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# Cost Estimate of Operation IMPACT in Iraq

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## Cost Estimate of Operation IMPACT in Iraq

The mandate of the Parliamentary Budget Officer is to provide independent analysis to Parliament on the state of the nation's finances, the government's estimates and trends in the national economy; and upon request from a committee or parliamentarian, to estimate the financial cost of any proposal for matters over which Parliament has jurisdiction. This report provides an estimate of the financial cost of Operation IMPACT, as requested by two parliamentarians.

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## Executive summary

Operation IMPACT is the name given to Canada's contribution to the efforts of the United States and its allies to reduce or eliminate the efficacy of the Islamic State of Iraq and the Levant (ISIL), which has taken effective control of large swathes of territory in Iraq and Syria.

About 600 Canadian Armed Forces (CAF) personnel have been assembled into a Joint Task Force to conduct operations. The Air Task Force component consists of six CF-18 Hornet fighter aircraft, two CP-140 Aurora surveillance aircraft, one C-150T Polaris air refueller, one C-17 Globemaster and one C-130J Hercules aircraft.

PBO was asked by two Members of Parliament to provide the cost of a six-month and 12-month mission. This posed a significant challenge, given the paucity of detailed information available on the underlying characteristics of Operation IMPACT, such as the composition and characteristics of personnel deployed, the amount of ammunition used, the flying hours of the various air assets being used, and the in-theatre arrangements for providing food and accommodation.

PBO made a number of information requests to the Department of National Defence (DND) to facilitate this analysis. While DND provided an up-to-date version of its *Cost Factors Manual 2014-15*, it refused all PBO requests for specific data on Operation IMPACT. Several of these refusals appear to breach DND's legal obligations under the *Parliament of Canada Act*. Information that would have been helpful for PBO analysis was also denied to parliamentarians in the context of Order Paper questions. Much of the uncertainty in this report's estimate of the cost of Operation IMPACT arises from DND's withholding of information.

That said, based on information released in irregular technical briefings and other data in the public domain, PBO was able to produce an estimate based on a combination of costing by analogy and cost factors.

The main cost drivers for such a mission abroad are Pay and Allowances and Food and Accommodations for CAF personnel on the ground, as well as Aircraft Operations, and Vehicles and Communications Costs. PBO estimated all these individually. In the case of Aircraft Operations, PBO estimated highs and lows based on the tempo of Operation IMPACT to date.

In providing its estimate, PBO sought to provide the incremental costs of the mission, that is, those costs that would not have been incurred if the mission did not happen. There are, however, limitations to representing incremental costs as the costs of overseas operations. For example, by ensuring that allocated yearly flying hours can absorb the additional hours flown in the operation, CAF could effectively eliminate the incremental cost of Aircraft Operations.

For the purposes of this report, all costs are incremental. However, Aircraft Operations will create incremental costs to the extent that the hours flown exceed the Royal Canadian Air Force's (RCAF) allocated yearly flight hours. PBO had no way of determining whether the flying hours estimated fell within these allocated yearly flying hours.

The estimated incremental cost of Operation IMPACT for six months ranges between a high of \$166.40 million and a low of \$128.80 million as shown in Summary Table 1.

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**Summary Table 1: Estimated incremental costs of Operation IMPACT by category (in millions) for the six-month mission**

Cost Category	High	Low
Pay and allowances	\$ 5.24	\$ 5.24
Food and accomodations	\$ 20.62	\$ 5.55
Initial supply flights, return flights to theatre	\$ 26.80	\$ 26.80
In-theatre supply flights	\$ 18.29	\$ 18.29
Aircraft operations	\$ 75.23	\$ 66.28
Ammunition	\$ 15.72	\$ 2.14
Vehicles and communication	\$ 4.49	\$ 4.49
<b>Total</b>	<b>\$ 166.40</b>	<b>\$ 128.80</b>

Source: PBO

The marginal cost of operations is estimated at between a high of \$7.11 million and a low of \$4.38 million per week and a high of \$30.81 million and a low of \$18.98 million per month, as shown in Summary Table 2. This represents the additional costs incurred by continuing operations; accordingly, it does not include sunk costs, such as initial supply flights to theatre and return flights to Canada.

**Summary Table 2: Estimated marginal costs of Operation IMPACT (in millions)**

	High	Low
Per week	\$ 7.11	\$ 4.38
Per month	\$30.81	\$18.98

Source: PBO

If the mission were lengthened for another six months, extending the analysis forward would result in an estimated incremental cost of Operation IMPACT for the 12 months of between a high of \$351.27 million and a low of \$242.71 million. Summary Table 3 shows the breakdown of these costs.

**Summary Table 3: Estimated incremental costs of Operation IMPACT by category (in millions) for the 12-month mission**

Cost Category	High	Low
Pay and allowances	\$ 11.38	\$ 11.38
Food and accomodations	\$ 45.00	\$ 11.75
Initial supply flights, return flights to theatre	\$ 26.80	\$ 26.80
In-theatre supply flights	\$ 36.58	\$ 36.58
Aircraft operations	\$181.83	\$ 143.63
Ammunition	\$ 40.68	\$ 3.57
Vehicles and communication	\$ 8.99	\$ 8.99
<b>Total</b>	<b>\$351.27</b>	<b>\$ 242.71</b>

Source: PBO

It is worth noting that the full costs for Canada’s most recent overseas mission in Libya (i.e. Operation Mobile) were almost six times the reported incremental costs for the mission.<sup>1</sup>

<sup>1</sup> Defence Department of National (2011-12); for more information on full and incremental costs, see grey box on page 8 entitled “Incremental versus full costs”.

# 1 Introduction

## 1.1 Background

PBO was asked by Jack Harris, Member of Parliament for St. John's East, and Joyce Murray, Member of Parliament for Vancouver Quadra, to estimate the cost of Canada's proposed mission in Iraq, which the Government has titled Operation IMPACT.

### Operation IMPACT

Operation IMPACT seeks to reduce or eliminate the efficacy of the Islamic State of Iraq and the Levant (ISIL), which has taken effective control of large swathes of territory in Iraq and Syria.

Mission operations began in August 2014 with the Canadian Armed Forces (CAF) delivering 35,000 pounds of military supplies to Iraqi forces in the north of the country. Similar operations took place in September.

On October 7, 2014, the House of Commons expressed its support for the continuation of Operation IMPACT for six months, involving air strikes. Air strikes began, in earnest, on October 30, 2014.

While the House of Commons motion authorized a six-month mission, Operation IMPACT will, in fact, be longer, because, as outlined above, it began, according to the Department of National Defence in August 2014<sup>2</sup> and, moreover, all indications suggest that the mission will be extended beyond April 7, 2015.<sup>3</sup>

The House of Commons expressed its support of Operation IMPACT on October 7, 2014, by way of a motion that:

(a) supported the Government's decision to contribute Canadian military assets to the fight against ISIL [Islamic State of Iraq and the Levant], and terrorists allied with ISIL, including air strike capability for a period of up to six months; [and]

(b) noted that the Government of Canada will not deploy troops in ground combat operations; [...]

Following the motion, CAF personnel were assembled into a Joint Task Force, consisting of:

- An Air Task Force
- 69 advisors
- Liaison officers
- Command and control personnel
- Medical personnel
- Logistics<sup>4</sup>

DND has not publicly released the exact number of liaison officers, command and control personnel, medical personnel and those charged with handling logistics. However, it has indicated that the total number of personnel is around 600.

The Air Task Force includes the following aircraft:

- Six CF-18 Hornet fighter aircraft, used for striking ISIL fighting positions using precision guided munitions
- Two CP-140 Aurora surveillance aircraft, which provide surveillance and reconnaissance capabilities
- One C-150T Polaris aerial refueller, which can deliver passengers, freight, or medical supplies and can provide air-to-air refueling for CF-18 Hornet fighter aircraft
- One C-17 Globemaster aircraft, which delivers troops, cargo, and equipment
- One C-130J Hercules aircraft, which transports troops, cargo, and equipment<sup>5</sup>

<sup>2</sup> Department of National Defence (2015a).

<sup>3</sup> Lawson (2014); Vance (2015); Naumetz (2015).

<sup>4</sup> Department of National Defence (2015a).

<sup>5</sup> Ibid. The RCAF officially uses the following formal designations for RCAF aircrafts: CF-188 Hornet, CP-140 Aurora, CC-150T Polaris, CC-177 Globemaster, and CC-130J Hercules. To improve readability and

**Figure 1-1: C-130J Hercules aircraft**



Source: Royal Canadian Air Force

PBO was asked to provide the Senate and House of Commons with the cost of Operation IMPACT for the stated period of up to six months following the motion, as well as a cost estimate of Canada's mission if it were to be extended by a further six months, for a 12-month period.

While the House of Commons motion supported the use of force for six months, senior officials have stated that the coalition mission in Iraq will continue beyond this six-month time frame.<sup>6</sup>

The Air Task Force arrived in Kuwait on October 28 and started flying operations on October 30. On February 11, 2015, DND reported that they had flown 473 total sorties: 310 by fighter aircraft, 77 by Polaris tanker, and 86 by Aurora surveillance aircraft.<sup>7</sup> These same reports indicate that Royal Canadian Air Force (RCAF) aircraft had conducted a total of 79 airstrikes over this period and the

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compatibility with common parlance, PBO has adopted the more common designations throughout.

<sup>6</sup> Vance (2015); Lawson (2014); Naumetz (2015).

<sup>7</sup> Department of National Defence (2015a).

Canadian refueling aircraft had transferred 4.32 million pounds of fuel to coalition aircraft.<sup>8</sup>

**Figure 1-2: CF-18 squadron**



Source: Royal Canadian Air Force

## 1.2 Information Requested

In performing this analysis, PBO made a series of requests for information to the Department of National Defence (DND). While DND provided PBO with some information, the majority of PBO's requests went unfulfilled.

DND made it clear that it took a very narrow view of PBO's right to access information under the *Parliament of Canada Act* and would provide information only where it interpreted there to be a clear legal obligation under that Act to do so.

This lack of detailed information on Operation IMPACT's characteristics, such as the composition and characteristics of personnel, the amount of ammunition used, the flying hours of the various air assets being used, and the in-theatre arrangements for providing food and accommodation, meant that PBO had little option, in many circumstances, but to

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<sup>8</sup> Ibid., Department of National Defence (2015b).

extrapolate from past missions and operations. This introduces substantial uncertainty into the analysis.

### DND information requests

PBO filed four information request related to this work.

On October 10, 2014, PBO asked DND for its current Cost Factors Manual.<sup>9</sup> PBO requested this information by October 24, 2014. DND provided the Cost Factors Manual on December 3, 2014.<sup>10</sup> PBO asked whether the information was confidential, and DND responded that it was not.

On October 15, 2014, PBO asked DND for:

“The additional funds that are estimated to be spent on the Government's decision to contribute Canadian military assets to the fight against the Islamic State of Iraq and the Levant (ISIL), and terrorists allied with ISIL, including an air strike capability for a period of up to six months, how these funds are intended to be spent, and where these funds are intended to be sourced from (i.e. will they be net new or taken from some other account) for this fiscal year (2014-15) and the next (2015-2016).”<sup>11</sup>

PBO requested this information by October 31, 2014. On November 4, 2014, Lieutenant-General Jonathan Vance confirmed that the Canadian Joint Operations Command had provided the Government with “an estimate of [the cost of] operations over the course of six months.”<sup>12</sup> DND has repeatedly refused to provide that estimate, claiming it as a Cabinet confidence.<sup>13</sup> The estimate is not a Cabinet confidence because it provides the factual basis for a decision that has been made, and, regardless, PBO is entitled to the information contained in Cabinet confidences provided the information appears in any other document.<sup>14</sup>

On October 17, 2014, PBO asked DND for:

“The breakdown of direct and indirect incremental costs associated with Canada's air missions associated with Operation Mobile, Operation Friction, Operation Mirador,

and Operation Echo and any other international missions in which Canada has deployed CF-18s.”<sup>15</sup>

PBO requested this information by November 7, 2014. On November 18, 2014, DND provided a partial breakdown.<sup>16</sup>

On November 7, 2014, PBO requested “all flying hours to date.”<sup>17</sup> DND refused to provide this on grounds that it was not “financial or economic data” to which PBO is entitled under legislation.<sup>18</sup> If “economic” is to mean anything distinct from “financial,” it must include factors of production, such as how many employees worked how many hours, or in this case, how many hours have been flown. Such information is essential for producing cost estimates.

On November 20, 2014, PBO asked DND for tracked costs to date for a number of different components of Operation IMPACT.<sup>19</sup> While DND responded on December 23, 2014, the information was not provided.<sup>20</sup>

PBO analysts also requested to participate in regular technical briefings. However, they were told by DND personnel that such briefings were reserved for stakeholders, i.e., “academics and analysts who are experts in defence and security.”

Since the operational data used in this report was obtained from publicly available information, rather than information received in confidence, PBO has not treated it as confidential.

As outlined, PBO did receive an up-to-date version of its *Cost Factors Manual 2014-2015*, which was instrumental in allowing PBO to estimate Aircraft Operations costs.

### DND's Cost Factors Manual

DND prepares an annual Cost Factors Manual, which is an unofficial publication outlining cost estimates for performing various missions or using various equipment. It provides factors to apply for estimating costs associated with personnel, equipment, and facility costs.

<sup>9</sup> Parliamentary Budget Office (2014a).

<sup>10</sup> Department of National Defence (2014d).

<sup>11</sup> Parliamentary Budget Officer (2014b).

<sup>12</sup> Vance (2014).

<sup>13</sup> Defence Department of National (2014a), Department of National Defence (2014e).

<sup>14</sup> Parliament of Canada Act (1985) s 79.3(2)(b).

<sup>15</sup> Parliamentary Budget Officer (2014a).

<sup>16</sup> Department of National Defence (2014c).

<sup>17</sup> Parliamentary Budget Office (2014b).

<sup>18</sup> Defence Department of National (2014b).

<sup>19</sup> Parliamentary Budget Officer (2014c).

<sup>20</sup> Department of National Defence (2014f).



## 2 Analysis

### 2.1 Introduction

PBO broke down the costs of Operation IMPACT into five categories:

1. Pay and Allowances
2. Food and Accommodations
3. Aircraft Operations
4. Ammunition
5. Vehicles and Communication

These categories reflect the way in which DND broke down the incremental costs of Canada's most recent overseas mission called Operation Mobile.<sup>21</sup>

#### Operation Mobile

Operation Mobile refers to Canada's operation in the 2011 military intervention in Libya. In that operation, Air Task Force Lebeccio involved the use of seven CF-18 Hornet Fighters, two C-150 Polaris Tankers, and two CP-140 Aurora Patrol Aircraft, among others. These three types of aircraft are currently used in Operation IMPACT.

The above categories were calculated based on the following information:

1. Pay and Allowances was based on Operation Mobile's figures
2. Food and Accommodation was based on the daily Mission Sustainment Allowance of the UN Department of Peacekeeping Operations
3. Aircraft Operations was based on DND's 2014-15 Cost Factors Manual
4. Ammunition was based on the most recent United States Air Force (USAF) ammunition requests to Congress

5. Vehicles and Communication was based on Operation Mobile figures

The methodologies PBO used to cost these categories varied. In the case of Pay and Allowances and Vehicles and Communication, it used costing by analogy. Costing for Food and Accommodation, Aircraft Operations, and Ammunition was based on the application of cost factors.

The analysis drew on a pool of past costs and adjusted them based on the specific parameters forecast for Operation IMPACT. For the purpose of this analysis, this report seeks to estimate the incremental costs of the mission.

Where figures were in Canadian dollars for past fiscal years, the all-items Consumer Price Index (CPI) was used to convert them to current fiscal year dollars. Where figures were in US dollars, average annual spot exchange rates were used to convert them to Canadian dollars. Where figures were in US dollars for past fiscal years, the US all-items CPI was used to convert them to current fiscal year dollars. It is also worth noting that many studies have shown that defence inflation is higher than CPI. As a result, this estimate may, in some respects, underestimate the incremental cost.

#### Incremental versus full costs

DND presents information on the costs of expeditionary military deployments in two formats: incremental costs and full costs.<sup>22</sup>

The incremental cost represents the short-term, marginal cost of Operation IMPACT. It is useful for weighing the cost of Operation IMPACT against competing in-year government priorities and other methods of addressing ISIL. It is not useful, however, for deciding whether maintaining the capacity to engage in overseas operations is worthwhile.

<sup>21</sup> Access to Information Request A-2012-00440 (2012) p. 54.

<sup>22</sup> Department of National Defence (2013-14).

Short-term, incremental costs have the potential to be misleading. For example, if DND decided to increase its annual flying hours in peacetime, the incremental short-term cost of overseas operations would be lower, even though the government would be paying more.

DND has many costs which are sunk in the short run—such as the cost of its aircraft and base pay—but which need to be taken to account in long-run planning. Those expenditures are broadly outlined in the Canada First Defense Strategy and amount to \$490 billion over 20 years. Part of those costs is attributable to maintaining the capacity to engage in major international operations for extended periods. It is beyond the scope of this report and publicly available data to determine the magnitude of those costs. They represent the long-run cost of overseas operations and should be taken into account in decision making beyond a one-year horizon.

To the extent possible, this report presents only those in-year costs that would not have been incurred if the mission did not happen. The only exception to this is Aircraft Operations. Whether the activities of RCAF aircraft operating in support of Operation IMPACT are incremental costs or not depends on whether they fall within the RCAF's allocation of yearly flight hours.<sup>23</sup> If flights in support of Operation IMPACT exceed these allocations, they will be considered incremental costs. PBO had no means of making this assessment, however, as it does not have access to current yearly flying hour allocations.

It is important to remember that what follows is a cost estimate, and its accuracy is subject to the following limitations.

First, DND has provided few details of actual costs to date. It has also provided limited operational information. Second, the cost factors provided by DND and used by PBO to prepare this estimate, though widely accepted, are based on historical averages. These risk not capturing the unique circumstances of this operation. Third, the activity rates of this operation could change depending on the needs of the Combined Air Operation Centre.

<sup>23</sup> Fetterly (2006).

## 2.2 Pay and Allowances

The category Pay and Allowances encompasses any compensation that would not otherwise be paid if the mission did not occur. This includes pay for any reservists deployed on Class C service and a range of allowances that might be paid to Canadian Armed Forces (CAF) members for deployment on operations, personal risk, and hazards.<sup>24</sup>

The calculation for Pay and Allowances is typically based on multiple factors reflecting the planned composition of deployed CAF members. According to DND's response to an Order Paper question requesting this information, these amounts "could vary considerably depending on several factors including the length of the deployment, length and duration of prior deployments, the location, and individual personal circumstances."<sup>25</sup> DND did not provide such information.

As a result, an estimate was prepared by normalizing the cost of this category for Operation Mobile to Operation IMPACT data.

Pay and Allowances totalled \$7 million for Operation Mobile. Operation Mobile lasted 225 days. Operation IMPACT is currently stated to last until April 7, 2015.<sup>26</sup> From the start of the mission's initial

<sup>24</sup> Department of National Defence (2014b) at "Chapter 10 – Military Foreign Service Instructions."

<sup>25</sup> Defence Department of National (2015a) p. 3.

<sup>26</sup> This is based on the assumption that the mission's six month duration started when the motion was passed by Parliament, on October 7, 2014. Department of National Defence (2015a). Clarification as to the specific date the mission ends was requested from DND in Order Paper question 803 question "(c) is this mission scheduled to end six months from October 7, 2014, the date the motion to initiate it was adopted by the House of Commons?" DND's response referred only to the original motion put before Parliament October 6, 2014. Defence Department of National (2015b). Calculations in this estimate assume the mission started October 28 and ends April 7. Any errors resulting from this discrepancy would be minor and attributable to PBO's inability to secure official clarification.

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operating capability, this amounts to 162 days.<sup>27</sup> Thus, Operation IMPACT is roughly 72 per cent of Operation Mobile's length. At 600 personnel, Operation IMPACT is a slightly larger mission than Operation Mobile, which had 570 personnel.<sup>28</sup>

PBO normalized the reported costs for Operation Mobile to Operation IMPACT by inflating and multiplying it by 0.72 (reflecting the reduction in duration). The result is \$5.24 million for Pay and Allowances.

It is important to acknowledge that this is a rough estimate. The degree to which it reflects the true costs depends on a number of factors. These include the composition of the deployed task force in terms of military occupational speciality, rank, years of service, and previous time spent in a deployed theatre of operations. It will also depend on the degree to which the Consumer Price Index reflects the true inflation to be attributed to Pay and Allowances.

### 2.3 Food and Accommodations

The category Food and Accommodations encompasses any costs of quartering CAF personnel in Kuwait. This would include rent, food and basic necessities, utilities, and so on.

DND did not make publicly available detailed information on the nature of the provisioning arrangements in Kuwait. Without such information, it is impossible to estimate costs for Food and Accommodation from the bottom up.

PBO, therefore, relied on the daily Mission Sustainment Allowance presented in the UN Department of Peacekeeping Operations.<sup>29</sup> As of 2014, these costs ranged from \$56 to \$208 per person per day (assumed to be 2014 USD).<sup>30</sup> These figures are based on the long-term cost to individuals of purchasing accommodation, food, and miscellaneous expenses where they are deployed, which is not the case in Kuwait. As shown in Figure 2-1 and Figure 2-2, CAF is constructing infrastructure in Kuwait. Therefore, the figures presented for Food and Accommodations, especially the low bound, may underrepresent the actual cost.

**Figure 2-1: Construction of structures in Kuwait**



Source: DND<sup>31</sup>

<sup>27</sup> Air operations did not start until October 30, 2014. Thus, the calculations for air operations assume 160 days of operations through April 7, 2015.

<sup>28</sup> The difference in personnel numbers between the two operations is marginal, especially given the prospect of fluctuations, and therefore, no adjustment was made to Pay and Allowances on this basis.

<sup>29</sup> Coleman (2014).

<sup>30</sup> Ibid. p. 9.

<sup>31</sup> Department of National Defence (2015a).

**Figure 2-2: Cutting wood to build shelters**



Source: DND<sup>32</sup>

Assuming that the mission troop strength remains constant at 600 personnel, deployed between October 28, 2014<sup>33</sup> and April 7, 2015, these CAF

<sup>32</sup> Ibid..

<sup>33</sup> All assets and personnel were deployed as of this date. In a January 19, 2015 technical briefing, Lieutenant-General Jon Vance, Commander Canadian Joint Operations Command indicated that there were 625 personnel deployed in support of Operation IMPACT. However, the DND website for the mission indicates a force of 600, so this 25-person increase might be attributable to temporary fluctuations due to technical assistance or other visits whereby CAF deploys personnel temporarily to theatre. Vance (2015).

members will be deployed for 162 days. This is the equivalent of 97,200 person days.<sup>34</sup>

Multiplied by the daily rates, this provides a sustainment cost estimate high (at \$208 per day) of \$19.28 million USD and a low (at \$56 per day) of \$5.19 million USD. PBO normalized these figures by converting them to Canadian dollars. The result is a sustainment cost estimate high of \$20.62 million and a low of \$5.55 million.

As already mentioned, it is important to note that the actual cost of Food and Accommodations depends on actual provisioning arrangements in Kuwait and the needs of personnel.

## 2.4 Aircraft Operations

Aircraft Operations costs are based on the number of hours that each of the aircraft involved in the mission flies. Since Operation IMPACT began, DND has been releasing, at irregular intervals, information on the number of sorties and resupply missions flown by each of the aircraft in theatre.<sup>35</sup> PBO requested the total number of flying hours, but DND did not provide them and has not provided any figures publicly.

PBO, therefore, estimated the total number of flying hours attributable to Operation IMPACT. This report distinguishes three types of flight hours.

Section 2.4.1 provides an estimate of the total number of hours flown in theatre in support of coalition air operations. This is a combination of actual sorties flown to date and a projection of future sorties over the mission's duration.

<sup>34</sup> That is,  $600 \times 162$ . The Canadian contingent was deployed progressively over the three-week period up to October 28, 2014. PBO does not have any information available to be able to account for specific numbers of deployed personnel over time. It is therefore impossible to account for personnel deployed in Iraq before this time.

<sup>35</sup> Department of National Defence (2015a).

Section 2.4.2 estimates the total number of hours already flown in support of supply missions up until mid-November, or in deploying and redeploying assets to theatre. These are estimated separately because hours already flown in support of supply missions or in deploying and redeploying assets to theatre do not vary based on in-theatre activity rates.

Section 2.4.3 estimates the total number of hours flown in support of supply missions after mid-November and those that will be flown until the mission ends. These are flights transporting materiel from Canada to Kuwait to support the ongoing efforts of Joint Task Force Iraq and, therefore, support the in-theatre activities described in section 2.4.1.

To estimate the total cost of these flight hours, DND’s *Cost Factors Manual 2014/2015* was used.

The operating cost per flying hour, by fleet, is listed in Table 2-1. The figures reflect operating costs, including aviation petroleum, oil and lubricants; operations and maintenance costs other than those for aircraft fuel and any facility related costs from the flying squadrons; and national procurement, both variable and fixed.<sup>36</sup>

Operating costs is the cost category used because these are the costs used by DND when calculating recoveries from other government departments. This category of costs will form DND’s request for incremental funding from the government subject to DND’s ability to internally reallocate resources.<sup>37</sup>

<sup>36</sup> DND’s National Procurement budget is a centrally managed Operations and Maintenance fund controlled by the ADM (Materiel). It funds a variety of activities related to the in-service support of military equipment including life extension programs, repair and overhaul of weapon systems, the acquisition of spare parts and maintenance services. Fetterly and Essaddam (2008) pp. 59–70.

<sup>37</sup> Department of National Defence (2014-15) p. 1; PBO Sources.

**Table 2-1: Operating costs per flying hour**

Aircraft	Cost/hr
CF-18 Hornet	\$16,750
CP-140 Aurora	\$19,750
C-150T Polaris	\$17,150
C-17 Globemaster	\$21,350
C-130J Hercules	\$20,750

Source: DND Cost Factors Manual 2014/2015

**2.4.1 In-Theatre Activity**

In-theatre flights are conducted by the CF-18 Hornet, CP-140 Aurora, and C-150T Polaris. The information released by DND indicates that RCAF aircraft have flown the number of sorties and resupply missions shown in Table 2-2.

**Table 2-2: Total number of sorties to date (i.e. February 11, 2015)**

Aircraft	Sorties
CF-18 Hornet	310
CP-140 Aurora	86
C-150T Polaris	77

Source: DND<sup>38</sup>

The number of sorties yet to be flown was estimated based on these figures. To do this, the following assumptions were adopted:

First, the House of Commons expressed its support for the mission on October 7, 2014, and the mission’s six-month duration started that day. This mission ends April 7, 2015.<sup>39</sup>

<sup>38</sup> Department of National Defence (2015a).

<sup>39</sup> Ibid. Vance (2014), Vance (2015), House of Commons (2015).

Second, the deployed aircraft can fly a maximum number of sorties per day on a sustained basis. These are shown in Table 2-3.<sup>40</sup>

**Table 2-3: Maximum number of sorties per day per aircraft**

Aircraft	Sorties/day
CF-18 Hornet	4
CP-140 Aurora	1
C-150T Polaris	1

Source: PBO Sources

Third, the deployed aircraft would fly approximately the number of hours per sortie listed in Table 2-4.

**Table 2-4: Hours per sortie**

Aircraft	Hrs/sortie
CF-18 Hornet	4
CP-140 Aurora	10
C-150T Polaris	5

Source: RCAF<sup>41</sup> and PBO Sources

While the number of hours per sortie can vary considerably, the figures presented above are broadly consistent with data available from Operation Mobile provided in Table 2-5.

**Table 2-5: Operation Mobile**

Aircraft	Hrs/sortie
CF-18 Hornet	4.1
CP-140 Aurora	7.8
C-150T Polaris	5.5

Source: DND<sup>42</sup>

The number of hours that will ultimately be flown by these aircraft will depend on the coalition’s needs and conditions on the ground. Given the possible variability of these factors, PBO prepared three estimates of a reasonable range of future flying hours from February 11, 2015 through April 7, 2015.

The first is based on the “current average sortie rate”, which extrapolates the current average number of sorties per day shown in Table 2-6 over the remaining 56 days of the mission.

The second is based on a “high sortie rate”, which assumes that the activity rates for the three aircraft flying in theatre – the CF-18 Hornet, CP-140 Aurora, and C-150T Polaris – increase to the maximum number of planned sorties per day listed in Table 2-3 above.

It is possible that the rate could reach the maximum, as the sortie rate of the overall coalition continues to rise for aircraft flying the same three types of missions performed by RCAF aircraft deployed to the theatre.<sup>43</sup>

The third is a “low sortie rate.” This rate was determined by analyzing the data provided by DND in three time periods: October 30 to December 1; December 2 to January 5; and January 6 to February 11.

<sup>40</sup> PBO Sources.

<sup>41</sup> Royal Canadian Air Force (2015). These figures were based on published airspeed data for RCAF aircraft and PBO calculations of probable flight distance, likely aircraft routings, and take-off and landing considerations.

<sup>42</sup> Department of National Defence (2014a).

<sup>43</sup> United States Department of Defense (2015).

## Cost Estimate of Operation IMPACT in Iraq

This analysis shows that the flying rate has varied for each aircraft operating in theatre. The “low sortie rate” uses the lowest flying rate experienced to date in any one of these periods to provide a reasonable lower range of possible flying activity, based on actual experiences to date.

Table 2-6 captures, as of February 11, 2015, RCAF activity flown as part of Operation IMPACT in Iraq.

**Table 2-6: Task Force Iraq operations, Oct 30, 2014 to February 11, 2015**

Aircraft	Days Operating	Sorties Flown	Sorties /Day
CF-18 Hornet	104	310	2.98
CP-140 Aurora	104	86	0.83
C-150T Polaris	104	77	0.74

Source: DND<sup>44</sup>

Table 2-7 provides three estimates of possible activity between February 11 and April 7, 2015.

**Table 2-7: Estimated future sorties, February 11 to April 7, 2015**

Aircraft	Current	High	Low
CF-18 Hornet	167	224	149
CP-140 Aurora	46	56	44
C-150T Polaris	41	56	38

Source: PBO

Table 2-8 adds the sorties already flown as of February 11, 2015, to the three estimates of future sorties from Table 2-7.

**Table 2-8: Estimated total sorties, Oct 3, 2014 to Apr 7, 2015**

Aircraft	Current	High	Low
CF-18 Hornet	477	534	459
CP-140 Aurora	132	142	130
C-150T Polaris	118	133	115

Source: PBO

Table 2-9 converts the estimated number of sorties flown from Table 2-8 into an estimate of the total flying hours flown for Operation IMPACT by multiplying the average estimated duration of each sortie from Table 2-4 above.

**Table 2-9: Estimated flying hours for in-theatre activity, Oct 30, 2014 to Apr 7, 2015**

Aircraft	Current	High	Low
CF-18 Hornet	1,908	2,136	1,837
CP-140 Aurora	1,323	1,420	1,299
C-150T Polaris	592	665	574

Source: PBO

Table 2-10 multiplies the estimates for flying hours in Table 2-9 by the operating cost per fleet in Table 2-1, to produce an estimate of the incremental cost of operations for each type of aircraft supporting Operation IMPACT.

<sup>44</sup> Department of National Defence (2015b).

**Table 2-10: Estimated incremental cost of in-theatre activity (in millions), Oct 30, 2014 to Apr 7, 2015**

Aircraft	Current	High	Low
CF-18 Hornet	\$31.95	\$35.78	\$30.78
CP-140 Aurora	\$26.13	\$28.05	\$25.65
C-150T Polaris	\$10.16	\$11.40	\$9.85
Total	\$86.53	\$93.52	\$84.57

Source: PBO

## 2.4.2 Initial supply flights and return flights to theatre

Initial supply flights and return flights to and from theatre are facilitated by the C-17 Globemaster and the C-130J Hercules.

As mentioned above in section 1.1, prior to the House of Commons motion, CAF carried out a number of resupply missions to Iraqi forces; in August and September, one C-17 and one C-130J aircraft were tasked with flying supplies to Iraqi forces in Northern Iraq. These aircraft made a total of 25 flights to deliver supplies to Iraqi security forces between August 15 and September 26, 2014.<sup>45</sup> As well, according to the DND website on Operation IMPACT, prior to mid-November, the C-17 conducted 17 flights to deploy forces and equipment to Kuwait.

Further, each of the aircraft operating in theatre had to fly to the theatre and will subsequently need to return to Canada. In combination, the return flights, initial flights to Kuwait and the airlift of supplies to the Iraqis in August and September produced a cumulative number of flight hours as shown in Table 2-11.

<sup>45</sup> Office of the Minister of National Defence (2015): "Minister Nicholson commits military gear to the Iraqi Security Forces, departs for London for high level discussions on ISIL."

**Table 2-11: Total flight hours for Iraqi airlift, initial deployment and return flights to Kuwait**

Aircraft	Flight Hours
CF-18 Hornet	210
CP-140 Aurora	49
C-150T Polaris	35
C-17 Globemaster	852
C-130J Hercules	170

Source: PBO Calculations (for CF-18, CP-140 and C-150T) and PBO Sources (for C-17 and C-130J)

These flight hours were then multiplied by the cost per flight hour provided in Table 2-1, to produce the costs per aircraft shown in Table 2-12.

**Table 2-12: Estimated incremental costs for Iraqi airlift, initial deployment and return flights to Kuwait (in millions)**

Aircraft	Costs
CF-18 Hornet	\$ 3.52
CP-140 Aurora	\$ 0.97
C-150T Polaris	\$ 0.60
C-17 Globemaster	\$18.19
C-130J Hercules	\$ 3.53
Total	\$26.80

Source: PBO

In sum, this totals \$26.80 million in aircraft costs for initial supply flights and return flights to theatre.

## 2.4.3 In-theatre supply flights

DND has provided some information on the resupply flights by the C-17 Globemaster and C-130J Hercules while in theatre. However, the information that has been made publicly available is not as recent as information on sorties for the other three aircraft.

The most up-to-date information on the C-17 Globemaster and C-130J was provided for the period of November 16, 2014 to January 7, 2015. It should be noted that this was the only time that the number



of resupply flights flown was mentioned in a DND briefing.

As a result, the calculations in this section are based on future activity from January 8, 2015 through April 7, 2015, as no other update on resupply flights was given after January 7, 2015.

In contrast, the most recent update for the in-theatre sorties discussed in section 2.4.1 was as of February 11, 2015. Because of this, the estimate of future sorties as shown in Table 2-15 covers a different time period than the estimate of future sorties outlined in Table 2-7.

**Table 2-13: Actual days operating, resupply missions flown, and resupply missions per day**

Aircraft	Days Operating	Resupply Missions Flown	Resupply /Day
C-17 Globemaster	53	5	0.09
C-130J Hercules	53	3	0.06

Source: DND<sup>46</sup>

The average hours per resupply mission are presented in Table 2-14. The number of hours per resupply mission for the C-17 Globemaster and C-130J Hercules may vary significantly and will depend very much on operational needs and diplomatic clearances.

That said, for the purposes of analysis, the average hours per resupply mission were assumed to be constant. This assumption is reasonable, as there is no reason to believe resupply locations and distances will change throughout the mission.

<sup>46</sup> Constable (2015).

**Table 2-14: Average hours per resupply**

Aircraft	Hours/Resupply
C-17 Globemaster	36
C-130J Hercules	50

Source: RCAF<sup>47</sup> and PBO calculations of probable flight distance, likely aircraft routings, and take-off and landing considerations.

It is possible, therefore, to estimate the number of future resupply missions to be flown by multiplying the rates presented in Table 2-13 above by the number of days between January 8 and April 7, 2015. The rate at which these resupply flights occur might increase or decrease somewhat based on changes to operational activities or local conditions, but PBO had no way to provide a reasonable estimate of how this might vary. The results are shown in Table 2-15.

**Table 2-15: Estimated future resupply flights, Jan 8, 2015 to Apr 7, 2015**

Aircraft	Resupply Flights
C-17 Globemaster	8
C-130J Hercules	5

Source: PBO

The future resupply missions, provided in Table 2-15, can be combined with the actual resupply missions already flown, provided in Table 2-13, to obtain the total number of resupply missions presented in Table 2-16.

<sup>47</sup> Royal Canadian Air Force (2015).

**Table 2-16: Estimated total resupply flights, Nov 16, 2014 to Apr 7, 2015**

Aircraft	Resupply Flights
C-17 Globemaster	13
C-130J Hercules	8

Source: PBO

Based on the average hours per resupply, provided in Table 2-14 above, the total estimated flying hours for the entire mission can be calculated, as shown in Table 2-17.

**Table 2-17: Estimated flying hours, Nov 15, 2014 to Apr 7, 2015**

Aircraft	Flying Hours
C-17 Globemaster	468
C-130J Hercules	400

Source: PBO

These hours can then be multiplied by the hourly costs presented in Table 2-1 above. The results are shown in Table 2-18.

**Table 2-18: Estimated incremental cost of in-theatre support flights (in millions), Oct 30, 2014 to Apr 7, 2015**

Aircraft	Current
C-17 Globemaster	\$9.99
C-130J Hercules	\$8.30
Total	\$18.29

Source: PBO

## 2.5 Ammunition

DND technical briefings have indicated that a variety of CF-18 ammunition has been used in theatre, including both 500-pound and 2,000-pound variants of the Paveway II laser guided munition and the 500-

pound and 2,000-pound variants of the GPS guided Joint Direct Attack Munition (JDAM).

Data regarding actual ammunition usage were not provided by DND or CAF officials. The actual ammunition usage depends on a variety of factors that cannot be reasonably estimated, such as the nature of a target and its location. Instead, lacking greater detail, this report provides an upper and lower range for the maximum costs of ammunition usage, based on known factors. This estimate makes the following assumptions:

First, the costs of CF-18 ammunition reflect those available in the most recent USAF ammunition request to Congress, shown in Table 2-19. It is important to note that differences in prices paid by CAF relative to USAF will affect the degree to which this estimate is accurate. It is possible, for example, that the amounts paid by USAF for its ammunition are lower than the per unit cost CAF would pay given differences in volume.

**Table 2-19: CF-18 US ammunition costs USD (per unit)**

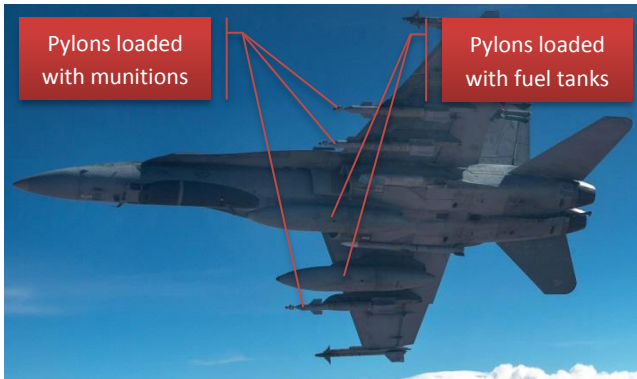
Ammunition	Cost
2,000lb JDAM	\$31,890
500lb JDAM	\$24,790
2,000lb Paveway	\$26,321
500lb Paveway	\$16,448

Source: United States Department of Defense<sup>48</sup>

Second, the CF-18s have five pylons capable of mounting air-to-ground munitions, with two pylons used for extended range fuel tanks, consistent with combat camera pictures of CF-18 aircraft in theatre.

<sup>48</sup> United States Department of Defense (2013).

**Figure 2-3: Underbelly of CF-18 Hornet**



Source: Global Aviation Report<sup>49</sup> and PBO<sup>50</sup>

Third, the three available pylons each hold only single munitions (i.e., there has been no use of a vertical ejector rack that would permit the aircraft to carry two 500-pound munitions per pylon), consistent with combat camera pictures of CF-18 aircraft in theatre.

Fourth, the high estimate assumes that all three weapons on each aircraft are used on a strike sortie, and the low estimate assumes that only one weapon per aircraft is used.

DND's website indicates that as of February 11, 2015, there have been a total of 79 airstrikes over the mission's first 104 days.<sup>51</sup> Since the mission started, airstrikes have occurred at a rate of one every 0.76 days. This is based on the assumption that unless an airstrike by only a single aircraft was specified, each airstrike represents two CF-18 Hornets dropping munitions.

The maximum ammunition usage to date would, therefore, be determined by multiplying the number of strikes to date by the number of weapons pylons, which is three, and multiplying that product by the

most expensive munition, i.e. the 2,000-pound JDAM, which costs \$31,890 USD per munition. This would provide an estimate of the maximum cost of ammunition used to date of \$7.56 million USD.

As of February 11, there were 56 days remaining in the mission. Assuming air to ground strikes continue at the same aggregate average rate, this would mean that there would be 43 ( $56 \times 0.76$ ) additional air to ground strikes for the duration of the mission.

The rate at which airstrikes have occurred has varied significantly, however. PBO was unable to find any indication of whether this increased rate of activity would be sustained. The rate of airstrikes increased significantly from January 5 through 25 to 1.33 per day. If airstrikes were to continue at this same rate, there would be another 75 through April 7, 2015.

Using the same methodology employed above, this would result in a maximum cost of ammunition to be used of \$7.14 million USD.

An estimate for the maximum total ammunition usage for Operation IMPACT is, therefore, \$14.70 million USD. PBO normalized these figures by converting them to Canadian dollars. The result is that the most costly ammunition usage for the entire mission would be \$15.72 million.

Similarly, a calculation can be made of the minimum ammunition usage based on known data. This assumes that only one of the cheapest munitions used (the 500-pound Paveway II) is dropped on each strike.

Assuming the same 79 strikes through February 11, 2015 used in the calculation above, the least costly ammunition usage to date would be \$1.30 million USD ( $79 \times 1 \times \$16,448$ ).

Assuming the lower of the two ranges for possible additional strikes for the remainder of the mission

<sup>49</sup> Global Aviation Report (2015).

<sup>50</sup> Indicating lines and text boxes.

<sup>51</sup> Department of National Defence (2015b).

outlined above (43), the least costly ammunition usage would be \$0.70 million USD ( $43 \times 1 \times \$16,448$ ).

Combined, the total minimum ammunition cost would be \$2.00 million USD. PBO normalized these figures by converting them to Canadian dollars. The result is that the least costly ammunition usage to date would be \$2.14 million.

## 2.6 Vehicles and Communications

PBO believes that this cost category captures the costs of local transportation, such as rental cars and taxis, as well as the costs for additional communications support required for a mission. Communications would include additional satellite communications capabilities obtained to support the mission.

Without a means of estimating these costs for Operation IMPACT, the \$6 million in costs for Operation Mobile were normalized, to provide a rough proxy, for the length of the Operation IMPACT (i.e. 72 per cent as long). PBO normalized these figures by inflating them. The result is \$4.49 million for Vehicles and Communication.

There are reasons to believe that this figure underrepresents the incremental cost. In the case of Operation Mobile, PBO has no information that suggests that communication infrastructure had to be constructed. However, Figure 2-4 and Figure 2-5 show CAF in the process of constructing and using constructed communications facilities, respectively, which could increase costs. Therefore, the figures presented for Vehicles and Communications may underrepresent the actual cost.

**Figure 2-4: Digging trenches for communications conduits**



Source: DND<sup>52</sup>

<sup>52</sup> Department of National Defence (2015a).

**Figure 2-5: Resource Management Support Clerks**



Source: DND<sup>53</sup>

### 3 Results

PBO’s analysis has found that the estimated incremental cost of Operation IMPACT for the six months ranges between a high of \$166.40 million and a low of \$128.80 million.

**Table 3-1: Estimated incremental costs of Operation IMPACT by category (in millions) for the six-month mission**

Cost Category	High	Low
Pay and allowances	\$ 5.24	\$ 5.24
Food and accommodations	\$ 20.62	\$ 5.55
Initial supply flights, return flights to theatre	\$ 26.80	\$ 26.80
In-theatre supply flights	\$ 18.29	\$ 18.29
Aircraft operations	\$ 75.23	\$ 66.28
Ammunition	\$ 15.72	\$ 2.14
Vehicles and communication	\$ 4.49	\$ 4.49
<b>Total</b>	<b>\$ 166.40</b>	<b>\$ 128.80</b>

Source: PBO

This breaks down into the following weekly and monthly estimated marginal costs of Operation IMPACT, representing the additional costs incurred by continuing operations; accordingly, it does not include sunk costs, such as initial supply flights to theatre and return flights to Canada.

**Table 3-2: Estimated marginal costs of Operation IMPACT (in millions)**

	High	Low
Per week	\$ 7.11	\$ 4.38
Per month	\$30.81	\$18.98

Source: PBO

If the mission were lengthened from six months to 12 months, extending the analysis forward would widen the range of the estimate as provided in Table 3-3.

**Table 3-3: Estimated incremental costs of Operation IMPACT by category (in millions) for the 12-month mission**

Cost Category	High	Low
Pay and allowances	\$ 11.38	\$ 11.38
Food and accommodations	\$ 45.00	\$ 11.75
Initial supply flights, return flights to theatre	\$ 26.80	\$ 26.80
In-theatre supply flights	\$ 36.58	\$ 36.58
Aircraft operations	\$181.83	\$ 143.63
Ammunition	\$ 40.68	\$ 3.57
Vehicles and communication	\$ 8.99	\$ 8.99
<b>Total</b>	<b>\$351.27</b>	<b>\$ 242.71</b>

Source: PBO

Thus, the estimated incremental cost of Operation IMPACT for the 12 months ranges between a high of \$351.27 million and a low of \$242.71 million.

It is worth noting that the full costs for Canada’s most recent overseas mission in Libya (i.e. Operation

<sup>53</sup> Ibid..

Mobile) were almost six times the reported incremental costs for the mission.<sup>54</sup>

This analysis is predicated on the assumption that the size and composition of the deployed forces remain the same, that the same rates of aircraft sorties and ammunition usage employed in the estimates above can be extended over an additional six-month period, and that the estimated amounts for Pay and Allowances, Food and Accommodations, and Vehicles and Communications could simply be normalized to an additional period of 183 days (i.e. April 8, 2015 to October 8, 2015).

This further assumes that there is no need for aircraft to return to Canada for scheduled maintenance.

#### 4 Caveats

Estimates provided by this report are incomplete. That is, if the estimates in this report are accurate, the incremental cost should be higher because some costs could not be calculated given the data available. Specifically, there was no means of estimating any change to aircraft amortization rates. No data were available to suggest how usage in theatre is different than usage under normal operating conditions. The estimate does not include the cost of Canadian aircraft returning to Canada for scheduled maintenance.

The accuracy of these estimates depends on:

- The degree to which the composition and individual durations of the 570 personnel in Operation Mobile reflect, proportionally, the composition and individual durations of the 600 personnel in Operation IMPACT, vis-à-vis Pay and Allowances
- The degree to which the category Food and Accommodations for the 600 personnel falls

within the converted figures provided by the daily Mission Sustainment Allowance of the UN Department of Peacekeeping Operations

- The accuracy of the estimated activity rates for the aircraft
- The degree to which the factors contained in the Cost Factors Manual reflect the true cost of flying the aircraft
- The accuracy of the estimated ammunition used
- The degree to which the actual cost of the munitions reflects the cost converted from the United States Department of Defense Fiscal Year 2014 President's Budget Submission
- The degree to which the costs for Vehicles and Communications reflect the cost in Operation Mobile
- The degree to which there are no significant changes to the mission profile or activity in-theatre
- The degree to which the past US dollar exchange rate holds true going forward

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<sup>54</sup> Defence Department of National (2011-12).

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