreased the marketing campaigns from 100% (that it was since quarter 6) to just 60%, as it made no sense have such expenses with no return.

Conclusion

After a comprehensive analysis of Quattro Motors' performance over the six-year simulation, its transformative journey from a legacy combustion vehicle manufacturer to a cutting-edge electric car company was marked by challenges and successes.

Innovation was fundamental for the main objective of this simulation. It was able to manage a schedule of investments that made Quattro Motors a major e-mobility player and a technologically advanced company. Its development of cars gave the image desired for Quattro Motors, even though consequently provoking problems in production.

For Operations, the management of inventory and factory capacity emerged as formidable challenges. The initial objective of economies of scale was not met, but with adjustments in the production strategies, such as aiming for more conservative volumes, it adapted to have a sustainable production in the end of the simulation.

Marketing played a crucial role in fostering informed decision-making and cultivating Quattro Motors' identity as a sustainable, high-end brand. The insights garnered from market research predominantly influence and guide the majority of our strategic choices. Despite facing constraints in addressing the company's core challenges, marketing remained instrumental in shaping our brand's image.

All departments contributed significantly to the company's success while facing their own specific challenges. HR was successful in the management of factories' workload, motivation among the workforce and in hiring the talent needed for Quattro Motors' goals. And Finance was crucial in supplying funds to the company and managing the internal finances of the company.

Overall, Quattro Motors demonstrated adaptability and commitment to its vision. Besides our issues, Quattro Motors excelled in the simulation, ranking first in value-added with \$2,891.50 Million, a difference of \$2,226.30 million from the nearest competitor, and with an average 0,00 g/mile in its fleet (Appendix 11). Notice our exponential increase in the later quarters, a consequence of Quattro Motors adaptation. Also, the four cars that provided most revenue in the global market were all from Quattro Motors, being the Goiania-E the unexpected winner (Appendix 12). I write "unexpected" because there was not much hope for this car. It was just a car to fill the sedan car segment, with not so amazing features. For that reason, it was not influenced by the strict ideologies of grandeur, and so it was developed and managed very factually. It was still a purely Quattro Motors vehicle, still being the sedan with the best features, but it wasn't to excess, it was exactly what the market demanded. In many ways, this car defines what Quattro Motors could have been in its entirety. Still, it is not what could have been, but what actually was that matters: the most successful brand in the market.

To conclude, Quattro Motors was successful on its transition and mission on being a brand synonymous with advanced technology, quality and luxury, thanks to the efficient interdependency between its functions.

Personal reflection

Introduction

My 3-week experience with BIP gave me the opportunity to explore an intensive working environment unlike anything I have ever experienced before. Before I started, I was especially hesitant of what kind of team I would end up with. And Since teams are chosen based on the differences in backgrounds, I already knew that I would join a team that was composed of people with diverse backgrounds and personalities. That was exactly what happened, and after the experience I can say with all certainty, I couldn't be more thankful for the team I worked with. The sense of teamworking and compassion between ourselves was incredible, from the first days as we prepared mentally and technically with many office tools to help in our simulation, to the decision-making process for the short time we had between each year in the simulation. There were conflicts, many times passionate and serious, but there was always the posture and respect to reach a conclusion. Non-judgmental and honest communication resulted in trust and effective collaboration (Toegel and Barsoux 2016). Everyone would not always have got what they wanted, but there were never grudges between us. The priority was always to argue and act for the best result for our company. Teamwork really was the ultimate advantage in business for us (Lencioni 2002).

This very positive environment made me at ease with the situation. I am normally a very anxious and quiet person around people I just met, not the most outgoing or the conversation starter. According to Insights Discovery personality test, I am influenced by a Cool Blue, but very close to Earth Green. It describes my personality well, as I do have attributes related to Cool Blue (such as cautious, precise, formal, and reserved) influenced by attributes related to Earth Green (caring, encouraging, docile). But having a team like that made me share my beliefs and problems better, and overall get a much better performance. Many other teams did not have this luck, and if I hadn't, I wouldn't have adventured so

much into arguing and representing my position as the Innovation Director.

Overall, the experience was exciting, stimulating and in many ways very fun for me, and the main result was the chance to explore many things a person can only discover from himself when that person is pushed harder than before. I will explain two such incidents that affected me especially, and that influenced the most my way of working for the future. My first incident was the decision not to invest in the last Connectivity project. At first it was obvious that we shouldn't invest in such, but this decision took me to rethinking the strategy of our company and how that may affect real companies around the world.

My second incident was the conflict and consequent disappointment of our Sado micro car. This was a situation where the team needed a special kind of car, but due to the company's values, I designed it in a way that in the end, it did not perform as it was intended.

1st incident

Before the simulation started, my team and I had already developed a plan for our investment throughout the six years of the simulation. In our file named "Financial Management and Control" was an excel file where every predictable investment and payment was scheduled for each quarter, i.e. our Company's CAPEX plan. In my department's specific sheet "Innovation CAPEX Plan" were investments regarding Electrification, Connectivity and Autonomous Driving, all scheduled for a certain quarter and with all information, including cost of the investment, quarters remaining, justification for the investment, among others.

Throughout the simulation, I and the other departments that had CAPEX investments, that are Operations and HR, tried to follow as much as possible this initial plan of investments. Some unexpected events happened that constraint our investment budget, such as the urgent need for the launch of a new car. In those situations, we would ask Finance for additional funds, to comply with our schedule, or we would postpone it, never more than 2 quarters.

More times than not, we decided to postpone it, as the health of the company's finances was usually more important than an investment that can start a quarter later. But the main objective was to follow our respective CAPEX plans, for the sake of having as little unexpected incidents or results as possible, as in the simulation we already had enough of those. From Innovations, my CAPEX plan was followed very strictly, for the following reason. My investments were what made it possible to select higher levels of Connectivity, Autonomous Driving and Battery size (Electrification) for Quattro Motors' cars. It was extremely important to have these innovations as quickly as possible. Since Quattro Motors focus was on technological advanced luxury, our cars had to have the best and latest extras available, with the objective of being the most equipped compared to the competition and still with a competitive price. In conclusion, these investments were what empowered our brand, justifying the strict scheduling.

That is until we reach quarter 17. At this point, all investments in Electrification, Connectivity and Autonomous Driving are completed, except the level IV Connectivity investments named "Cross-Platform Technology". It was scheduled to be invested in this quarter, but besides the schedule, there was no reason to invest in it.

The issue was with the competition. All other cars on the market had level I or level II Connectivity and Autonomous Driving. We already had available level III Connectivity and level IV Autonomous Driving; hence we were already far ahead of the competition in terms of those extras. To pursue innovation, a company needs an incentive and an opportunity (Wesseling et al. 2013), and there was no incentive at that moment. Understanding the current situation, I asked my team for feedback. Explain in detail why it doesn't make much sense to make the investment, as it would cost us 200 million that we could use elsewhere, plus depreciation costs over the years. But the initial plan was to follow the schedule strictly and to invest in every single investment available. So, should

we invest just to have this extra, or should we not invest it and continue?

Analyzing the hypothesis that we did invest, we had the initial cost and further cost for depreciation, with the only benefit of the level IV now available for new cars. But at this point so far into the simulation, we were not planning to launch new cars, hence no car would ever have that extra. There would be no opportunity to gain from this extra. Even if we developed a new car, from our experience in the quarters before, extras did not make such a difference in customer preference, so in practical terms, Connectivity level IV in a car would only increase their price, making it less competitive.

If we did not invest in it, there would be no cost, and we would just move on. The cost for this decision can be the possible jeopardizing of our brand. Quattro Motors should always invest heavily on R&D, since our strategy in designing vehicles required the latest levels compared to the competition. But the competition did not have or showed any car previously that was as equipped as ours. To quarter 17, we had the Berlin E GTX with Autonomous Driving level IV and the Beirut E with Connectivity level III. These were the most equipped cars in the market, so much so that as a side note, we had trouble selling them in the future for how equipped they were and consequently how expensive they were. After explaining to the team, the whole team concluded that the best would be for me to decide. At this point I realized even though the decision in practical terms seems obvious, it was difficult for me for the following two reasons: the lack of a rule book, the trust of my team in my decision, and the stubbornness of the initial plan.

Firstly, this simulation had to clear path to follow. The only possible path of decisions all teams should take would be to transform their fleets electric and remain profitable. Now, to reach those objectives, and to exceed in the different parameters of the company for the sake of the competition between teams, there was no clear decision path. Every decision would have to be ours, based solely on our knowledge of the matter, not knowing exactly

what the future consequences would be. Also, since this is a simulation, I also thought we were supposed to because, as in any game, you should get all the extras to complete it well. The gamification of the simulation made me think that we should invest in it because there was the option to do so. All this made me very uncomfortable, a little throughout the whole simulation, but especially in this incident.

Secondly, I was quite surprised by the trust that the team had in me. It is true that this is a minor investment in terms of costs. However, the weight of that decision was put solely on my shoulders. Not counting any possible data analysis, as the Innovation Director, I do not have many actions available, besides these investments and launching cars. Since the investments were all scheduled with the knowledge of the team, and the process of designing cars involves the whole team, this is truly the first opportunity I could decide on my own. According to the peer and self-assessment chart (Appendix 13), my team thought I contributed more to the team than what I thought. This concludes that my team trusts me more than I do.

Thirdly, I am a person that prefers strongly to develop a plan and follow it to the end. Basically, I like predictability. Any unpredictable event made me very anxious about how that would affect the plan. And this simulation was very prone on unpredictable events and results, so I was very used to it at this point to change the plan from time to time. But this involved not only the plan, but the identity of the brand itself.

In the end, I concluded to not invest in Connectivity level IV. As a result, we did not face neither the cost of the investment nor the depreciation cost, and there was of course no gain. This was no doubt the correct way to move forward, as there was no launch of a new car where Connectivity level IV could be implemented. But the fact that this wasn't such an obvious decision for me made me truly think about my previous actions and how I should act in the future.

The in-hand facts are always the most important. The thought of “I should do for the sake of doing it” justified by some interpretation of the company’s initial plan or the gamification of the simulation, is obviously wrong. This investment would only hurt the company.

As for the mission of the company, to be the most advanced luxury car brand in the market, it wasn’t betrayed. We still had the best cars on the market, it is only that Connectivity level IV was still not available for customers. It is always better to analyze practically the situation instead of looking at it through a lens of some predetermined value. I was surprised and worried about how long it took me to realize how easy this decision was, justifying it from all the wrong reasons and interpretations. In the future, I must be more practical in my approach, as it cannot take such a long time to take action, or in this case take no action, to resolve such a minute problem. I also should have been more honest and disclosed my feelings of insecurity and somewhat panic (West 2012), perhaps my colleagues had taken extra time to analytically analyze the problem and show me that not investing was the rational option. The mission of the company is important, and the details matter, but in this case such an obsession with them made me realize how efficient I was being, and it is something that I must correct for future experiences.

2nd incident

In quarter 16, Operations requested me to launch a car that was capable of economies of scale i.e. that it would sell so much that it could justified 3 slots in one of the factories. Factory capacity was bothering our team since the beginning of the simulation (quarter 4) as no matter how many different combinations of cars in the factory slots available, we couldn’t get it right. This resulted in constant change in the factories’ slots, causing inefficiency that became the main problem for the company’s added value.

To solve this problem, Operations wanted a car that would fill 3 slots of a factory no matter what happened, so that inventory would be below 45 days. We tried it previously with

Lisbon E, an electric compact car. It had a level I in both Connectivity and Autonomous Driving, but it had an extra-long battery pack. Even with low technology extras, which were the only ones we had at the time it was launched, such a big battery pack made it too expensive for it to justify 3 slots. It was never able to sustain 3 slots, only being able to from quarter 12 to 16, increasing its inventory from 37 to 98 days.

So, this new car had to be able to sell in big volumes, and Operations proposed for us to create an electric micro car. I initially wasn't very interested, as the vision of our company was for technologically advanced luxury cars, and I could not see how a micro car could fit in that vision. But Operations pointed out that Mercedes-Benz Group, one of the most luxurious names in the automotive world, has not only a car but a brand dedicated to micro cars, the Smart. Hence, based on that example I agreed to design a micro car. After market research, we concluded that the competitors all had a micro electric car, with a short battery pack, and level I in both extras.

Now, it was my time to create the characteristics of the car. It would have to be an electric micro car, with a short battery pack. Short because the car had to be cheap to sell at high volumes, and the battery pack was the most expensive characteristic of the car. Now for the technological extras, there was a problem. All our competitors had the micro car at level I in both characteristics, but the car policy that we had since the beginning was to always chose one characteristic and increase it one level. Hence, in this case, it would have to be level II in Connectivity or in Autonomous Driving. I chose to select level II in Connectivity, as it was the extra that had a lower effect on the car's price, but I didn't tell my colleagues about this detail, that it would be a problem later. With this, the car was ready to launch. We decided to call it Sado, in honor of the short-lived Portuguese car brand of the same name that produced exclusively micro cars.

Two quarters later (quarter 18) the car was ready for manufacturing. Operations put them

straight into 3 slots, even if the car was still in the beginning stages. It was urgent for them to fix factory capacity as quickly as possible. By quarter 22, it had 94 days of inventory, representing accumulation of our stock. In conclusion, the Sado car failed to produce economies of scale, the main purpose of its development.

So, what happened? Everybody in the team was looking at me expecting an answer. I explained how I design the car and told them about Connectivity level II, and they all pointed at that for being the main reason for the failure, and I agreed. It is true that putting Sado in 3 factory slots would increase inventory that would not sell, but that does not explain such excess. Also, we had previously tried to make the car cheaper so it would sell more, a strategy that we used before, but still the inventory accumulated to 94 days. The reason was Marketing could not decrease the price any lower, because the Connectivity level II had put the lowest price economically possible too high for the market. As for the competitors, even though they had less extras, they could always beat our lowest price.

My colleagues' reaction was not of blame, but of disappointment for the car. They assured me that this was not only my fault, since the process of developing a car was a team-wide decision. But I did blame myself, as this time it was I that did not communicate my decision to put Connectivity level II, solely for the purpose to follow the initial plan for developing cars. A plan that had brought tremendous hardship for Operations and hurting the company's performance.

The conclusion from this incident is that I should not have been so quiet and not so stubborn. I am the kind of person that doesn't share his opinion in order to avoid conflict i.e. I often subject myself to social conformity (Brown 2000). Even with the pressure we were facing, I should have mentioned that I was following the same development plan as always. If I had done that, maybe a moment such as "wait a minute, let's think about it" would appear. Such a moment would consequently emphasize that what we needed was not only a cheap

car, but a car that would not fail in economies of scale. That was the objective, and that is what we should have had. Even with a basic car equal to all the others, this boring car could have resolved Operations' problems. A simple "guys I'm going to follow the same plan" would have been enough to not have this issue. And if it wasn't, at least I would not feel so guilty about it. But if I wasn't so stubborn about following the initial plan and had only focused more on adapting to the company's current needs, the choice of Connectivity level II would not have been selected for the car. As Michael A. West (2012) explains, negative brainstorming can help find flaws in proposals constructively and provide an opportunity to think about better solutions, and that is exactly what was missing here.

Conclusion

Even though this was just a simulation, I took it seriously from start to finish, and because of that I learned what I should improve in myself. Looking into the future, I cannot let such minute troubles or fear of speaking out affect me or my work as these two incidents did.

If I was more relaxed and had analyzed the data that was in front of me, instead of relying on ideologies of perfection and imagining infinite scenarios of "what if", such a small incident about the decision of an investment project would have never affected me. A more straightforward approach with more confidence is the lesson to be had.

Ease of communication and transparency would have resolved the Sado E development, pushing my team towards the top. An improvement in my relationship management and social awareness skills would also contribute to not have such conflicts in the future (Bradberry and Greaves 2009). But it is adaptability that is the main lesson of this incident.

The current situation demanded a change of plan, and my stubbornness was in the way.

This experience opened my eyes to what I just work on in order to be better prepared for the real world, where such incidents will have much worse consequences, and for that I am grateful.

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Appendix:

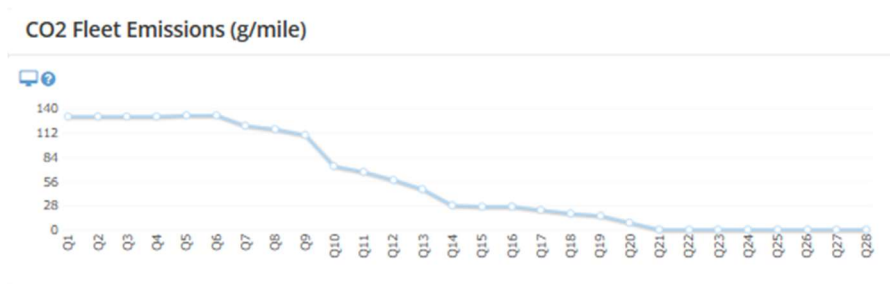
Appendix 1: CO2 Penalty/Bonus of Quattro Motors

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industrymasters.com/>



Appendix 2: CO2 Fleet Emissions (g/mile) of Quattro Motors

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industrymasters.com/>



Appendix 3: Autonomous Driving's fourth investment project – Secure Infrastructure

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industrymasters.com/>



Secure Infrastructure



Secure Infrastructure Investment	\$400M
Investment Budget	\$707M
Depreciation Period	8 Years
Annual Depreciation	+\$48.00M
Implementation Time	2 Business Quarters

Fully automated and autonomous driving will soon be available everywhere. One prerequisite is the development of software, algorithms and infrastructure for a secure autonomous driving system.

✓ Commit✕ Close

Appendix 4: Battery technology management issue

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industrymasters.com/>

Management Issue



Battery technologies are crucial for economic success and the achievement of sustainability in electromobility. Decide about the future battery technology of your fleet.

LFP: Existing Chemistry, Limited Energy Density at a cell level, Inherent Safety means competitive performance at a pack-level. This equates to limited range (about 250miles range), but does allow for fast charging rates (10min. for 80%). Less technology innovation needed. Using more abundant raw materials (carbon). A lithium iron phosphate (LFP) battery is a type of lithium-ion battery that is capable of charging and discharging at high speeds compared to other types of batteries.

Solid State: Requires innovation on chemistry and pack level. Whereas solid-state batteries use a solid electrolyte and provide a smaller size with higher energy density, longer lifespan, and increased safety.

Be aware of the economical, ecological and ethical impacts.

LFP-Blade Technology ⓘ

More...

Solid State Technology ⓘ

More...

You have made 0 out of 1 allowed choices

Appendix 5: Battery variant management issue

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industrymasters.com/>

Management Issue



You have to decide which of the available battery variants you will use for your cars. The cheaper variant enables considerable cost savings, but is not certified to the EU & UN specifications (Ethical Sourcing & Recycling) yet. This could possibly lead to problems later and thus also to dissatisfaction among your customers.

Solid State Expensive ⓘ

More...

Solid State Cheap ⓘ

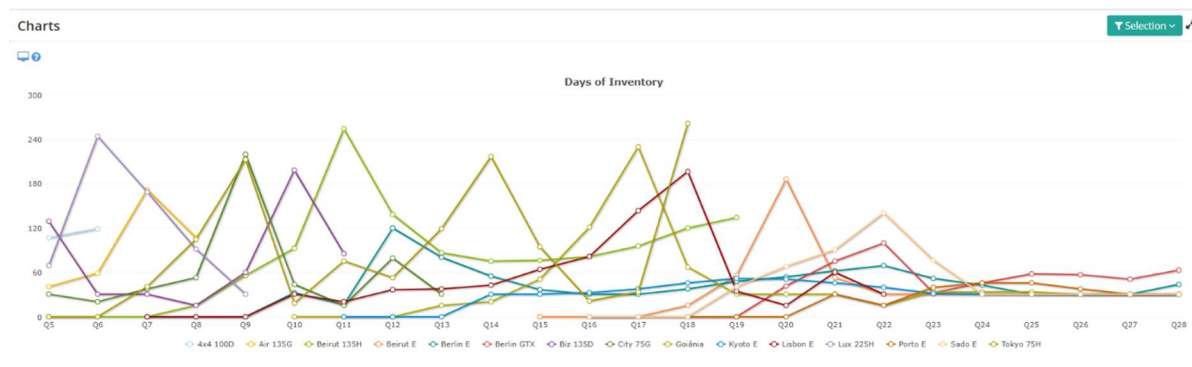
More...

You have made 0 out of 1 allowed choices

⚠️ You cannot proceed to the next period without making a decision

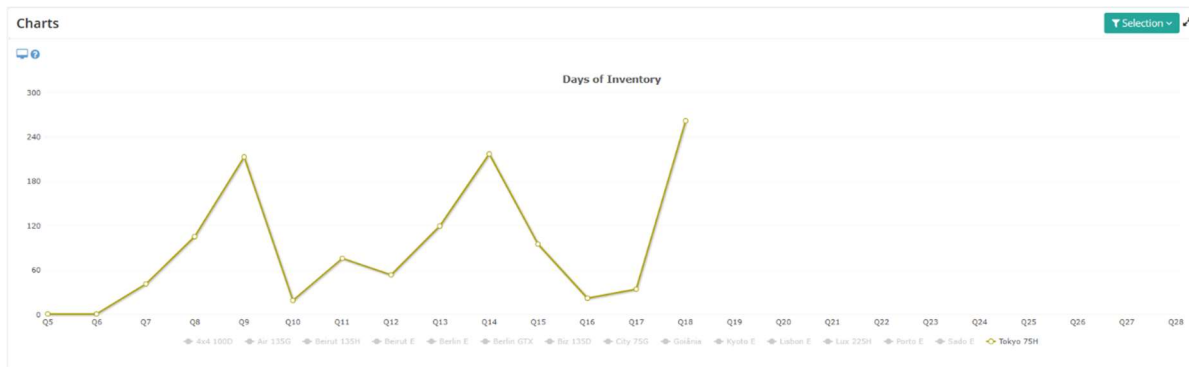
Appendix 6: Days of Inventory of every Quattro Motors car

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industrymasters.com/>



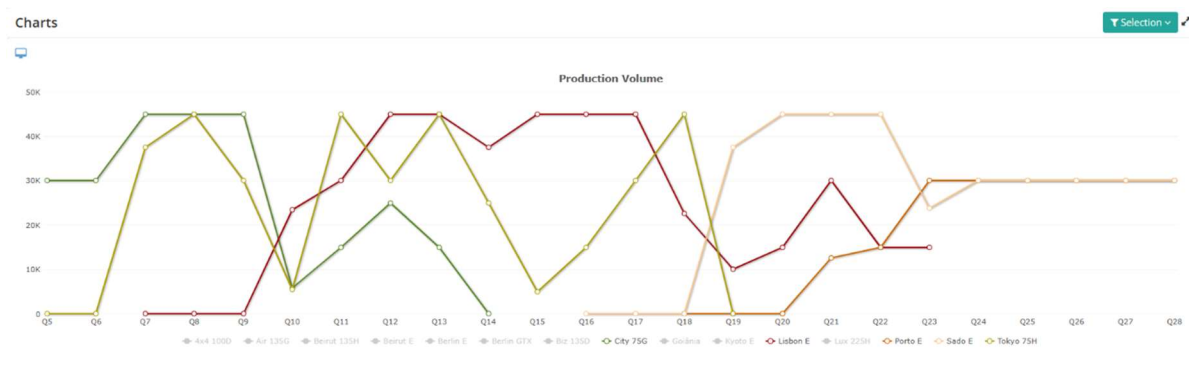
Appendix 7: Days of Inventory of Quattro Motors' Tokyo 75H

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industry-masters.com/>



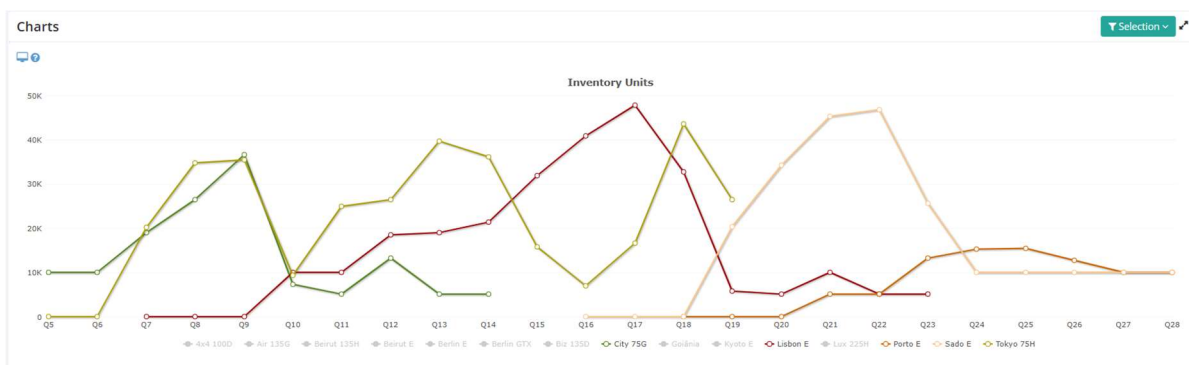
Appendix 8: Production Volume of each Compact and Micro Quattro Motors' car

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industry-masters.com/>



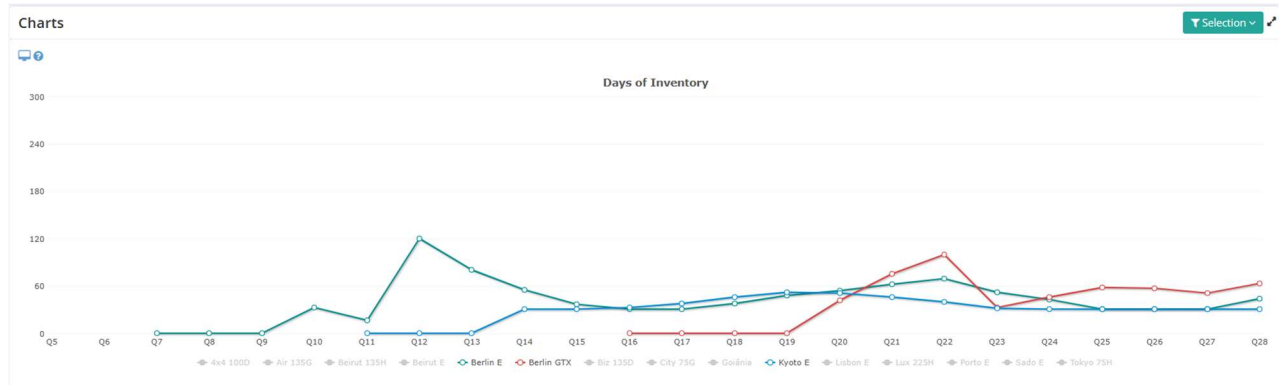
Appendix 9: Inventory Units of each Compact and Micro Quattro Motors' car

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industry-masters.com/>



Appendix 10: Days of Inventory for the SUV Kyoto-E and the Luxury cars Berlin-E and Berlin GTX

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industrymasters.com/>

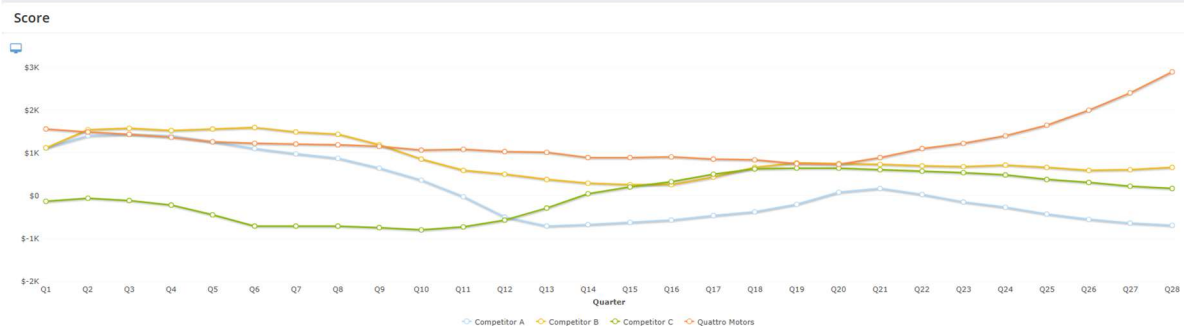


Appendix 11: Markets' ranking by Value-Added.

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industrymasters.com/>

Rank	Corporation	Marketing Mix	Credit Rating	Debt Ratio	Revenue	EBIT Margin	Share Capital	CO2	Value Added
1	Quattro Motors (7*)		A-	50%	\$7,008M	29.8%	\$9,300M	0.00g/mile	2,891.50
2	Competitor B (7*)		AAA	15%	\$5,562M	16.4%	\$10,000M	8.76g/mile	665.20
3	Competitor C (4*)		AAA	0%	\$2,960M	13.0%	\$10,000M	0.00g/mile	164.70
4	Competitor A (7*)		A+	32%	\$5,207M	8.0%	\$10,000M	6.23g/mile	-698.00

* Number of Products



Appendix 12: Cars' ranking by revenue generated.

Source: Industry Masters, 2023. <https://msp-novasbe-eu.industrymasters.com/>

Total Sales by Product

Rank	Product	Manufacturer	Type	Sales	Price	Revenue	Segment Market Share
1	Goiania	Quattro Motors	Executive Electric Class	29,752	\$47,231.67	\$1,264M	6.1%
2	Berlin GTX	Quattro Motors	Luxury Electric Class	12,828	\$96,642.26	\$1,128M	5.4%
3	Berlin E	Quattro Motors	Luxury Electric Class	12,659	\$93,738.48	\$1,093M	5.3%
4	Kyoto E	Quattro Motors	SUV Electric Class	15,000	\$75,045.80	\$1,033M	5.0%
5	Lux-E	Competitor B	Luxury Electric Class	13,901	\$79,873.91	\$1,012M	4.9%
6	Biz-E	Competitor A	Executive Electric Class	27,356	\$39,922.88	\$976M	4.7%
7	Lux-E	Competitor A	Luxury Electric Class	13,559	\$77,978.97	\$970M	4.7%
8	Porto E	Quattro Motors	Compact Electric Class	29,994	\$36,139.75	\$966M	4.7%
9	C 1 140E	Competitor C	Luxury Electric Class	13,974	\$75,355.96	\$965M	4.7%
10	Air-E	Competitor A	Convertible Electric Class	21,999	\$48,163.36	\$961M	4.6%

Appendix 13: Peer & Self-Assessment chart

Source: Moodle Nova SBE, 2023. <https://moodle.novasbe.pt/>

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