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The Client-Supplier Relationship in Managing Innovation: Delineating Defence Industry First Mover Challenges within the Government Contract Competition

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***Abstract*—**All companies are confronted with the need to innovate in order to meet market demands. In so doing they are challenged with the dilemma of whether to aim to be first into the market with a new innovative product, or to deliberately wait and learn from a pioneers' mistakes; potentially avoiding higher risks. It is therefore important to critically understand from a first mover advantage and disadvantage perspective the decision-making implications of defence industry transformation onset by an innovative paradigm shift. This paper will argue that the type of industry characteristics matter, especially when considering what role the clients play in the innovation process and what their level of influence is. Through investigation of qualitative case study research, this inquiry will focus on first mover advantages and first mover disadvantages with a view to establish practical and value-added academic findings by focusing on specific industries where the clients play an active role in cooperation with the supplier innovation. The resulting findings will help managers to mitigate risk in innovative technology introduction. A selection from several defence industry innovations is specifically chosen because of the client–supplier relationship that typically differs from traditional first mover research. In this instance, case studies will be used referencing vertical-take-off-and-landing defence equipment innovations.

***Keywords*—**Innovation, pioneer, first mover advantage, first mover disadvantage, risk.

I. Introduction

A. The Management Problem and its Importance

A first mover company introducing an innovative product is likely to be confronted with substantial investment costs and risky challenges. Porter describes first mover advantage as an advantage gained by a company that is first to introduce an innovative product into a market [1]. Contrary to thinking, being the 'first' can also present additional challenges making it also a disadvantage [1]. As taken from Kerin et al., "The foregoing discussion indicates that the notion of first-mover advantage is a complex phenomenon as the current literature suggests" [2, p.48]. This is a perplexing dilemma for incumbent companies because they have already financially invested and entrenched themselves in a previously proven product [3]. Decision makers for the entrenched company must decide to risk (or not to risk) pursuing the switchover. This problem is made more complicated by the introductory timing of the innovation; company leaders must decide between whether to be the first mover innovator, or among the first, or to perhaps just wait and learn from previously addressed mistakes by competing pioneers also on a similar pathway for change.

B. Determination of the Research Problem

This research problem is best expressed by the title of the book written by Christensen; "The Innovator's Dilemma: New Technologies Cause Great Firms to Fail" [4, p. book cover] which exposes the problematic dilemma: Should established companies become an innovative first mover or should they wait and become a follower? Both strategies have their own unique advantages and disadvantages [4]. "The inability to anticipate new technologies threatening from below and to switch to them in a timely way has often been cited as the cause of failure of established firms and as the source of advantage for entrant or attacking firm" [4, p.39]. The justification for being a first-mover, or not, is explained in the detail by Porter whom states; "Technological innovations can have important strategic implications for individual companies and can greatly influence industries as a whole. Yet, not all technological change is strategically beneficial*."* [5, p.70]. He focuses on ways to recognize and exploit the competitive significance of change.

C. The Research Problem

Existing research has investigated a cross-section of industries and highlighted some conditions favouring being first into a market as well as being a follower. But it is not clear whether the defence equipment industry, given its unique characteristics, is affected in an identical manner by first mover advantages when compared to other types of industries. Given the unique nature of the defence industry innovation process, this may highlight important differences between the client/supplier relationships versus common market industries. As highlighted by Kerin et al., from this researcher's perspective, it would be interesting to understand whether the "First mover advantage denotes competitive advantages arising from market entry timing. The overall magnitude of positional advantages accruing to the first mover depends on the comprehensive competitive strategies employed by the pioneer and followers, in concert of the timing" [2, p.46].

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D. The Subject Matter Interest

This research is interesting from Christensen's "innovator's dilemma" perspective, as stated by Christensen et al. "the risk in change-over can be much greater than for other types of industries" [6, p.2]. Industries that cling onto existing technologies without thought to innovative improvements put themselves at risk. As Hargadon noted, "It's easy to single out organizations that couldn't let go of their old knowledge, refusing to see and adapt to breakthrough technologies that pushed them aside. Often, however, these are the very same organizations that led the previous revolution (an innovative product and making gains from first mover advantages). Somehow, these visionary firms went blind" [7, p.73]. As exclaimed by Porter; "For, example, even a company with a strong position in an industry unthreatened by potential entrants will earn low returns if it faces a superior or lower cost substitute product." [8].

E. The Goal of this Research

This research will better explain the challenges posed in the client-supplier relationship within defence equipment innovation. The following specific research question will be addressed: What are the key factors affecting first-mover advantage in defence equipment innovation?

This paper is structured as follows: first, there will be a review of existing literature concerning first mover advantages and disadvantages. Second, there will be a description of the methodology. Third, there will be a presentation and discussion of the results. Finally, there will be a highlight of the contributions as well as limitations of the research.

II. Literature Review: First Mover Advantages and Disadvantages

Porter's pioneering research concerning first mover advantage is focused on the use of technology; an essential ingredient in a company's overall competitive strategy [1]. "However not all technological change is strategically beneficial; it may worsen a firm's competitive position and industry attractiveness." [1, p.165]. Porter provides a synthesis of what has already been developed from previous research. Referring to the military industry and the commercial aircraft industry, Porter makes the following statement: "The pattern of technological evolution is the result of a number of characteristics of an industry, and must be understood in the context of overall industry structural evolution. Innovation is both a response to incentives created by the overall industry structure and a sharper of that structure." [1, p.194-195].

According to Schilling, entrants into markets are often divided into three categories; first movers, early followers, and late entrants [9]. This research has suggested the first firm into market is often times the first to fail, causing early followers to outperform first movers. A number of factors influence how timing of entry affects firm survival, risk, and profits [9]. Of concern are companies that are new to the design and manufacture of an innovative product and will face unexpected issues that would otherwise prevent a first mover from successfully launching product into market [10].

In their article "First-Mover Advantages" Lieberman and Montgomery explain that a more precise mapping between industry characteristics and first-mover mechanisms may be useful. Empirical studies have not been able to unambiguously show that first mover advantage exists, and agreement on their effect and importance seems to be limited to by content in previous research [11].

Utterback adds a new level of complexity with the idea of dominant design and that there are no superior innovations per se. A lot depends if the innovation is convergent within the majority of players [3]. Utterback states that: "Firms that are unable to make the transition toward greater process innovation are unable to compete effectively and very often fail" [3, p.30].

Though this research is not about disruptive innovation, Christensen's research concerning "disruption" highlights the idea of innovation coming in the form of an apparently inferior technology that incumbents have neglected or completely ignored [4]. This provides competitors the long-term potential opportunity of matching incumbent technologies and potentially surpassing them. This will be exemplified later in the case study examples. The research conducted by Christensen expresses his point of view that disruption and innovation are very clearly defined; and often times misunderstood or contested by other academics [12]. Handling the changes of disruption and innovation will require knowledgeable and strategic decision making with all the facts in alignment.

A. The Gaps in Knowledge

Ashford points out that "A gap of information exists in the academic research concerning how innovative change occurs in industrial firms, and what kind of firms come up with what kind of technical responses and how it confers to competitive advantage" [13, p.31]. Lieberman and Montgomery put forth that further research is necessary by making comparisons among specific first mover mechanisms and the industries in which they operate. It would be useful to know which of the various mechanisms are most important in practice, and in what industries they operate most strongly. "Nevertheless, many of the fundamental conceptual problems that we discussed remain unresolved" [14, p.1121]. Further, the research contributing to first-mover advantage and first-mover disadvantage literature explaining the dynamics within the defence equipment industry is not fully evolved. Kerin et al. reveal that "A consensus determining first-mover advantage/ disadvantage is not perfect in the literature, and descriptions in theory contexts are contradictive in terms of product innovation and non-existent in terms of innovative process adaption" [2, p.43]. Previous academic research is not clearly defined; "In summary, the conceptual and analytical arguments supportive of first mover advantage have equally attractive counterarguments" [7, p.35]. The focus of this academic paper will be on the defence equipment industry because this industry presents specific features that allow us to highlight certain key drivers of first mover advantage and first mover disadvantage. Thus, an improved base understanding of company first mover knowledge provides important long term implications for

company success.

III. Empirical Methodology

According to Eisenhardt and Yin, case study research can be applied to empirically test previous theories and potentially build upon theory [15] [16]. "Analytical – not statistic – generalisation of the results of several cases being used to other contexts with similar theoretical conditions can be obtained by means of applying replication logic-both literal and theoretical and the so-called pattern-matching analytical procedure [15] [16]. Literal replication enable researchers to capture subtle similarities and differences within group of case studies related to a specific expected pattern, whereas theoretical replication allow researchers to identify key differences between groups of cases associated with different expected patterns [15]. Therefore they are expected to differ among themselves but for a priori predictable reasons" [16, p.122].

To begin, "An initial definition of the research question, in at least broad terms, is important in building theory from case studies" [17, p.585]. This case study research will aim towards theory building. Based on the article by Eisenhardt in "Building Theories from Case Study Research", we consider working on four to six qualitative case studies concerning innovations in the defence equipment industry. This should be sufficient to contribute to first mover advantage and first mover disadvantage theory building [15]. The material selected for the case studies' writing will originate from clear and respected journals as well as other quality sources. The case studies will be elaborated based on content of holistic and in-depth investigation. The chosen case studies will display sufficient evidence and offer valuable insights. The work of exemplary scholars driving first mover advantage and first mover disadvantage knowledge will be used to synthesize a document characterising intricate differences within the defence equipment industry from other industries.

Eisenhardt states that: "Overlapping data analysis with data collection not only gives the researcher a head start in analysis but, more importantly, allows researchers to take advantage of flexible data collection. Indeed, a key feature of theory-building case research is the freedom to make adjustments during the data collection process" [15, p.539].

A selection of three chosen defence industry innovations have thus far been selected to be used in the case study comparisons. The tiltrotor aircraft innovation has been chosen for study because sufficient data regarding the history and competition between different manufacturers is available. The material has been assembled; the case studies have been developed with the known factors driving first mover advantages/disadvantages. These factors are compared to see if they match, or not, with common academic advantages and disadvantages. At the same time, it has been attempted to discover if there are elements not mentioned in the first mover advantage/disadvantage literature. It has also been initially studied why established factors that do not match the advantages and disadvantages and try to explain the reasons. In the future, a model will be proposed of first mover advantage/disadvantage factors specific to the innovative tiltrotor and explain how this might also contribute to the management of innovation in other main stream industries.

IV. Conceptual Framework

From the gathered data, a rich and in-depth comparison between case studies opens up qualitative findings that address the proposed research question. The multiple case study research method delineates why some first mover strategies work and why some fail; including the origins of the success in the defence industry. The raw data obtained from the case studies are put into tables and then the differences between cases have been analysed. It has been ascertained whether there are differences between the cross-over of first mover advantages and first mover disadvantages within the different cases. The cross reference has also been checked against the list of first mover advantages and disadvantages outlined by Porter and other key contributors concerning main stream/academic first mover advantages and disadvantages [1]; for example, determining if there is common ground between first mover advantages and/or first mover disadvantages within all defence equipment industries. It has been established that there is common ground within the specific defence equipment industries in specific areas. A cross-over of the Porter list of first mover advantages and first mover disadvantages highlight a key new discovery of uniqueness and potential importance within the defence equipment industries when compared to main stream industries [1].

V. Analysis of the Case Studies

A. An Explanation of the New Tiltrotor Technology and how it is better than Previous Solutions

The mesmerizing ingenuity of the tiltrotor aircraft makes it easy to understand why it is an interesting candidate for research concerning innovative first mover advantage. It should first be noted that this aircraft went through a very prolonged and uncertain development passage in order to get to where it is today. There are many reasons for the tiltrotor taking many decades to develop into the functionally reliable vertical-take-off-and-landing aircraft. Different than the design of helicopters, the tiltrotor aircraft is capable of lift and forward propulsion by means of powerful rotors mounted at each end of a singular wing. This design amalgamates the benefits of vertical and horizontal flight. By angling the two rotors directionally upward it can generate lift, functionally similar to the lift generated by a typical helicopter rotor system. As the name tiltrotor suggests, once the rotors are progressively tilted into the forward and horizontal direction, this allows the aircraft to gradually gain forward momentum. With the rotors in the face-forward direction the forces provide similar thrust to airplane propeller(s). This rotor/wing combination is better than a helicopter because the fixed wing air foil design assists with lift during the forward motion of the aircraft. The two-rotor design can achieve higher cruise speeds and heavier take-off weights than helicopters. This is possible because the rotors are configured to be more efficient for propulsion. This design avoids the helicopter's inherent flaw known as retreating blade

stall, a critical factor limiting the maximum forward speed of a traditional helicopter. To explain and better understand this problem, the fixed wing begins lift as soon as the rotors start tilting in the forward direction, but for a helicopter to produce lift and simultaneously move forward using a spinning rotor it needs the advancing blade to reduce the angle of attack as it cuts through the air. This is because the helicopter blade must maintain both lift as well as forward momentum. Several attempts to solve this helicopter issue have been addressed but because of shear physics, as forward speeds increase, the helicopter blade will reach a maximum critical angle; and once that angle is reached it will begin to stall causing loss of lift and loss of control.

Fig. 1 The V-22 Osprey can switch between flying like an airplane or a helicopter during any flight. The V-22 Osprey is pictured on the left flying horizontally with the tiltrotor in a forward motion direction and in the adjacent photo on the right the same aircraft flies vertically with the tiltrotor in a lift configuration [18]

B. Case Study #1 - Bell Boeing V-22 Osprey

Tiltrotor history began well before the efforts of the Bell-Textron partnership when they started development of the XV-15, a twin-engine research aircraft funded by NASA and the U.S. Army; the infusion of government funding for this demonstrator was a stepping stone in order to develop and enter into the newly established tiltrotor aircraft paradigm shift [19]. In 1981, first with U.S. Army support but later in 1986 with a changeover to the U.S. Navy and the U.S. Marine Corps, and using the experience gained from previous prototype work including the XV-15 model the development of the new model V-22 Osprey began [20]. This became the first tiltrotor aircraft made available to the U.S. Air Force and the U.S. Marine Corps for military use.

Development of the V-22 Osprey evolution has been enduring, costly, complicated, controversial, and deadly because of program scope creep issues, politics, high aircraft maintenance requirements, support costs, and machine failures [20]. Government program office approval has been turbulent at times because the aircraft did not meet "Test Aircraft Delivery Configuration Requirements"; the V-22 frequently grappling for survival because of more than 130 contract modifications and numerous design specification waivers [21]. The V-22 Osprey had its friends and foes in the government, and as development costs greatly increased, those for-and-against the project tried to fund and defund the aircraft's development. Politics played a big role into the obstacles as well as the V-22's development [22]. Multiple tiltrotor functionality studies found that the V-22 provided more capability and effectiveness with similar operating costs [23]. Finally on March 19, 1989 the first two prototypes flew in the helicopter mode and fixed-wing mode [24]. The third and fourth prototypes successfully completed the first sea trials in 1990; but a major setback occurred when the fourth and fifth prototypes crashed in 1991 and 1992 [25]. Flights resumed in mid-1993 after safety changes were made to the prototypes; but not after adding heavily to the costs of redesigning the V-22's weight, manufacturing processes, and aircraft engineering. Tiltrotor crashes and fatalities continued on into the new millennium [20].

Into present day, it is important to understand that large U.S. military contracts are awarded by law in order to: a) replace worn-out equipment, b) replace outdated equipment, or c) to fill an existing need/gap in military tactical advantage; many times requiring innovative and/or disruptive transformation [26]. Hence, a multi-phase competition is offered to vendors to participate in an attempt to win a military program contract. The vendors first enter the contest by offering their capabilities and presenting their wares, thus to advance forward into the next phase/level of the competitive bid. The vendors are competing against each other for a decreasing number of available spots during each escalating phase of the competition. As the competition progresses there may be a requirement from the candidates to present a: a) concept, b) design, c) engineering manufacturing development (EMD) d) prototype, e) successful testing, f) weapons system demonstration, g) capability of special variants, h) spares, i) logistics/delivery, j) upgrades, k) support, etc. In many cases during each phase, the military department offering the contract may supply a monetary grant to provide support for the costs incurred during the specific phase, for example it can be very expensive to produce a prototype vehicle and it cannot be expected that the vendor absorb all the monetary costs with the chance that they might not win at the end of the competition. This advancement process eventually narrows down the number of competitors and by the end of the competition a single competitor or joint venture group will have won the contract to run the program. The U.S. Army, U.S. Navy, U.S. Marine Corps, U.S. Airforce award the contract by considering a number of factors, including who is the winning competitor in the competition. In large military contract competitions, it is possible only a small number of competitors initially enter the contest, depending on the type of contract. Often times some competitors are knocked out early because a company does not have what is required to win and the military department does not want to further offer any expensive grants. From the perspective of the tiltrotor aircraft, this process has been a decade's long drawn-out process. Once the award winner is placed as the incumbent of the contract, it is difficult for competitors to do anything else, other than to possibly dispute the victory.

Figures vary but one source pegs the money spent on development and procurement of the V-22 at $37.9B USD between fiscal years 1982 to 2012 [27]. Not without issues, the Bell V-22 Osprey is now in full-development and production mode, thus creating a first mover advantage for themselves. By 1994 the program consisted of 523 units to be manufactured well into 2020's [20], thus making it very difficult for the few existing competitor(s) to equal or better what has been

entrenched by a government contract.

C. Case #2 - Sikorsky Boeing SB-1 Defiant

The U.S. Army has a long standing, deeply entrenched working relationship with Sikorsky dating back to the years around WWII [28]. Today Sikorsky owns a large industrial base in the helicopter market; one of several first mover advantages that they benefit from by being in partnership with the U.S. Army for many years. Sikorsky's transport helicopter designs are currently the most operated in the U.S. Army. Since the up-rise of the V-22 Osprey, Sikorsky Aircraft and Boeing jointly produced a medium-sized demonstrator helicopter named the SB-1 Defiant, this in order to compete against tiltrotor technology. Originally planned to fly in late 2017 to compete for the Future Long Range Assault Aircraft program contract (FLRAA); a contract the Army is supposed to choose in order to replace the very versatile thirty-year-old UH-60 Black Hawk helicopter made by Sikorsky [29]. The current FLRAA program that is up for offer has in 2021 authorized an additional bill worth $5 million to increase investment in FLRAA advanced component development and prototyping; this on top of the Army's nearly $648 million request [29]. Lawmakers previously added $76 million in funding to FLRAA's top line in 2020 to drive down technical risk and to speed up delivery through the competitive demonstration and risk reduction bidding process [29]. When the SB-1 was pitted up against the new model Bell V-280 Valor tiltrotor, the Bell V-22 successor, the SB-1 repeatedly suffered numerous delays during its development, all the while travelling down the classic path of an incumbent defending their position by using the technologies that they know best, helicopters, which has proven well for them in the past.

D. The Race between the First Mover and the Other Strong Competitor: Introduction of the Bell V-280 Valor

Continuing on from the previous V-22 tiltrotor success Bell partnered with Lockheed Martin to develop the V-280 Valor tiltrotor. Part of their success is the result of the response time of the innovative aircraft; a critical criterion for military forces when they are engaged in combat [20]. Key mechanical parameters that the FLRAA program is requesting includes 2000 feet pressure altitude in 85 degree heat, with a full payload of 12 troops at 290 lbs each [30]. A normal helicopter limit will hit speeds of about 150 knots/277 km/h while the Bell V-280 tiltrotor has a relatively high maximum speed of over 300 knots/560 km/h [31], this due to the tiltrotor technology. The V-280 is reported to have a range of 3,900 km, and an effective combat range between 930 km to 1,480 km. It has a lift capacity to carry 4,500 kg [31]. A new design improvement to the rotors has allowed the V-280 to redirect the focused heat emanating from the back side of the equipment, thus preventing the destruction of whatever direction the tiltrotors are pointing at, for example it prevents the burning of a ships deck as it lifts vertically in the upwards direction. Improvement to the driveshaft running through the straight wing allows both prop rotors to be driven by a single engine; used as backup safety feature in-case an engine loses power [32]. The V-280 will have retractable landing gear, and it has a V-shaped tail without a prop [32]. Emphasis has been placed on the V-280 to reduce the weight using composites in the wing, fuselage, tail, and props; which in turn will reduce product cost over the long term [32]. Tiltrotors also provide substantially greater cruise altitude capability than helicopters. The V-280 tiltrotor can easily reach 6,000 m altitude [31], well above the FLRAA specification request.

Fig. 2 Sikorsky-Boeing SB-1 Defiant in flight with dual rotors and tail prop [33]

The drawback of the tiltrotor is that the mechanical design is more complex than helicopter technology, thus requiring considerably more maintenance and testing. In sum, these improvements and setbacks have been an important consideration for military end users in better understanding the intended use of tiltrotor's combat missions [20]. Meanwhile, the Sikorsky-Boeing's SB-1 might look like a normal helicopter, the design offers a pair of more efficient counter rotating blades. The opposite rotation of the main blades provides extra lift, more stability, and smoothness. It also eliminates the need for a counter rotating tail rotor. The SB-1 Defiant designers added a forward facing tale prop for greater horizontal speed.

Fig. 3 The Bell V-280 Valor in forward flight [34]

Both the tiltrotor and compound rotor designs are competing head-to-head for the U.S. sponsored FLRAA program contract. Both aircraft allow their pilots to simultaneously manipulate thrust in multiple axes which is not possible with the UH-60 Blackhawk, the helicopter that the FLRAA winner is intended to replace. Bell and Lockheed claim that an AV-280 variant can launch rockets, missiles, and even small unmanned aerial aircraft forward or aft without rotor interference [32]. GE Aviation will manufacture the engines for the V-280 also

funded by the Army's Future Affordable Turbine Engine (FATE) program [35].

VI. Academic and Tabulated Data

TABLE I
ACADEMICALLY RECOGNIZED MAIN STREAM FIRST MOVER ADVANTAGES [1, P.186-188]

1-b	reputation improvement
2-d	pre-empting positioning
3-e	switching costs
4-f	channel selection
5-n	proprietary learning curve
6-c	favourable access to facilities, inputs, or other scarce resources
7-a,k	cost-efficient ways of producing, delivering, and improving the product
8-i	definition of standards
9-h	institutional barriers
10-l	early profits
11-g,m	time to develop
12-j	economies of scale

The small letters in the academic first mover advantage left hand column Table I above have commonality with the same small letters in the military first mover advantage left hand column Table III below.

TABLE II
ACADEMICALLY RECOGNIZED MAIN STREAM FIRST MOVER DISADVANTAGES [1 P.189-191]

1	lower pioneering costs
2	low cost imitation
3	chance of a competitor improving the product
4	cost of creating a new value chain
5	demand uncertainty
6	changes in buyer needs
7	specificity of investments to early generations
8	risk of technology uncertainty discontinuities

None of the academic first mover disadvantages correspond to the military first mover disadvantages and therefore there are no matching items between the columns in Tables II and IV.

TABLE III
MILITARY CASE STUDY FIRST MOVER ADVANTAGES

1	military funding to support development costs – highly technical and innovative products involving detailed contracts are not normally possible without support of enormous funding – only when the USMC, U.S. Army, Airforce, Navy intervene into the development process can a highly innovative technological project be sustained up to the demonstration point of the project. [26, p.202]
2	forged military need – in a continuous race to be the best, militarily pushing the equipment innovation envelope for equipment requiring speed, volume, capacity, protection, value, effectiveness
3-c,h	unique institutionalized support and access - the support and access to institutions such as DARPA: only possible because of the size of the country (i.e., USA) utilizing a large talent pool, large pool of ideas, expansive educational and institutional support, available funding, and a whole host of other supporting factors
4	opportune moments - the government taking advantage of the political situation, severity of need – i.e., need for better equipment because of a failed attempt during a rescue mission of hostages (need for better rescue equipment) or USMC replacement of an existing fleet that is wearing out
5-m	being in the correct place at the correct time - this is mainly possible by being able to afford to be in stagnant position for a period of time
6	protection from political circumstances – i.e., the Vietnam war and the need for the government to win the war – throwing money at the situation
7	protection from living in a bubble – Bell splitting with Augusta
8-d	elimination process - in the end only one player (or team of players) remains standing and competing to be the best; no competition thereafter – a very big advantage
9-i	timing and perseverance – a very long history for tiltrotor research and development by numerous players – playing the long game – capability of the company to be “the last man standing”
10-a,n	technology development over the long haul – i.e., technology development of tiltrotor technology and the use of carbon fibre as rotor blades
11-j	Economies of scale – the incumbent making more with less over the course of time
12-k	creating corporate partnerships – applying expert knowledge together to create the-best-of-the-best – in order to create winning partnerships
13-d	buying your way in – the unobtainable cost for smaller companies to buy product information – i.e., buying information concerning designs, patents on motors, etc.
14	timing in relationship to the government needs/optics - i.e., wars, politics – sources of information
15	keeping the large corporate machines running on research and development until a military contract is awarded - waiting for a war to start – the politics of the unemployment numbers
16-b	successful auditing - successfully displaying the capabilities of the equipment – important to the success of the optics of procuring the innovative product from the eye of the government and the end user i.e., Clinton - information and propaganda about the value of the V-22 presented to Congress
17-e	historical relationships - the Army bought its first Vought-Sikorsky XR-4 in 1941 – Sikorsky/Army relationship is entrenched since the first purchase – Similarly, Bell began developing the V-22 Osprey, for use by the U.S. Air Force and the U.S. Marine Corps
18-a,g	time consuming step-by-step evolutionary machine improvement/upgrades - innovation development may take decades to come to fruition/final development, ie drones
19	awaiting new technologies – waiting for the computer to be faster i.e. 5G phones
20	innovative eureka moments/accomplishments – redirection of government funds; sometimes at the last minute, due to so called Eureka moments – perfectly timed or at least presented at the opportune moment
21-b	brand improvement – being in the class of top products, i.e. Hummer, F-16, Abrams, etc
22	windows of opportunity - waiting for the window of opportunity to introduce the product which can sometimes take years or even decades – timing is everything
23-l	guaranteed profits

TABLE IV
MILITARY CASE STUDY FIRST MOVER DISADVANTAGES

1	many obstacles towards reaching innovation success - continuous obstacles through a long and rigorous competitive selection process – once award obtained there are no/few obstacles
2	demanding selection process – a lengthy and rigorous competitive selection process that is formed and supported by US law

3	skilled people moving between companies
4	scope creep changes – i.e., technology design changes
5	company reputation and track record - a company's track record of success – high incidences, very costly, and long term failure(s)
6	enormous incurred costs – the large costs involved by supporting huge specialized staffs for long periods of time while developing a very complex product with higher risk
7	forcing or forging innovation creating obstacles - initially unforeseen by developer – leading to scope creep
8	extensive lobbying in congress to obtain a desired outcome – sometimes the lobbying having nothing to do with the innovative product in itself (politics) – I will employ certain number of people in your state and in return you will vote in favour of procurement for the following innovative product
9	huge risk – the risk of losing the contract despite investing heavily in one's own time and money - incredibly high-stake programs/contracts, the winner takes all, a selection process that can potentially last for decades – can also potentially tailspin the profitability of a company that loses i.e., the Model 2 tiltrotor
10	sometimes a small number of players in the bidding for a large contract – made up of large conglomerate players
11	outside factors – factors that have nothing to do with the product design contributing to the favourability of a specific company
12	knowing the competition - essential to pay close attention to what the other company(s) are doing – copy – strategically place yourself into the leading position – at the correct time.
13	congressional lobbying - win/lose; a company staying afloat until the next allying government, or staying out of sight – diverse product line to insulate against winning and losing
14	trapped into using previously proven designs and technology – i.e., Sikorsky
15	losing brain power to competition - skilled people moving between companies i.e., Transcendental 1-G information passing between one company to another, potentially with a clean slate to work with a company that has no baggage in order to achieve aggressive goals – i.e., the success of LinkedIn
16	the reasons to generate military technology to the demonstration point 1) avoidance of causality, 2) security threats ie 911, 3) technology transfer, Israel and USA, 4) cross sector diffusion, commercial and military sectors [26 p. 193 to 195]

VII. Discussion

It is quite evident that the military innovation process for developing large scale equipment is different than main stream market innovation processes of similar scope. Subsequently the application of first mover advantage manoeuvres take on different requisites in order to become a leader in the military market. The basic principles of innovation are still spawned by the causation of need by a military customer; but success by way of award-of-military-contract is evidently researched to be only possible via key company attributes, namely: a) forming a trustworthy client/manufacture relationship, b) being able to allow for inherently long term planning and/or the ability to put aside projects for extensively long periods of time until the innovation can strategically be put to use, c) an agreement of project funding for pre-through-to-post innovative product development within the client/fabricator relationship, d) the indiscriminate support of project innovation failure(s) when it expectedly or unexpectedly occurs, e) owning a large and varied pool of specialized and talented people to support a broad cross section of efforts, f) owning the capability and infrastructure to support a specialized large scale project, g) the access to institutional support where no other help is available - for example universities, NASA, and DARPA, h) to be able to grapple with a variety of bureaucratic hurdles where important decisions are made by politics and not necessarily other factors such as business or engineering, i) the positive gains onset by advertising company success stories, i.e. prototype launches, this in order to proceed forward with a specific project and extend that success by advertising other projects, j) forming joint venture partnerships with other companies when it is in the best interest of both companies, k) the ability to agilely handle last minute scope changes onset by the customer, l) ability to provide service life extensions, and finally m) the ability to perform some wins in field testing in front of the customer in order to gain confidence.

When military manufacturing companies are fused into the situation of an open competition with other competing companies, and simultaneously being stipulated to produce an entirely new innovation, this state of affairs leads to inherently high-risk decision making. Mitigating risk by knowing what are the company's own capabilities prior to entering into a competition and understanding a first mover path beforehand are a binding characteristic essential for obtaining a contract award. In so doing they are challenged with the dilemma of forging forward into a first mover advantage position within the military contract contest; there is no option for deliberately waiting and learning from a competing pioneers' mistakes; being a follower. The contract winner inherits the first mover advantages and thereafter there is no second place offering for the runner-up company – the winner of the contract takes all, the end. It is therefore important to critically understand from a first mover advantage and disadvantage perspective the high-stakes decision making implications concerning defence industry transformation during production of an innovative product. For this research endeavour, the isolated characteristics in the military innovation process highlight some very important factors relating to first mover advantage. These resulting findings can potentially transfer over into the non-military/mainstream manager's knowledge-base, but this still needs to be better understood through further research.

From the qualitative data in Tables I and III it shows that in the military first mover advantages there is either: a) a close knit and direct connection to the academic first mover advantages, or b) if the data have no connection to the academic first mover advantages it is observed in Tables I and III that the non-conformance's are strictly politically motivated military first mover tactics. In the military first mover disadvantages Table IV there are literally no connections to the academic first mover disadvantages Table II; a finding that indicates that the military contract system appears to eliminate any academic disadvantages. Therefore, it is possible to say that the military contract winner enters an arena of no competition and there are

literally no academic first mover disadvantages.

VIII. Conclusions, Implications, and Future Research Directions

This case study research has established that military innovation processes take on a similar first mover advantages compared to normal market conditions, but additional advantages that do not pair-up are politically motivated. Military innovation development is isolated from normal innovation conditions thereby giving us new insight into the isolated military first mover benefits. Some important military advantages include: a) funding for innovation projects in the form of grants are a source of income before the contract is awarded, b) award of contract results in staking claim to a specific market share where winner takes all; not usually found in traditional markets, c) isolation from its competitors once the contract is awarded - also not usually the case in the normal market, d) exclusivity - a competitor cannot just step in with a new innovation because the existing product and contracts are locked into long term agreements with the customer, e) the winning brand is thrust into a category of other legendary brands - M1A1/2 Abrams tank, Apache Helicopter, F-117 Stealth Bomber, A-10 Warthog, F-16, etc., f) there is a cycle of continuous product improvement upon contract award and this continues deep into the product lifecycle, g) insurmountable barriers are in place preventing competitors to penetrate the market once the contract has been awarded to an incumbent; to do so would take years, i.e. Bell V-22 Osprey has demonstrated how long it can take, h) the eventual winning design has a much greater likelihood of holding itself during the test of time as many of the inherent flaws have been previously eliminated.

This research in itself highlights that there are factors that are "military-specific" and affect first mover advantage and first mover disadvantage. Porter's research and his statement concerning first mover advantage states: "First mover advantages rest on the role of timing in improving a firm's position viv-a-vis sustainable sources of cost advantage and differentiation. In general terms, a first mover gets the opportunity to define the competitive rules in a variety of areas." [1, p.186]. A successful military manufacturer will have company characteristics that enable the company to develop a new military innovation; a new area yet to be discovered in future research. The Bell Boeing partnership is exemplary of how it is possible to insurgently tap into an incumbent's business by infiltrating a long-standing exclusive client/manufacturer partnership; the steps for doing so are time consuming, heavily politically/bureaucratically involved, and expensive.

Comparing the academically recognised first mover advantages and disadvantages against the military first mover advantages and disadvantages highlights some critical differences. It is yet to be understood what is the root cause of the variables that do not correspond to the academic first mover disadvantages and whether they play a lesser role in the success of achieving first mover success; further understanding of this phenomenon needs to be addressed. Successful treatment of the above research can offer lucrative rewards by enabling surgical planning and risk assessment and in so doing save and generate enormous revenues. The contribution from this military case study research enriches the theory of first mover advantage and first mover disadvantage by highlighting first mover variables not previously understood or taken into account. It can potentially become a go-to source of information for management and academic decision making.

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