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CANADA'S STRATEGIC AIRLIFT CAPABILITY: AN EROSION OF OPERATIONAL EFFECTIVENESS

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Exercise Solo Flight

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EXERCISE *SOLO FLIGHT* – EXERCICE *SOLO FLIGHT*

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Maj B.M. Graham

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CANADA'S STRATEGIC AIRLIFT CAPABILITY: AN EROSION OF OPERATIONAL EFFECTIVENESS

In order to adequately respond to increasing global and domestic demands as mandated by the Government of Canada (GoC), the Canadian Armed Forces (CAF) must ensure that military assets are ready at all times. Such support depends heavily on availability and reliability, centered on the ability to manage assets in a cost effective manner and ensure the health of the equipment is maximized over the long term.¹ Coupled with these expectations, is the increased pressure to fulfill other demands, notwithstanding our domestic obligations, which could result in a commitment to three international Lines of Operations (LOO) – Iraq, Latvia, and potentially Peace Support Operations (PSO) in Africa. Although Canada does have the capacity to support three LOO simultaneously, it would be very difficult under current conditions to sustain multiple endeavours long term, thus placing significant pressure on logistic nodes which are fundamentally centered on what the strategic airlift capability (hereafter referred to as the C-17 fleet) provides.²

The ability of the CAF to fulfill multiple commitments is underpinned by the capacity of units to perform such demands, measured through their operational readiness. 429 (T) Sqn (hereafter referred to as the Sqn) was re-established in 2007 when the GoC received its first of what would eventually become a fleet of five C-17 Globemaster aircraft, filling a much needed strategic airlift void. In 2014, Canada announced the

¹ Office of the Auditor General of Canada website. “2016 Fall Reports of the Auditor General of Canada: Report 7 - Operating and Maintenance Support for Military Equipment - National Defence.” last accessed 1 April 2017. http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html#p62.

² Parliament of Canada, Senate website, “Military Underfunded: The Walk Must Match the Talk,” April 2017, https://sencanada.ca/content/sen/committee/421/SECD/Reports/DEFENCE_DPR_FINAL_e.pdf.

purchase of a fifth C-17 for the RCAF, with the intent of easing the burden on the existing fleet and extending the life of all five planes by approximately seven-and-a-half years.³ Since the addition of the fifth C-17 in 2015, the aircraft Mission Capability (MC)⁴ rate has been in steady decline, resulting in an erosion of operational effectiveness.⁵ Contributing to this precipitous drop in efficiency is an increased maintenance workload, mainly attributed to the implementation of the fifth aircraft. Finally, incomplete fiscal forecasting to account for these pressures has resulted in a lack of support to alleviate maintenance pressures. Combined, these effects have contributed to a drop in the Sqn's operational effectiveness. Furthermore, these factors are symptomatic of a complex, or wicked problem.

The overarching mandate of a flying maintenance organization is to ensure aircraft are maintained, in order to enable high serviceability rates which are capable of meeting operational requirements in a safe and effective manner. As such, the Sqn must be agile enough to maintain a high degree of operational readiness, which is underpinned by the success of three pillars: availability, serviceability and sustainability. Through these pillars, an aircraft is inherently vulnerable to becoming unusable due to maintenance requirements, which often conflict with already scheduled missions, many of them complex in nature from a planning perspective. These pillars have been under increased stress over the past two years and are now showing signs of weakness, thus necessitating the need for reinforcement. Exploring the decline in MC rates and the

³ CTVNews.ca Staff, "Ottawa to buy 5th C-17 aircraft," *CTV News*, last modified 19 December 2014, <http://www.ctvnews.ca/canada/ottawa-to-buy-5th-c-17-aircraft-1.2155642>.

⁴ Mission capability rate denotes an aircraft's capacity to perform one, some, or all of its assigned tasks. Canada developed a mission capability rate goal of 80-percent for its' C-17 fleet, which indicates that collectively all aircraft must be capable of performing mandated missions 80-percent of the time.

⁵ Boeing, Trenton Site Manager, Boeing Monthly Reports from January 2016 to January 2017. Provided by Boeing Trenton site manager 20 February 2017.

current organizational manning and funding, this paper argues that there are inefficiencies within the C-17 maintenance organization that are negatively affecting the MC rate and that the CAF needs to explore strategies such as a hybrid maintenance model to reverse the current erosion of operation effectiveness.

This paper is structured in four parts. The first part will provide a brief background describing the Sqn's mandate and the supporting organizations, and how the C-17 has significantly changed the strategy landscape. The second part will address declining MC rates. Next, an analysis of the organizational manning construct will be applied to illuminate deficiencies which were not captured during the procurement of the fifth C-17. The fourth section will address funding shortfalls and highlight the importance of implementing a long-term funding model. Finally, pulling the various analyses together, this paper will outline a hybrid approach which would increase operational effectiveness for Canada's C-17 fleet.

BACKGROUND

The C-17 was purchased to fulfill an urgent need for the GoC to support the broad range of missions around the globe. The Sqn's mission is "to develop and maintain a globally responsive capability that enables the Canadian Forces to reliably impact all theatres of operations with relevance and unlimited reach."⁶ This blend of strategic and tactical ability is what makes the C-17 unique.

Constrained to five aircraft, four up to 2015, the C-17 has accomplished a tremendous output for the GoC and Canadians. The fleet's vast accomplishments include

⁶ Royal Canadian Air Force website, "429 Transport Squadron," last accessed 11 April 2017, <http://www.rcf-arc.forces.gc.ca/en/8-wing/429-squadron.page>.

highly visible missions supporting disaster stricken nations such as Haiti, the Philippines, Libya, and Nepal; and notable enduring missions in Afghanistan, Iraq and now Ukraine to counter Russian aggression. Just last year the Sqn flew over 140 missions and delivered over 12 million pounds of supplies supporting various missions around the world.⁷

Perhaps the best illustration of the C-17's unique capabilities is the hurricane support provided to the Philippines in 2013. After devastating Typhoon Haiyan hit the Philippines on 8 November 2013, the Disaster Assistance Response Team (DART) was deployed to the Philippines to provide humanitarian support.⁸ Executed through an air-bridge⁹, the C-17 provided a historic level of support on behalf of the GoC within a very short period of time, halfway around the globe. Over the span of nineteen days, in addition to the many DART and CAF personnel transported, the Sqn executed multiple missions, bringing approximately 900,000 pounds of equipment, vehicles, medical supplies, and food from non-government organizations.¹⁰

Within ten years, the C-17 fleet has made an immediate and enduring mark supporting GoC objectives, and has been widely supported by the Canadian public through its vast accomplishments. However, as a result of this immense success, increased pressure has been placed on the Sqn which has resulted in the need for

⁷ Royal Canadian Air Force, 429 (T) Sqn, power point presentation, "429 (T) Sqn Brief", drafted and provide by 429 (T) Sqn DCO in April 2017.

⁸ Global Affairs Canada Website, "Canada's response to Typhoon Haiyan in the Philippines," last accessed 7 May 2017, http://www.international.gc.ca/development-developpement/humanitarian_response-situations_crisis/haiyan/Haiyan_results-resultats_Haiyan.aspx?lang=eng.

⁹ An air bridge is a process of inserting crews at critical staging points between the point of origin and destination in order to facilitate the rapid transport of equipment and personnel to achieve a swift strategic effect. Canada's employment of the air bridge utilizing the C-17 has proven to be a unique capability which has enabled the GoC to respond to any global crisis within days, and hours in some cases.

¹⁰ Jerome Lessard, "New C-17 to land at 8 Wing," *The Intelligencer*, 19 December 2014, <http://www.trentonian.ca/2014/12/19/new-c-17-to-land-at-8-wing>.

additional support to ensure the long-term strength of this coveted capability. Because many pressures have been precipitous in nature, it is important to look at how effective the C-17 fleet has been over time, and one of the best ways to measure this is through an analysis of the MC rate, in particular since the addition of the fifth aircraft in 2015.

EROSION OF MISSION CAPABILITY

The strategic airlift capability has seen a precipitous drop in the MC rate since the addition of the fifth C-17, thus impacting aircraft availability and the ability to conduct operational and training missions. Furthermore, neither the aircraft availability nor the Line of Tasking (LoT)¹¹ output has increased since the addition of the fifth aircraft. With the fifth C-17, the fleet is currently operating below its' originally prescribed usage level compared to when it was a fleet of four. As such, this section will highlight the drop in the MC rate, and when compared with MC rates of other nations, will illuminate how initiatives such as a hybrid maintenance model¹² could significantly contribute to an increase in operational readiness and effectiveness.

With the addition of the fifth aircraft, the operational benefit should have resulted in an availability of at least three aircraft more than 90-percent of the time, capable of responding to concurrent international and/or domestic demands.¹³ In theory, this translates into an increase of aircraft availability and the capability to sustain an average

¹¹ A LoT is an average tasking number derived from a fleet of aircraft which accounts for forecasted down time (maintenance requirements, etc.) and what the MC goal of the particular fleet is. The result will yield a number which, for planning purposes, the fleet is expected to be able to sustain on average per month.

¹² The proposed hybrid maintenance model is an initiative that allows for a specified number of contractors to be embedded within an existing maintenance organization, thus synergizing efforts and enhancing maintenance outputs (first line maintenance, home station checks, training, etc.).

¹³ CTVNews.ca Staff, "Ottawa to buy 5th C-17 aircraft," *CTV News*, last modified 19 December 2014, <http://www.ctvnews.ca/canada/ottawa-to-buy-5th-c-17-aircraft-1.2155642>.

of 2.8 LoT¹⁴ per month. In order to achieve that goal, it has been estimated that MC rates needed to remain at or above 80 percent.¹⁵ However, this estimation does not take into account the right balance of manning required when balanced with efficient use of resources, scheduling of maintenance activities, and other factors which should result in a lower MC rate required to achieve 2.8 LoT [(5 aircraft – 0.5) x .62 = 2.79 LoT].

Therefore, a 62% MC rate should be able to yield an output of 2.8 LoT. With the addition of the fifth aircraft, coupled with an 80% MC target, this should result in a higher LoT output [(5 aircraft – 0.5) x .80 = **3.6 LoT**]. Resultantly, the fleet should be capable of sustaining an average output of 3.6 LoT, which arguably has only been achieved in limited durations such as surges in operations. However, although the fleet has been operating consistently above 62%, the Sqn's LoT output has not been close to the 2.8 target. With the 2016 tasking output at approximately 2.20¹⁶, this highlights a fairly large discrepancy when correlated with the fleet MC rate. Interestingly, applying the 2.20 LoT output into the model yields an approximate MC rate of 45% required to achieve that output which infers the existence of some significant internal pressures.

Exploring the discrepancy further, it is important to identify where specific pressures exist, which begins with an analysis of Yearly Flying Rates (YFR). What Figure 1 illustrates is, aside from FY 11/12, the C-17 fleet was not under heavy demand

¹⁴ 2.8 LoT is an average tasking number derived from a four aircraft fleet. 4 aircraft - 0.5 (maintenance requirements) giving 3.5 available LoT. Of the 3.5 aircraft remaining, coupled with a mission capability goal of 80% yields 2.8 LoT (3.5 x 0.8 = 2.8). The 2.8 is further broken down between force employment (FE) and force generation (FG). As such, 0.5 was determined to be required to force generate and 2.3 for FE.

¹⁵ 429 (T) Sqn Briefing Note (BN) for Commander 1 Canadian Air Division, "MAINTENANCE IMPACT ASSOCIATED WITH AIRCRAFT 177705," BN drafted on 14 January 2015, Canadian Forces, 2015.

¹⁶ Boeing. Trenton Monthly Reports, January 2016-January 2017. Provided by Boeing Trenton site manager 20 February 2017.

when correlated with the expected steady state (dashed line) of 5,000 flying hours. This drop in flying output is both attributed to tasking restrictions due to fiscal clawbacks and a lack of productivity. However, further analysis of the flying rates will reveal that, although there have been periodic YFR clawbacks, the Sqn has faced increased pressures over the years and exploited some vulnerabilities.

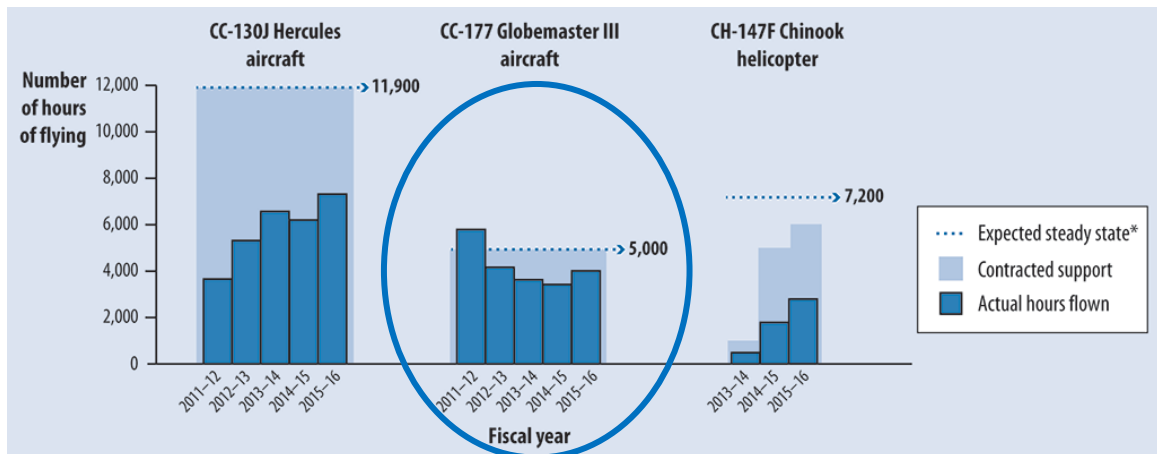


Figure 1: C17 fleet (middle graph) flying hour output.

Source: Office of the Auditor General of Canada website. “2016 Fall Reports of the Auditor General of Canada: Report 7—Operating and Maintenance Support for Military Equipment—National Defence.” last accessed 1 April 2017, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html.

To provide some context why these pressures have been manifesting, it is important to understand what the Sqn's capacity is to support various demands and identify if there are any connections that can be made to a drop in operational effectiveness. Analyzing the planned YFR for FY 14/15 presented in Table 1 (below) highlights that 1 Canadian Air Division adjusted its forecasted flying output of the C-17 fleet to 4,000 hours which was mainly attributed to budget constraints.¹⁷ Furthermore, a similar adjustment also took place in FY 16/17.¹⁸ Although a notable adjustment, the fleet was still unable to meet its adjusted YFR target for that FY, suggesting that it would have been extremely difficult to achieve a 5,000 hour output.

Table 1: C-17 Fleet Flying Rates

C-17 Fleet Flying Rates			
Monthly Average: 2011-2016			
Actual results presented in number of flying hours			
Fiscal Year (FY)	Expected Steady State (flight hours)	Contracted Support (flight hours)	Actual Hours Flown¹⁹
2011-12	5,000	5,000	5,792
2012-13	5,000	5,000	4,161
2013-14	5,000	5,000	3,630
2014-15	5,000 (4,000)	5,000	3,425
2015-16	5,000	5,000	4,012
2016-17	5,000 (3,850)	5,000	3568.6

Source: Office of the Auditor General of Canada website, "2016 Fall Reports of the Auditor General of Canada: Report 7—Operating and Maintenance Support for Military Equipment - National Defence," last accessed 1 April 2017. http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html#p62.

¹⁷ Office of the Auditor General of Canada website. "2016 Fall Reports of the Auditor General of Canada: Report 7—Operating and Maintenance Support for Military Equipment—National Defence." last accessed 1 April 2017, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html.

¹⁸ Such fluctuations are normal as some years budgetary pressures will drive YFR adjustments.

¹⁹ Actual hours flown is predicated on block-in/block-out times and not actual flying time which is how Boeing represents data, which has shown to be approximately 7% less. As such, FY2016/17 data point is extrapolated from Boeing data to give an approximation of 'actual hours flown to remain consistent with the rest of the data points: $3335.1 \times 1.07 = 3568.6$.

While the integration of the fifth aircraft into the fleet during FY 15/16 should have supported an elevation in YFR output, it actually had the opposite effect. As such, the fleet has not been able to meet YFR targets based on forecasted usage rates. Before looking at Canada's MC rates, it is important to view the performance metrics of the international fleet (including Canada) presented in Figure 2 below.

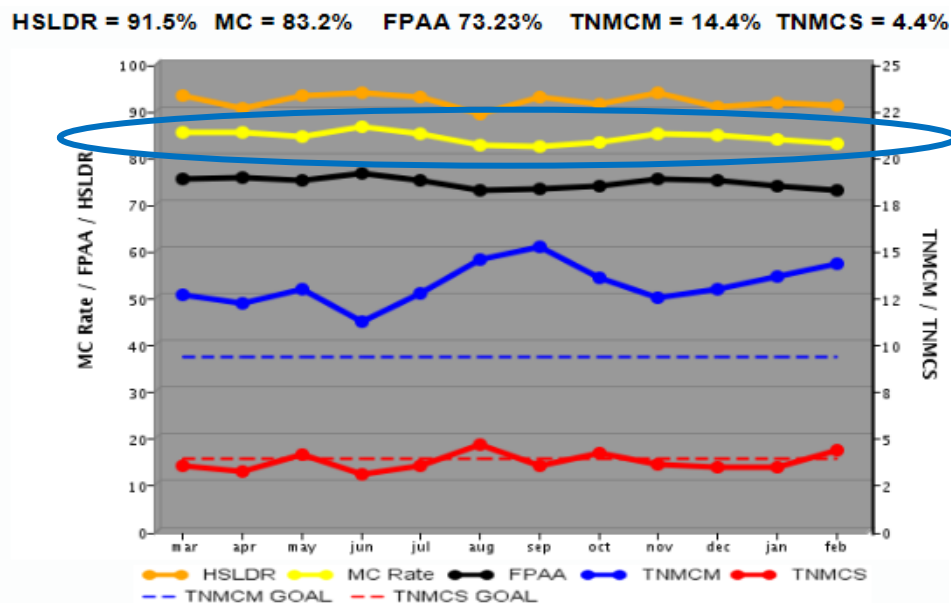


Figure 2: C-17 International Fleet Performance: March 2016-February 2017.
Source: Boeing, "Boeing C-17 Sustainment Review."

Observing the international fleet performance, which excludes U.S. data, reveals that MC rates (solid yellow line) are consistently above 80%, with an average of around 85%. With Canada's MC rates removed, this would elevate the international MC rates by approximately 1-2%²⁰ by conducting a comparative analysis between Figures 2 & 3.

²⁰ The total international fleet size is 52 aircraft, including Canada. As such, the 1% estimated increase in overall output is predicated on the impact that Canada's MC rate of 5 aircraft has on the rest of the international fleets performance. As such, the Canadian fleet contributes roughly 10% ($5/52 = .096$) to the overall performance. With Canada's MC rate at approximately 74% over the same timeframe, which is over 11% under the rest of the international fleet, lowers the overall average.

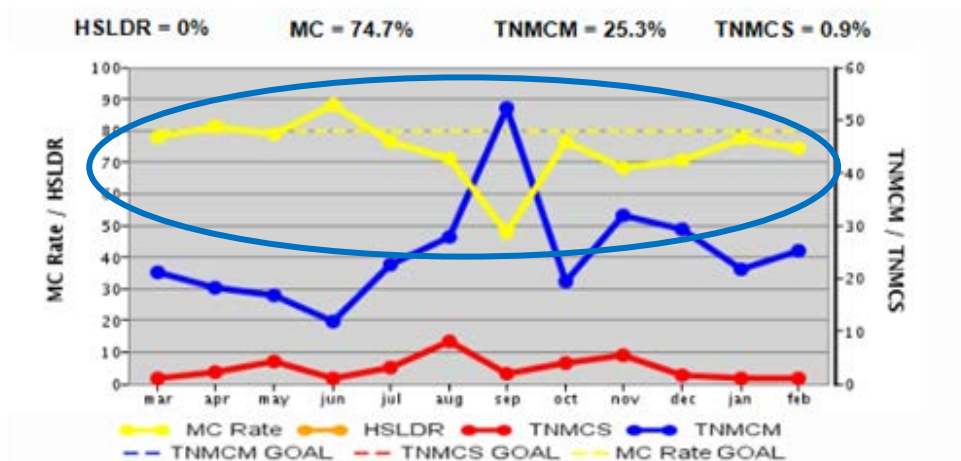


Figure 3: Canadian C-17 MC Rate: March 2016- February 2017, Source: Boeing, “Boeing C-17 Sustainment Review.”

What Figure 3 highlights is the MC rate (solid yellow line) for the Canadian C-17 fleet is consistently below Canada’s MC target (dashed yellow line) of 80%. Comparing the MC lines from Figure 2 & 3 reveals that the Canadian C-17 MC rate is over 10% below the international average. The significance of these data points is it highlights the large disparity between international and Canadian MC rates. However, this analysis alone does not substantiate making changes; therefore, it is important to look more closely at Canada’s MC rate from 2007-2017 and specifically in 2016.

Table 2: Canadian C-17 fleet MC Rates from 2008-2017

Canadian C-17 Fleet Mission Capability (MC) Rates									
Monthly Average: 2007-2017									
Actual results presented in percentage									
2008	2009	2010	2011	2012	2013	2014	2015	2016	2017 ²¹
78.76	84.08	87.55	82.47	85.38	84.30	82.00	83.75	74.24	75.2

Source: Boeing, Trenton site manager, data extracted from “Trenton MC Rates 2008-2016 for SAMEO.”

²¹ Boeing, Boeing Trenton site manager, “Trenton MC Rates 2008-2017,” data provided 16 April 2017.

What the MC rates from the end of 2007 to 2017 in Table 2 represent is that during the period starting with the arrival of the fourth aircraft and ending with the arrival of the fifth, Canada had a fairly respectable MC rate. In fact, the MC rates would be very comparable to the average of the international fleet. To visually represent this output, Canada's yearly MC rates are plotted in Figure 4.

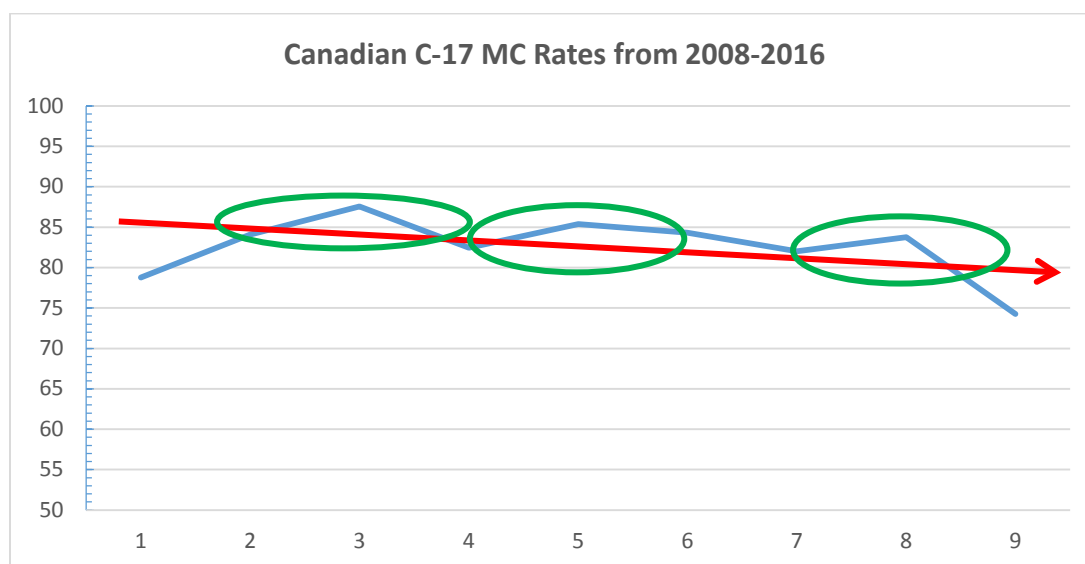


Figure 4: Canadian C-17 fleet MC Rates from 2008-2016.

Source: Boeing.Trenton site manager, data extracted from "Trenton MC Rates 2008-2016 for SAMEO."

What Figure 4 illustrates is that by superimposing a rough trend line (red line) over the MC line, it highlights a gradual drop in MC rates since the C-17 fleet was brought into service, and also demonstrates the more precipitous drop since the fifth C-17 was added to the fleet. Although there is a small margin of error with the trend line, it does not negate the overall trend. Furthermore, exploring the graph in more detail reveals some interesting observations.

Exploring the peaks and drop-offs reveal some interesting events and pressures. From 2007 to 2010 (data points 1-4), Afghanistan operations were still ongoing which

demanded significant output, thus placing heavy demand on the Sqn's ability to sustain operations. Analyzing the first peak (green circle #1) shows that although it is unrealistic to assume that the initial MC uptrend would have continued on that same trajectory, ideally a measured recovery to sustainable MC levels would have been anticipated. However, what took place near the top of the first peak is specifically noteworthy – 2010 Haiti support. With the Haiti crisis demanding elevated support from Canada's strategic airlift capability, what was not anticipated was the cumulative impact that multiple missions would have on the fleet. In particular, the longer the fleet was required to sustain multiple demanding operations, what would be the after effect? What the first drop-off represents is the after effect resulting from the heavy demand, mainly attributed to the concurrent Afghanistan and Haiti efforts. Moving to the second peak reveals a similar trend, in this case resulting from the surge to support the Libyan effort. Although Afghanistan support was still ongoing, operations were winding down, which explains why the second peak is not as abrupt as the first peak.

Moving to the final peak (green circle #3) represents the most significant drop-off which is approximately the timeframe in which Himalayan earthquake relief was taking place in 2015. Why such a sharp drop-off? Although the fleet was supporting various demands, there were no other significant LOO ongoing, which is where a possible connection to the fifth C-17 can be explored. Comparing with the trends of previous years, a normal recovery would be expected, however this is where the additional demands of the fifth aircraft disrupted a normal recovery. As such, the continued decline of the MC rates is largely attributed to the additional requirements to support the additional aircraft. Exploring this decline more closely in Table 3 allows for an

interesting observation to be made, which is a significant drop in MC rates throughout 2016.

Table 3: Canadian C-17 fleet MC Rates for 2016

Canadian C-17 Fleet Mission Capability (MC) Rates											
Monthly Average: 2016											
Actual results presented as a percentage											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
80.4	73.00	77.9	81.50	79.10	88.20	76.5	71.2	47.8	76.6	68.10	70.60

Source: Boeing, Trenton site manager, data extracted from “Trenton MC Rates 2008-2016 for SAMEO.”

Through an analysis of MC rates of the international and Canadian C-17 fleets, in particular since the addition of the fifth C-17 in Canada, it has been demonstrated that the Sqn has become less capable of sustaining supporting concurrent intensive operational demands. This drop in operational effectiveness is mainly attributed to a lack of depth within the maintenance organization. Furthermore, an in-depth exploration of MC trends has further highlighted the lack of depth and serves as an important indicator of the importance of the maintenance organization to be robust and agile enough to respond to and sustain multiple operations. In order to gain some additional context on why there is a lack of depth within the maintenance organization, the next section will explore the manning situation from a holistic perspective and identify why pressures have manifested as a result of the addition of the fifth aircraft.

INCREASED PERSONNEL PRESSURES

Currently there is no global standard or recipe on how many technicians are required within a flying maintenance organization. Emerging trends with many western nations such as Australia have seen a shifting toward more integrated maintenance

models, with an increase in the amount of civilian contractors providing supporting maintenance activities, targeted at improving operational effectiveness.²² Because of different fleet sizes and other operational requirements, this necessitates that each nation shape their support contracts to meet their specific needs, such as meeting minimum MC levels. With the current decline in operational readiness at the Sqn, the RCAF must assess what specific support is required in order to achieve GoC targets which are centered on current manning levels. As such, the RCAF must conduct a comparative analysis with other nations to accurately assess if the fleet has the right level of personnel and expertise in place to achieve maintenance and operational requirements.

Although it is important to understand the proportion of the workday maintainers spend ‘turning wrenches’, and how productive they are when carrying out such tasks, it is equally important to understand the impacts which external factors have on maintenance efforts. When the fifth C-17 was added to the fleet, there was an underlying assumption that additional maintenance personnel would not be required to support the additional aircraft, thus adopting a position of ‘PY neutral’. This resulted in no additional maintainers being added to the Sqn’s maintenance organization to perform first line maintenance and other maintenance related activities. This insular approach has resulted in an erosion of the Sqn’s readiness and reduced capacity to adequately react to surges in operations.

Although the Sqn has demonstrated the ability to surge in moments of crisis, it has never been manned robustly enough to be capable of sustaining a 24/7 support

²² Craig Stone, “Prioritizing Defence Industry Capabilities: Lessons for Canada from Australia,” Canadian Defence and Foreign Affairs Institute, January 2014, <https://www.policyschool.ca/wp-content/uploads/2016/03/defence-capabilities-stone.pdf>.

posture. The maintenance section is currently manned for 16/5 support, which restricts operational readiness; this is further exacerbated by the additional requirements associated with the fifth aircraft. The result has been additional pressures such as an increase in calendar-based maintenance and an increase in weekend work hours.²³ Although no specific data exists to confirm these elevated maintenance efforts, it is estimated that the total maintenance effort to support the additional aircraft is approximately 6,800 person-hours.²⁴ Furthermore, more recent discussions in relation to these pressures are suggesting that the impact could be even higher.²⁵ Although a detailed analysis would need to be conducted in order to more accurately measure and validate these pressures and the effects they are having, the significant increase in maintenance effort required to keep the additional aircraft operationally ready cannot be ignored. Also, lost within these additional pressures is the effect they are having on the individual workers to work harder and longer. To further investigate how these additional pressures are affecting the maintainers, an exploration of the increase in ground flight safety reports will reveal some interesting observations.

A correlation becomes evident between the significant labour hour increase in maintenance efforts and a significant increase in flight safety occurrences. An increase of ground flight safety events at the Sqn serves as a strong indicator and further supports the manifestation of the aforementioned manning pressures.

²³ Briefing Note (BN) for Commander 1 Canadian Air Division, "CC177 AIRLIFT CAPABILITY – MISSION ENHANCEMENT" BN drafted by 429 (T) Sqn on 06 January 2016, Canadian Armed Forces, 2016.

²⁴ Briefing Note (BN) for Commander 1 Canadian Air Division, "MAINTENANCE IMPACT ASSOCIATED WITH AIRCRAFT 177705," BN drafted by 429 (T) Sqn on 14 January 2015, Canadian Forces, 2015.

²⁵ IAW 26 January 2017 8 Wing Trenton flight safety minutes, CO 429 Sqn highlighted that the fifth C17 increased maintenance workload by 13.8 PY's and further emphasizing that the prescribed operational tempo is not sustainable given these manning pressures.

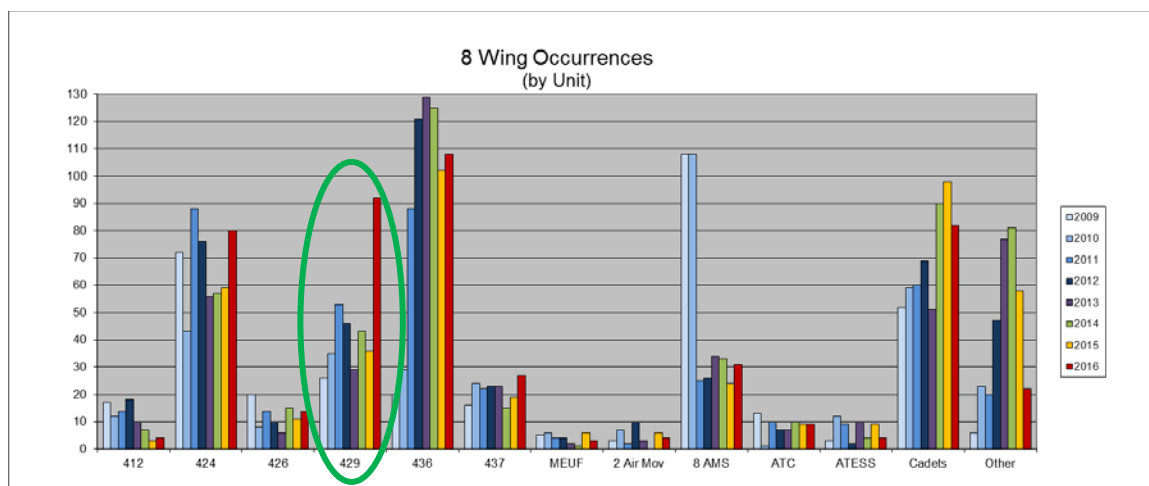


Figure 5: 8 Wing Unit Flight Safety Occurrences for 2016.

Source: 8 Wing Flight Safety Officer, figure extracted from “8 Wing: WFS Committee Meeting” PowerPoint presentation.

What data in Figure 5 represents is a significant increase in flight safety occurrences at the Sqn, from under 40 (yellow column) in 2015 to over 90 (red column) in 2016.²⁶ What was even more profound was the significant increase in occurrences per 1000 flight hours, 12.6 in 2015 to 25.1 in 2016.²⁷ This surge in occurrences is profound and further highlights the internal pressures which have been manifesting from the previous year. However, although these spikes can be attributed to a number of factors, including pressures resulting from personnel shortages, it is important to analyse if they are potentially linked to internal inefficiencies. Furthermore, a countering argument to consider is perhaps an additional influx of manning and/or funding may not be required and solutions may reside within the maintenance organization, such as an internal reinvestment.

²⁶ Wing Flight Safety Officer (8 Wing), 8 Wing Flight Safety PowerPoint presentation, “8 Wing: WFS Committee Meeting,” 26 January 2017.

²⁷ *Ibid.*

Increased internal efficiencies could be pursued through the enhancement of quality performance measures which would create more accountability within the maintenance organization. Residual institutional demands not attributed to core maintenance activities is impacting the availability of maintainers. Examples of these pressures include non-technical military training, Wing and community events, deployments, and various administration requirements. Although these additional duties are no different than the impact they present in any other fleet, it is important to highlight the specific impacts it is having. A recent KPMG report, presented as part of a Defence Renewal Team initiative, made recommendations addressing maintenance deficiencies. The report focused on increasing available maintainer wrench time with the intent of allowing reinvestment in other maintenance priorities. The report presented “targeted opportunities” which could be implemented across the CAF writ large that would yield higher actual maintenance output (wrench turning) significantly. In particular, the report identified a potential creation (through reinvestment) of 338,000 hours across the RCAF if suggested targets were implemented.²⁸ What was further revealed was approximately 15% of a maintainer’s time is spent on wrench turning activities.²⁹ Collectively, if the KPMG recommendations are fully implemented, they have the potential to yield a 19% increase in maintenance productivity across the RCAF.³⁰ This now raises the question if the pursuit of a hybrid initiative makes sense if efficiencies can indeed be achieved internally. However, comparing the individual output between a RegF worker and a

²⁸ KPMG Report, *Defence Renewal Change Management Services Maintenance Execution FINAL REPORT Volume I*, 5 May 2016, 7

²⁹ KPMG Report, *Defence Renewal Change Management Services Maintenance Execution FINAL REPORT Volume II (Part 2)*, 5 May 2016, 46

³⁰ KPMG Report, *Defence Renewal Change Management Services Maintenance Execution FINAL REPORT Volume I*, 5 May 2016, 31

contractor would yield a significant return on the investment. Because contractor support is more focused, working toward a bottom line, the net benefit in comparison to the output of a military technician is significant. Even if one were to take the best case outcome from a refinement of internal efficiencies highlighted above in the KPMG report, the net result would be close to 35% of a maintainer's time spent wrench turning. With the maximum benefit of internal efficiencies, the net benefit to hiring a contractor could yield an additional increase in productivity of approximately 70%.³¹

Along with the benefits that such initiatives would achieve, if combined with a hybrid initiative, the overall benefits would be significant. Although further analysis would need to be conducted on the amount of contractors that would be required, a surface level analysis of the potential benefits will illustrate the advantage of contractor support when compared with the productivity of a military maintainer. The significant difference in productivity between a military technician and a private contractor presents a persuasive argument and suggests significant benefits can be achieved with greater implementation of contractors. If contractors were to be hired they would likely come from retiring CAF members who currently work within the maintenance organization, which would likely create some temporary manning gaps. However, the impact of such manning gaps would be limited through the addition of military apprentices, thus mitigating the overall impact on the Sqn's maintenance organization.

Given no increase in lines of tasking or YFR, the additional C-17 has provided the Sqn with greater operational flexibility to fulfill operational and training requirements; however, additional maintenance requirements associated with the increase in fleet size

³¹ Boeing Trenton site manager, "Contractor Productivity," personal correspondence, 8 May 2017.

should not be ignored. Although the Sqn would benefit from internal adjustments outlined in the KPMG report, this singular approach is not enough. Combining such initiatives with the implementation of a hybrid model would add more depth to the maintenance organization, thus making it more capable to react to multiple demands over the long term. As such, through modification of the existing In-Service Support Contract (ISSC),³² this would empower and shift more accountability to Boeing to conduct front line labour. Additionally, such an effort would complement military maintainers and add depth to the maintenance organization. However, despite such benefits, amending existing contracts to facilitate such an endeavour will cost extra money which will be difficult to pursue within the current fiscal environment. Within that theme, the next section will explore funding reliability with the strategic airlift capability and how efficiencies could create fiscal flexibility to pursue maintenance efficiencies.

FUNDING CHALLENGES

Maintaining operational excellence and reliability has, and continues to be a top priority; however, there is a significant cost associated with maintaining high value assets such as the C-17 fleet. Resultantly, delaying repair and maintenance activities on aircraft runs a significant risk of potentially not having assets available when they are needed. As such, it is vital that sufficient funds are allocated to support maintenance requirements. In the case of the C-17, the military has not adequately assessed the funding required to support maintenance requirements to maintain the fleet over the long term. This raises the

³² Under the ISSC initiative, implemented as policy in 2008 highlighted that there would only be one prime contractor awarded per fleet who would be the single point of accountability. As such, including the acquisition contract, the prime contractor (Boeing in the case of the C-17) would also be awarded for in-service support contracts. Extracted from 2011 Fall Report of the Auditor General of Canada: Chapter 5—Maintaining and Repairing Military Equipment—National Defence,” last accessed 6 May 2017, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201111_05_e_35937.html.

question if the status quo in supporting the strategic airlift capability is good enough to meet current operational requirements, thus not necessitating additional influxes of money? Canada's Auditor General concluded that Defence officials have consistently underestimated the costs required to support maintenance requirements and the personnel who are integral in ensuring the military is able to do its job effectively.³³ In order for the GoC to achieve its' strategic mandate, it is vital that all military equipment is available and reliable when needed and not just supported in an ad hoc manner when responding to severe pressures.

Achieving a high level of sustained effectiveness over the long term is predicated on developing a robust investment plan that is focused on supporting operational and training requirements in a cost effective manner; this has been lacking. The 2016 Auditor General report concluded that over a number of years, support budgets for the C-17 fleet were not acceptable and significantly under levels required to fulfill operational and training requirements.³⁴ Furthermore, in a 2011 report it was highlighted that there was a significant delta between the demand for maintenance and repair services and available funding.³⁵ These gaps in demands and support, coupled with an apparent lack understanding with respect to what the fleet requires have translated into an erosion of support. The result is a capability that is still capable of providing effects, but in a reduced capacity in a sustainability role.

³³ Lee Berthiaume, "Auditor finds military maintenance, recruiting less than ship shape," *CBC News*, 29 November 2016, <http://www.cbc.ca/news/politics/auditor-general-military-maintenance-1.3872795>.

³⁴ Office of the Auditor General of Canada website, "2016 Fall Reports of the Auditor General of Canada: Report 7—Operating and Maintenance Support for Military Equipment—National Defence," last accessed 1 April 2017, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html#p62.

³⁵ Office of the Auditor General of Canada website, "2011 Fall Report of the Auditor General of Canada: Chapter 5—Maintaining and Repairing Military Equipment—National Defence," last accessed 12 April 2017, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201111_05_e_35937.html.

Further exploring these reports further raises the concern regarding the increase in maintenance pressures. The 2016 report highlights, when the military is provided with incremental funding from the GoC's fiscal envelope, the Treasury Board's (TB) expectation is the military will use the intended funds specifically for that purpose, such as operating and maintenance costs.³⁶ The report concluded that NDHQ did not effectively scrutinize if it utilized all of the funds provided by the TB, identifying that \$140 million a year was allocated in incremental funding for C-17 support, however only \$79 million was actually used throughout FY15/16.³⁷ This reinforces the importance for the military to ensure appropriate tracking mechanisms are in place to ensure specific funding is used for its intended purpose, and not routed to support other priorities.

A countering thought to consider supporting the argument that funds may have actually made it to the program is that NDHQ used incomplete tracking mechanisms to account for the additional funds provided for the strategic airlift capability. This further suggests that it is difficult to conclude with certainty if certain aspects of the program were supported or not. A lack of clearly defined life-cycle costs, including support costs, runs the risk of NDHQ potentially not setting aside adequate funds to support the equipment as planned.³⁸ This could result in unintended consequences such as a reduced level of effectiveness, an effect which has already manifested as illustrated in the first section of this paper. As such, although it is likely that funding intended for the strategic airlift capability was completely absorbed into the wider military fiscal envelope, it is

³⁶ Office of the Auditor General of Canada website. "2016 Fall Reports of the Auditor General of Canada: Report 7—Operating and Maintenance Support for Military Equipment—National Defence." last accessed 11 April 2017. http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html#p62.

³⁷ *Ibid.*

³⁸ *Ibid.*

important that an appropriate analysis be conducted to identify inefficiencies. Such an analysis could present initiatives which would produce greater efficiencies which could even challenge if additional funding is actually required to alleviate maintenance pressures. For example, 8 Wing initiatives in response to the KPMG report suggest that funding is being made available to provide support within various maintenance organizations. Such initiatives include the potential employment of civilians and/or reservists within certain pockets of the maintenance organization such as Quality Management and Aircraft Maintenance Control and Records offices, jobs which may be limiting a technicians' ability to be carry out maintenance duties.³⁹ Although other internal efficiencies could be achieved they would unlikely yield the consistent benefits of a hybrid maintenance endeavor.

In order to ensure operational effectiveness is optimized, NDHQ must ensure that incremental funding provided by the GoC is appropriately monitored and utilized. The result of inconsistent funding places a heavier burden on those currently employed within the maintenance organization to ensure assets are available when needed while also compromising the future financial situation of the CAF writ large. As such, the military must adopt a more robust funding support model to ensure the needs of the C-17 fleet are supported over the long term.

CONCLUSION

There is no denying that Canada's C-17 fleet has revolutionized the way in which the CAF operates, and also greatly enhanced the political reach of the GoC. Captured by

³⁹ Operational Order (8 WING), "OP ORDER: DEFENCE RENEWAL TEAM MAINTENANCE EXECUTION: 8 WING INITIATIVES," 28 April 2016.

a previous RCAF Comd, "...With the arrival of our new [strategic airlifters], we will be more agile, more flexible, and better able to respond when the Government of Canada calls on the RCAF."⁴⁰ With global humanitarian efforts and regional conflicts prominent within the geopolitical landscape, there will be continued pressure on the GoC to be a leader in response efforts. Highlighting areas of pressure within the C-17 fleet, this paper focused on determining what actions could be taken to improve operational effectiveness. Through an analysis of MC rates, manning within the maintenance organization, and funding support, it has been demonstrated that the Sqn's operational readiness and effectiveness have degraded since the arrival of the fifth C-17, through an erosion of the three fundamental maintenance pillars: availability, serviceability and sustainability.

Although senior leadership did not foresee the eventual impact that the additional aircraft would cause, what was missing was a plan which could be put into action which would reinforce the maintenance organization if there were unintended impacts. With additional funding unlikely under the current government, although an undesirable outcome, perhaps this coveted capability needs to fail in order to get the required attention. However, the consequences of taking on such a risk could be catastrophic in nature and must be avoided with the increasing warning signs.

Although the prime contractor has a vested interest in MC rates, there is no contract in place for front-line maintenance, thereby limiting their ability to impact maintenance beyond an advisory role. With hybrid models yielding positive results thus

⁴⁰ Government of Canada website, "Government of Canada Welcomes Increased Air Power for the Royal Canadian Air Force - Canada's Fifth CC-177 Globemaster touches down at 8 Wing Trenton," last accessed 16 April 2017, <https://www.canada.ca/en/news/archive/2015/03/government-canada-welcomes-increased-air-power-royal-canadian-air-force-canada-fifth-cc-177-globemaster-touches-down-8-wing-trenton.html?=&wbdisable=true#travel>.

far in the U.K. and Australia, this presents a unique opportunity for Canada to explore the potential benefits and how such a model could be implemented to support Canadian C-17 operations. With the security landscape becoming more uncertain, implementing such a framework within Canada will synergize efforts through the enhancement of scheduling and line maintenance procedures. Most importantly, revising the corporate structure will not only result in a more consistent and reliable maintenance structure, but also present some cultural benefits. Although further analysis would need to be conducted to ascertain to what degree of success a hybrid maintenance option would achieve, it is clear that it will contribute to a capability that is more agile and responsive. As the Canadian C-17 approaches its 10th anniversary, ensuring the fleet is agile enough to sustain multiple demands, is underpinned by the strength of the maintenance organization. As such, in order to curb a further erosion of operational effectiveness, exploring the benefits of hybrid support would greatly contribute to achieving a higher readiness posture. As such, through a comprehensive analysis of how other maintenance organizations are employed, such as in Australia and the U.K., Canada would benefit from a revision to the existing in-service support contract which would expand the prime contractor's role within the maintenance organization, thus increasing the maintenance organization's readiness and improving the operational effectiveness of the C-17 fleet.

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