# Decision Making in a Complex Environment

## BOCR: Final Project

## April 26, 2022

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## Objective

The objective of this project is to determine if Apple should pursue a future in the automobile industry by either producing their own fully autonomous vehicle, “Project Titan”, or expand their CarPlay infotainment system into a more diverse and functional driving system in car brands that currently exist today.

# Background

The history of Apple is no secret and is widely known to the people of the Tech world. Steve Wozniak and Steve Jobs worked together in a garage to produce their very first computer in 1977, 55 years ago! Without going into a full timeline of the Apple, Inc organization, we will jump to 2014 when Apple launched ‘Project Titan’, a project to create and manufacture a fully autonomous vehicle, like Tesla’s Model S. After dominating the mobile device industry after the iPhone was introduced in 2007, Apple’s next target was the car industry.

CarPlay, Apple’s own software infotainment system, was introduced in 2014 and has been implemented in most car brands we see today. This is just a glimpse of what Apple can do in the automobile industry. However, since 2014 Project Titan has been through rough waters. It’s progress slow and problematic due to executive leadership changes and failed contract negotiations. Apple was having a hard time finding suppliers and manufacturers for car parts that agreed to their terms and conditions. Apple wanted more control into the look and feel of the vehicle. In 2016, Project Titan was not working out, so Apple had to shelve it. Rumors spread that in 2020, the Project was back on track and has been ever since.

Now that Apple has touched grass in the automobile industry with their CarPlay system, should they break the market barriers and create their own autonomous vehicle? If not, what are their other alternatives?

## Model Outline

The model used in this analysis is the BOCR model; Benefits, Opportunities, Costs and Risks being the top-level criteria. Each top-level criteria contains a sub-network of criteria. This report will go through each BOCR and its sub-criteria. The next section of this report will lay out the synthesized results of each top-level criteria. The model is designed to evaluate the decision based on four alternatives. These alternatives include:

1. Do Not Invest in a fully autonomous car
2. Invest in software used in delivery vehicles (UPS, FedEx, USPS, etc…)
3. Expand and invest in software used in other car brands within the industry (Lexus, Jaguar, Toyota, etc…)
4. Manufacture their own autonomous vehicle, fully branded and designed by Apple

Next, the strategic criteria used to evaluate the final decision in the model include **Accessibility**, or how integrated Apple's software products are in relation to each other and their usefulness in everyday activities. **Artificial Intelligence**, Apple is all about technological advancements. **Growth**, the organization as a whole and empowerment of the employees. **Innovation**, continuing the research and development of technology. **Market Expansion**, looking beyond the mobile and computer device industry. The last strategic criteria and arguably the most important is **Safety**, keeping consumers safe when using Apple's products.

Diving into the sub-criteria of the BOCR model, the nodes here were determined based on factors that revolve around the previously mentioned strategic criteria and things Apple should consider when making such a major decision. Looking at Benefits first, the nodes were split between the control criteria 'Economic' and 'Operational'. These two control criteria remain consistent through each top-level criteria. For Economic benefits, the Market and Financial clusters were evaluated. Apple's Brand equity, market share and pricing power are included here. For the Economic financial benefits there is Sales Revenue and Asset Diversification. This means that Apple is expanding is product base, not relying on just one industry for their source of income. Expanding into another industry expands their portfolio of products they offer, so if tough times were to come they would have a safety net of products

that could keep them above water. Operational Benefits are Technology and Asset Portfolio. Technology benefits include accessibility and data collection. Asset Portfolio include product variety and stocks.

Next top-level criteria are Opportunities. It also has the 'Economic' and 'Operational' control criteria in which each has its on sub-net factors. The economic opportunities for Apple include Financial and Loyalty. Market Expansion, Sales Revenue and Brand reputation and a new customer base respectively are the nodes within these sub-criteria. A new customer base is huge for Apple, as it provides a new source of revenue and reputation amongst the public. The operational opportunities are related to Software and Relationships with third parties. AI enhancements, cross-functionality between devices and contractor, manufacturer, and supplier relationships are up for grabs. If Apple is successful in implementing any one of these alternative decisions (besides not investing at all), their network of third-party vendors and suppliers can only improve.

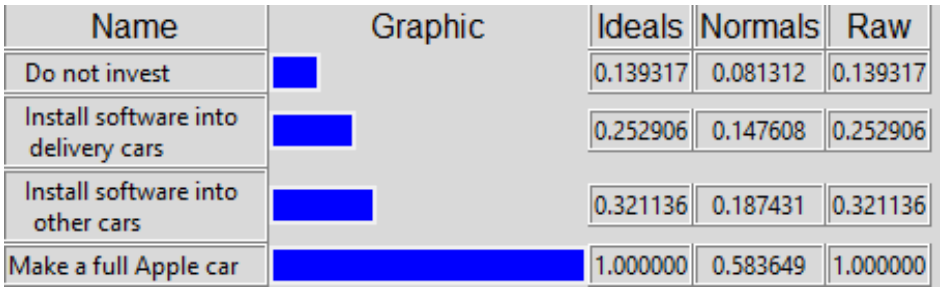
We move on to Costs. Under the control criteria of 'Economic', those costs include Marketing and Barriers of Entry. Ads, Commercials, and sponsorships to name a few. Apple also must face the economic costs associated with barriers to entry of the automobile industry – economies of scale, regulatory fees and manufacturer/supplier loyalty. The operational costs for each alternative include Human Capital, Technology and Production. The nodes for these include Job re-alignments, new hires, and training. For technology, there are contract fees, integration and migration of software and maintenance of the implemented software a.k.a. upgrades/updates. Finally, production costs include overhead, R&D, supplies, and methods used for distribution of the products.

Last are the Risks. Economic risks involve the Market and Finances. The barriers of entry are not only going to costly as we mentioned but they may just be too much to overcome. Competition is great in the automobile industry and Tesla's foot in the autonomous vehicle sector may prove to be too much to compete with. Consumer reactions and economies of scale are other economic risks Apple will have to face. Financial risks include excessive production costs that were not anticipated, low margins and overpricing. Operationally, the Production and

Apple's Reputation are at stake. The production risks include quality, safety, liabilities, Security (Hacking), and software failures. Autonomous driving and any kind of software in a vehicle can easily fail and have the potential to severely harm anyone who is in the vehicle and those on the road around them. Lastly, the risks involved with Apple's reputation include customer satisfaction, employee burnout, and failed contract negotiations. Apple may spend maybe resources and time on an autonomous car just to have a supplier or manufacturer of a needed part bailout or refuse service based on terms and conditions that Apple has set forth.

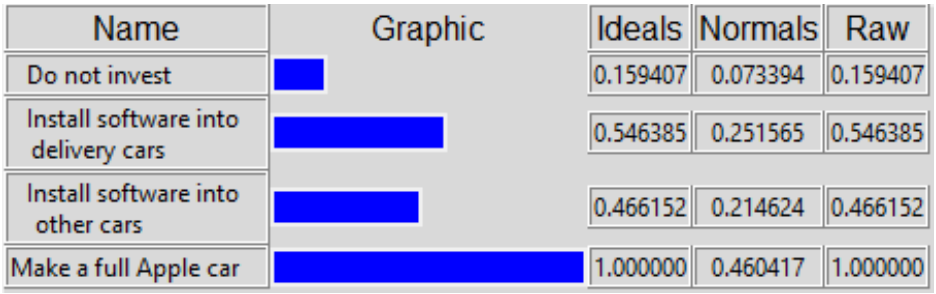
All these factors must be considered when evaluating the strategic criteria. Once the network connections of the model have been placed and pair-wise comparions have been entered, the following screenshots reveal the conclusions made by the model.

1. Benefits



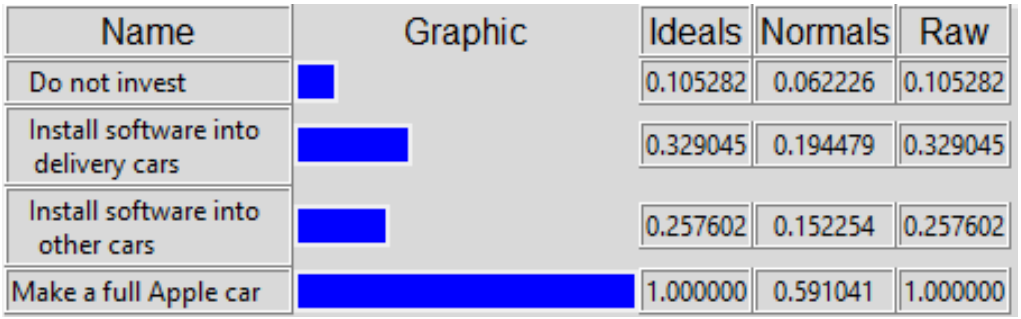
| Name | Graphic | Ideals | Normals | Raw |
|---|---|---|---|---|
| Do not invest | | 0.139317 | 0.081312 | 0.139317 |
| Install software into delivery cars | | 0.252906 | 0.147608 | 0.252906 |
| Install software into other cars | | 0.321136 | 0.187431 | 0.321136 |
| Make a full Apple car | | 1.000000 | 0.583649 | 1.000000 |

2. Opportunities



| Name | Graphic | Ideals | Normals | Raw |
|---|---|---|---|---|
| Do not invest | | 0.159407 | 0.073394 | 0.159407 |
| Install software into delivery cars | | 0.546385 | 0.251565 | 0.546385 |
| Install software into other cars | | 0.466152 | 0.214624 | 0.466152 |
| Make a full Apple car | | 1.000000 | 0.460417 | 1.000000 |

3. Costs



| Name | Graphic | Ideals | Normals | Raw |
|---|---|---|---|---|
| Do not invest | | 0.105282 | 0.062226 | 0.105282 |
| Install software into delivery cars | | 0.329045 | 0.194479 | 0.329045 |
| Install software into other cars | | 0.257602 | 0.152254 | 0.257602 |
| Make a full Apple car | | 1.000000 | 0.591041 | 1.000000 |

4. Risks

| Name | Graphic | Ideals | Normals | Raw |
|---|---|---|---|---|
| Do not invest |  | 0.073291 | 0.045302 | 0.073291 |
| Install software into delivery cars |  | 0.316858 | 0.195854 | 0.316858 |
| Install software into other cars |  | 0.227676 | 0.140729 | 0.227676 |
| Make a full Apple car |  | 1.000000 | 0.618114 | 1.000000 |

Additive Formula Results

| Name | Graphic | Ideals | Normals | Raw |
|---|---|---|---|---|
| Do not invest |  | 0.449998 | 0.198799 | 0.028767 |
| Install software into delivery cars |  | 0.521507 | 0.230390 | 0.033339 |
| Install software into other cars |  | 1.000000 | 0.441778 | 0.063928 |
| Make a full Apple car |  | -0.292076 | -0.129033 | -0.018672 |

Multiplicative Formula (Short-Term)

| Name | Graphic | Ideals | Normals | Raw |
|---|---|---|---|---|
| Do not invest |  | 1.000000 | 0.377283 | 2.822335 |
| Install software into delivery cars |  | 0.475687 | 0.179469 | 1.342549 |
| Install software into other cars |  | 0.820526 | 0.309571 | 2.315799 |
| Make a full Apple car |  | 0.354317 | 0.133678 | 1.000000 |

## Decision

Interestingly, the two formulas produce a different set of results that do not match in the order for the alternatives. Making a full Apple Car is the least desirable in both set of results. After a close call, It seems that the alternative for installing software into other cars would be the final determination for Apple because that alternative appears in the top 2 for both set of results. Even though ‘Do Not invest’ appears at the top for the short-term, it is next to lowest desirable decision in the long term. Therefore, the final decision Apple should make in how they approach the automobile industry based on the structure of the model and it’s factors would be to invest and install their own software into other models of cars.