Owner and Contractor in the Defense Industry: Two Sides at War[1, 2]

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ABSTRACT

The following paper constitutes the author's effort towards the "International Project Contracts" course at SKEMA Business School, in the context of a "Programme and Project Management and Business Development (PPMBD)" Master Degree.

In it, the author will study in details the following real-life transaction: the sale of 40 F-35As fighter jets by the Lockheed Martin corporation to the country of South Korea. Because of the heavy sums of money involved and the length it takes for the deliverables to be ready, it is important for both parties to understand exactly what each delay and acceleration might imply in terms of costs and other benefits. Extrapolating from real or assumed data, the author will try to establish a coherent analysis of the timeframe involved, and what each potential delivery date can mean for both the owner and contractor, essentially answering the question: "When is the best time for Lockheed martin to deliver?"

Coincidentally, we will see that in this case, the expected delivery date is the best compromise, but many other alternatives deserve consideration. This will allow us to discuss the pros and cons of taking risks to maximize profit, perhaps at the expense of healthy business relationships.

Keywords: military, defense, aircraft, international, contractor, time, cost, trade-off, optimum

INTRODUCTION

Time, costs and quality are often considered the three critical variables of any given project. It is generally agreed upon that compromising on quality is unacceptable, and this especially true

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in the defense industry, where said quality can make the difference between victory and defeat, power and impotence, and even life and death; and where contractors engage their whole reputation on every task they undertake.

Thus, we are left with time and costs as the variables at the front of everyone's thoughts. They are, of course, just as critical as quality when it comes to deliver a defense project ; tensions do no wait for weapons to finish assembling to escalate, and the enormous costs involved, coming directly from the pockets of the state and thus the taxpayers, are under close scrutiny. But unlike quality, they are expected to vary much more, and what may be favorable for one party, such as a faster delivery of the goods ordered by the owner, may not be beneficial for the contractor and vice-versa.

For this reason, in order to maintain a harmonious and healthy business environment, project owners and contractors both need to be aware, on any given project, of their own personal cost/time optimums, and agree on a compromise that will be mutually beneficial. Finding out what it is is of course no simple task, but for the purpose of this paper, the author will use the real-life example of the March 2014 purchase of 40 F35-A fighter jets by South Korea from Lockheed Martin, the world's largest defense contractor. The transaction will amount to $7 billion and the delivery date has been set to be between 2018 and 2025 and with an expected date of 2021 by South Korea, which, in the author's opinion, makes it a suitable time range to assume the possibility of acceleration initiative and delays. Using estimates to fill the missing data, the author will follow the footsteps of the excellent analysis of the US Department of Transportation in the Federal Highway Agency's document "Work Zone Road User Costs Concepts and Applications" figure 15, which also served as inspiration for Stephen J.C. Peterson's entirely theoretical case study of an oil and gas facility project. The author will hopefully manage himself to determine a comprehensive document illustrating the time/cost optimums for both South Korea and Lockheed Martin, and then suggest a good balance of interests. It is hoped said model can then be applied to other projects in the defense industry, and inspire contractors and owners of all kinds.

All this can be summed up in a single problem statement: "When is the best time for Lockheed Martin to deliver the F-35As to South Korea?"

METHODOLOGY

First, the author will determine the Contractor curve, which, in this case, is Lockheed Martin. The author will use the following numbers, interpreted directly from Lockheed Martin's public statements:

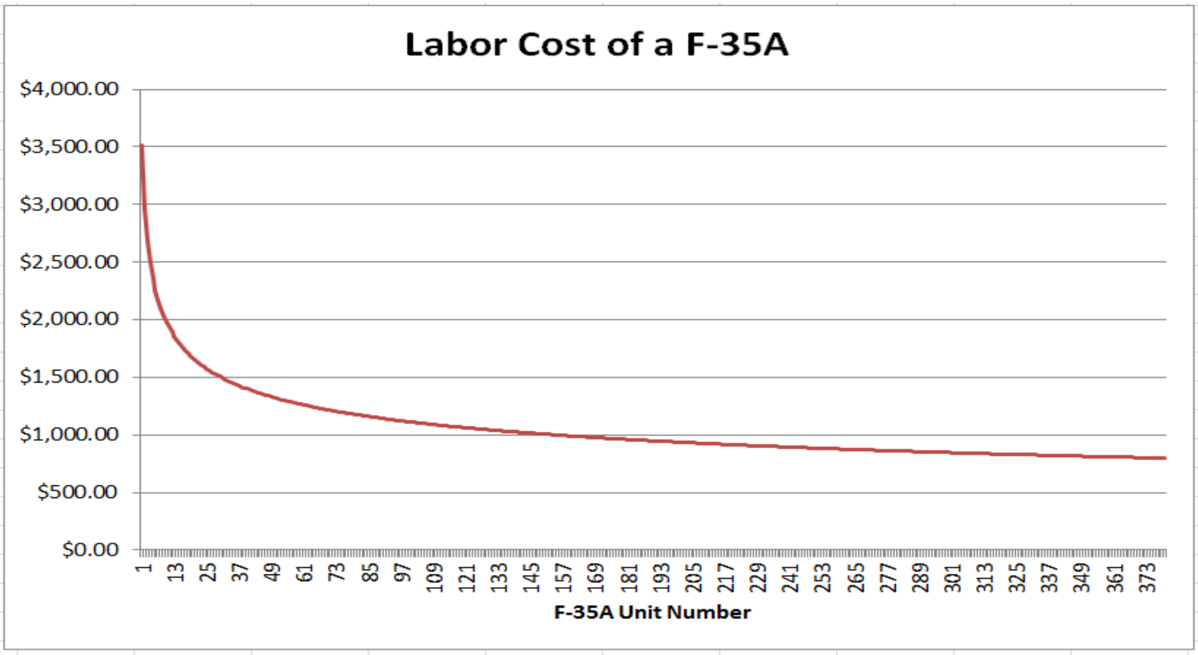
- As of 2016, the estimated labor time to build a F-35A is of about 45,000 hours, which is a striking difference from the 160,000 hours needed to build the first one in 2006 and justifies a Learning Curve approach for the Lockheed Martin curve.

- As of March 2017, 231 F-35 (all variants combined) have been produced. The author estimates the total number of F-35s to have been produced in 2016 to be of around 200, and among them, 180 F-35As.

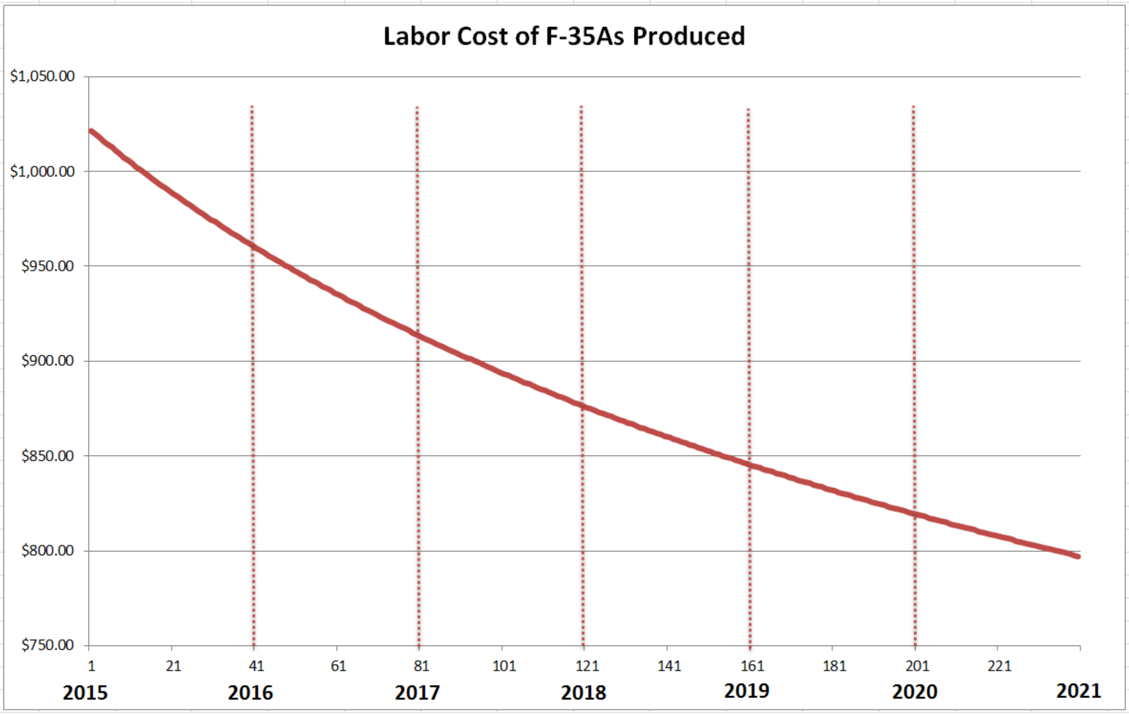
- Since 2015, around 45 F-35 are produced per year. Using the same estimates as before, that gives us 40 F-35A.

- This is enough to calculate the Learning Curve Factor (estimated at b = -0,25), and thus, the learning curve of Lockheed Martin. We will calculate the direct labor cost by multiplying the time with a standard labor rate of $22/hour.

We were able to calculate the labor cost of the 180 units already produced. A single F-35A will be cheaper if it is produced later in the future. Thus, we will now determine the curve of total cost all the way to 2021, where in total, 380 F-35A will have been produced.



For the purpose of this case however, we are only interested in the Labor Cost of Unit 140 to 380, which represent the F-35A produced from 2015 to 2021. Thus, we obtain:



In that situation, we can see there are no costs for the contractor associated with delays within the time range of the contract; as a matter of fact, it would technically be advantageous to spread out production.

To illustrate that, we calculate the cost of finishing the production at any given year, using the assumption that production would be spread evenly accross the years: delivering at the start of 2016 would mean producing 40 Units during the year 2015, using the average cost labor for a unit during the year and multiplying it by 40; delivering at the start of 2017 would mean producing 20 units at the average price of 2015 and 20 units at the average price of 2016, and so on.

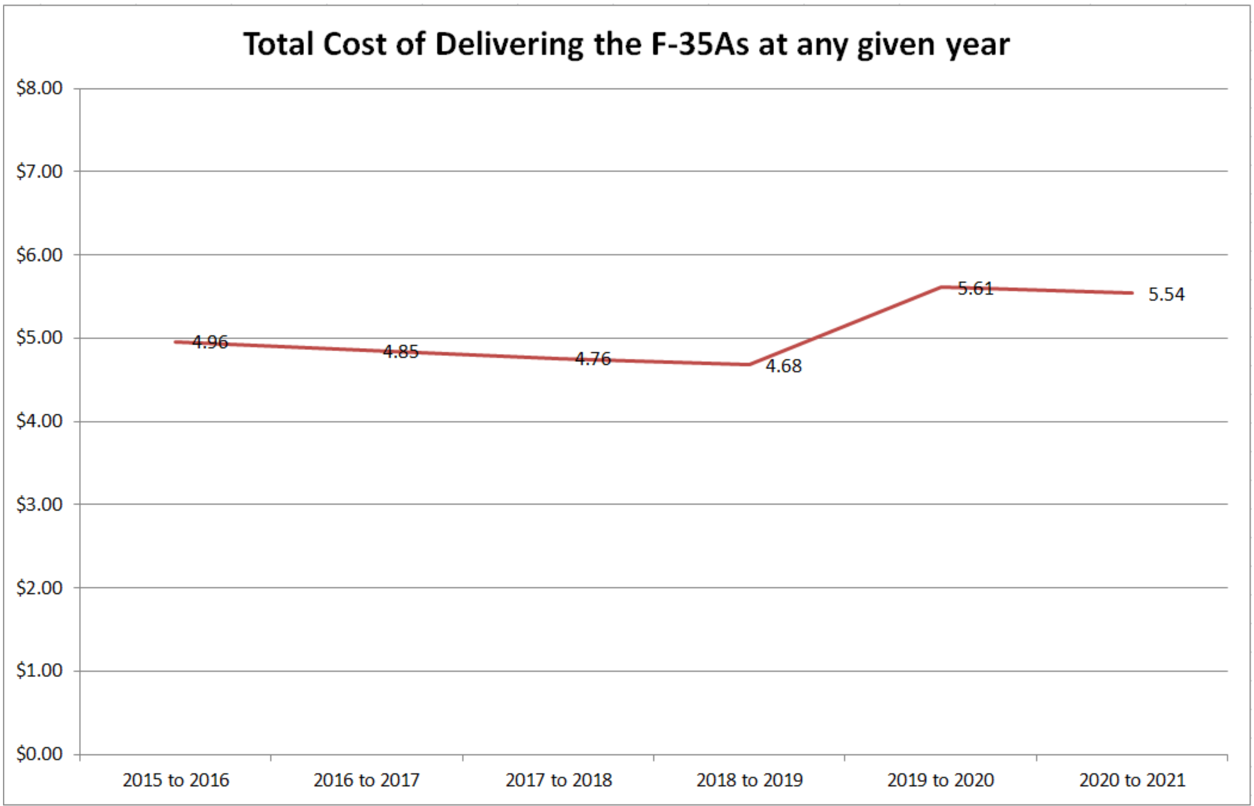
However, because the delivery date is supposed to be 2018, it can be expected for Lockheed Martin to face a penalty if they deliver after, which will estimate at a flat 1 billion that takes effect immediately after 2018 has elapsed and represents money that will be reimbursed to South Korea.

On top of that, we can add 1 billion per year to every single year to represent miscellaneous expenses, opportunity costs and the R&D needed to lower the cost of labor in the first place.

Thus, we obtain these numbers:

Year of Delivery	Total Cost of 40-F35As
2015 to 2016	4.958883
2016 to 2017	4.851482
2017 to 2018	4.759133
2018 to 2019	4.680559
2019 to 2020	5.610249
2020 to 2021	5.54373

(in billions of dollars, note the addition of the penalty fee from the year 2019)



This curve now accurately reflects the costs involved for Lockheed Martin.

To complete it and find the answer to our problem statement, we need to overlap it with the curve representing the payments from North Korea.

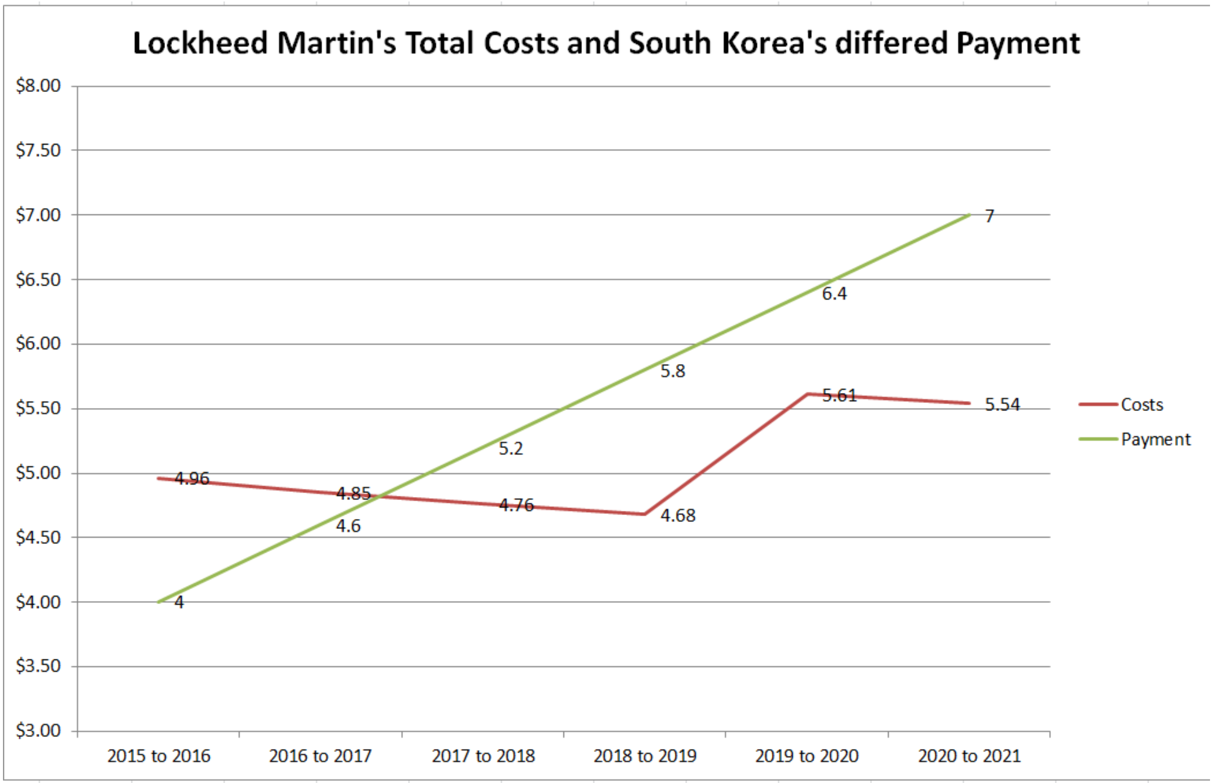
The author will use the following numbers:

- As mentioned before, the transaction will amount to a total of 7 billions, which will be paid fully in 2021 at the end of the program.

- Of those 7 billions, 4 billions will be paid up front to Lockheed Martin, and the remaining 3 billions will be paid in increments each year until 2021.

Year of Delivery	Money paid to Lockheed Martin
2015 to 2016	4
2016 to 2017	4.6
2017 to 2018	5.2
2018 to 2019	5.8
2019 to 2020	6.4
2020 to 2021	7

Using those, we trace the curve in the same chart as Lockheed Martin's costs:



This final graph will serve as a basis for our analysis of when it is better for Lockheed Martin to deliver the goods.

FINDINGS

The first thing to remember is that, no matter what happens, Lockheed Martin will eventually be paid 7 billions dollars, or 6 billions if they deliver after 2018, which here is counted as an additional cost on the graph. The question then becomes, "When is it most advantageous for them to deliver the final F-35As to South Korea?"

Using the graph obtained earlier, we were able to determine the pros and cons of each year.

F-35As delivered by :	2015 to 2016	2016 to 2017	2017 to 2018	2018 to 2019	2019 to 2020	2020 to 2021
South Korea Satisfaction :	Very High	Very High	High	High	Very Poor	Very Poor
Feasibility on LM's side :	Very Poor	Very Poor	Poor	Medium	High	Very High
LM Profit at the time of the sale:	-0.96	-0.25	0.44	1.12	0.79	1.46
Final LM Profit :	2.04	2.15	2.24	2.32	1.39	1.46
Total :	11	12	14	16	12	14
	Very Poor	Poor	Medium	High	Very High	
	1	2	3	4	5	

- **Delivering before 2016** is not only unrealistic, it would drive Lockheed Martin into a heavy deficit that would only be compensated the year after. Also, it would mean monopolizing the production to South Korea, which may not be well received by Lockheed Martin's other partners. While South Korea would certainly be happy to get its planes that early, all this make it a **VERY POOR** option.

- **Delivering before 2017** is only slighly more feasible, and also incurs a deficit at the time of the transaction. The final profit on Lockheed Martin's side is a bit better, but not enough to justify rushing, making it a **POOR** option.

- **Delivering before 2018** becomes profitable at the time of the sale, and starts being part of the realm of the possible. The final profit realized is comparatively very good, making it **ONE OF THE BEST** options.

- **Delivering in 2018** not only meets the target fixed by South Korea, it offers one of the highest profits at the time of the sale and the highest final profit, due to the absence of penalty and the decreased cost of labor. While not the easiest target to meet on Lockheed Martin's side, the incentives should be enough for it to be considered the **BEST** option.

- While **delivering before 2020** may just be one year later, it's a pretty terrible idea ; the penalty hits full force, disminishing the final profit drastically and South Korea's satisfaction. It may be easier to do for Lockheed Martin, it remains **ONE OF THE WORST** realistic options.

- **Delivering before the 2021 deadline** is, surprisingly, not too bad of an idea as far as Lockheed Martin is concerned. While the final profit might be lower, 6 years of passive income and a decent profit at the time of the sales are more than enough to compensate. However, South Korea's satisfaction will be so low it might void the possibility of future sales. The author considers that a **DECENT, BUT RISKY** option.

CONCLUSIONS

Perhaps a bit unsurprinsingly, delivering at the convened upon time is certainly the best compromise, and in hindsight, it may certainly be why the date was chosen in the first place. No doubt similar analyses have been run by Lockheed Martin's expert; for that reason, the author is optimistic this paper was at least pertinent.

Still, the presence of two other warrants consideration : delivering one year ahead of time (during 2017) in an effort to greatly increase South Korea's satisfaction, achieving a similar profit but no doubt going a bit faster than what may be comfortable with the defense contractor ; or delivering at the very last minute, which may displease South Korea greatly but still allows for a good profit and a lot of leeway for Lockheed Martin, making them free to pursue other opportunities with their production output.

As any planning expert knows, contracted projects are all about gauging the pros and cons of accelerated, delayed and on-time delivery. In the case of multi-billion, years-long projects such as the one observed here and in the Defense sector in general, there is sometimes no objectively best solution, and the chosen alternative will be a matter of the contractor's own priorities.

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APPENDICES

Calculation of the Learning Curve Factor

$T_n=T_1n^b$ where:
n = the unit number (180th unit)
T^1 = the amount of time to produce the first unit (45k hours)
T_n = the amount of time to produce unit n (160k hours)
b = the learning curve factor

$$45 = 160 \cdot 180^x \quad : \quad x = \frac{\ln\left(\frac{9}{32}\right)}{\ln(180)} \quad \left(\text{Decimal:} \quad x = -0.24428\ldots\right)$$

About the Author

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Arthur Vaesken, MSc in "Project and Programme Management & Business Development" at SKEMA Business School, is a student with extensive international experience. He is accustomed to working in the United Kingdom, France, and the USA, having done several long-term internships there in domains such as web development, web and traditional marketing, factory logistics, and project management. His most notable achievement so far is promoting a fertility clinic owned by an eminent North Carolinian surgeon during a year-long internship, where he reworked the clinic's website from the ground up, improved its visibility online and deployed various marketing strategies to bolster its business. He speaks fluent English and French, moderate Spanish, and basic Japanese.

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