

## **Valuing the indeterminable?**

**Summary for NZDF of the key research findings on the value proposition of the New Zealand Naval Combat Force**

February 2023

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## Authorship

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This paper was prepared at NZIER by Derek Gill of the New Zealand Institute of Economic Research and Jim Rolfe of the New Zealand Centre for Strategic Studies.

It is based on the Key Points summary of the full Research paper which was quality approved by John Yeabsley, and the external reviewers were Professor Keith Hartley of the University of York and Professor Paul Hansen from Otago University who reviewed the material on the Discrete Choice Experiment surveys. Rear Admiral (retired) John Martin acted as a sounding board as the project progressed.

The assistance of the following is gratefully acknowledged: Sarah Spring on the literature scan and document review, the team at 1000minds for assistance with survey design and interpretation, Dr Jelita Noviarini and Dr Andrew Coleman for technical support in the interpretation of the 1000minds results, the defence security experts who took part in the scenarios, Dynata who recruited survey participants and the ordinary Kiwis who took part in the survey.

How to cite this document:

NZIER. 2023. Valuing the indeterminable? Summary for NZDF on key research findings on the value proposition of the New Zealand Naval Combat Force.

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## Executive summary

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### Key points

- Placing an economic value on defence forces is something that has been discussed in the literature but never attempted before. This study is an original contribution to knowledge.
- Though initially sceptical, we have become increasingly confident about applying this task to the frigate force as we proceeded from a scoping phase to a pilot and then a proof of concept.
- In the final phase, we applied three different approaches to value the Naval Combat Force (NCF). These were from the perspective of Government Ministers, ordinary Kiwis and security experts.
- Our estimated valuations are ballpark estimates presenting a range of estimates.
- We expected the different perspectives to yield very different valuations – as we had found that kiwis and experts had quite different preferences in the proof of concept phase.
- We found remarkably consistent valuations as that while different stakeholders valued different attributes all placed a significant economic value on the NCF in the range of \$3.5B–\$10B over 30 years.
- Like any experimental, leading-edge research, this finding is subject to caveats and cautions which are outlined in the Report
- The research suggests that valuing defence forces is not an indeterminable issue and further refinements are possible.



## Navigating in unknown waters

The New Zealand Defence Forces (NZDF) sought authoritative advice on whether it is possible to put an economic value on naval combat forces and, if so, what that value would be for New Zealand. The first two phases of this project addressed the first question, and we concluded in our 2019 report that although it has never been attempted, it was feasible to assess the economic value. Our literature scan in 2018 found a sparse literature with no practical examples of defence forces actually being valued. However, techniques developed in fields such as environmental economics could be applied to defence. This conclusion was confirmed by the Rand Corporation in a major study for the UK MoD (Huxtable et al. 2021) [https://www.rand.org/pubs/research\\_reports/RRA638-1.html](https://www.rand.org/pubs/research_reports/RRA638-1.html).

This overview report focuses on summarising the key findings that emerged from the final phase of the research when we applied the techniques developed to the valuation of the Naval Combat Force. A more extended research report explains the full research project and includes more detail on the analysis undertaken. In addition, a background technical paper has also been prepared, which details the analysis undertaken of the 1000minds Discrete Choice Experiment (DCE) survey.

## Total value (V) is the sum of capability (C) and direct use (D) value

The original organising value framework for the project was  $V = C + D$ , where:

- C is the ‘could’ use value to protection and security that accrues through possession (rather than use) of the asset’s capabilities.
- D is the delivered or ‘direct’ use value generated from the delivered outputs obtained by physically using the asset.

While conceptually distinct and a useful way of thinking about the issues, in practice, we found it very challenging to unpack C and D in some of the approaches to estimating valuations. So while the surveys used in the research were based on this distinction, other measures presented conflated C and D into one value.

## On the cutting edge

Valuing the Naval Combat Force (NCF) requires building on ideas that have been explored but never actually attempted before. To address the question – What might the value of the Naval Combat Force be? – we needed to ask the prior question – Whose valuation do we privilege? We addressed this question by adopting three different perspectives using three different approaches:

- Perspective 1 – Cabinet Ministers’ willingness to pay – both stated and revealed by actual decisions
- Perspective 2 – Experts’ views using scenarios analysis to develop an overall value derived from the assessed value of economic deterrence
- Perspective 3 – New Zealanders’ stated preferences based on two surveys.

We expected these different stakeholders’ valuations would differ, perhaps dramatically, as we had found that the general public and experts had quite different preferences in the proof of concept phase. The rest of the section summarises what we found about the economic value of defence forces from various stakeholders’ perspectives.



## Perspective One: Cabinet Ministers' willingness to pay for the NCF

Willingness to pay can be assessed by what people say (*stated preference*) and what they actually do (*revealed preference*). We started the project by reviewing the government's stated willingness to pay and the revealed preferences through their willingness to use the naval combat force.

### Historical willingness to use and pay for the NCF

We reviewed written documents that make up the historical record as part of an earlier stage of the project. In brief, we found clear preference stated in successive Defence reviews since 1978 that the utility of the NCF outweighs the cost.

To assess revealed preference on willingness to pay, we looked at actual decisions on both capability and direct use in delivering outputs. Looking at delivery and willingness to use:

- New Zealand frigates have been deployed into areas of tension, including maritime and other security operations, at least once a decade
- annual exercises have been undertaken with allies and friends, combined with defence diplomacy
- routine support has been provided to other 'like-minded' navies.

To assess willingness to pay for capability, the easiest approach was to use historical cost data to express the cost of the current ANZAC frigates over the first 20 years of the expected thirty-year life. The key weakness of this approach is that it is based on decisions at a point in historical time, and the international strategic context and domestic political environment have altered significantly in the years since the initial acquisition decisions were taken. In other words, we recognise that past experience has limitations for valuing future use.

### Contemporary decisions to invest in NCF capability

Recent governments have taken a series of decisions to invest in sustaining the NCF and extend the ANZAC-class frigates' operational life to 2035. Since 2018 these have included: a \$638m Frigate Systems Upgrade updating the combat systems, a \$100m communications upgrade to retain interoperability and committing to an upcoming \$400m five-year frigate life extension project. This reveals a floor value that successive governments have been willing to invest in supporting and sustaining the NCF: a minimum floor value of \$NZ90m p.a.

### Adding up revealed preferences over the life of the naval combat force

Present value measures the worth of cash flows over a period of time by using a discount rate to allow for the time value of money. The present value of the historic cost of the ANZACs acquisition over 20 years (expressed in 2019 dollars) and discounted using the Treasury's recommended discount rate (5%) is \$NZ6.1B (or **\$5.1B** at 4%). Recent decisions on the Frigate Systems Upgrade and the frigate 5-year life extension can also be added: \$NZ90m. p.a., which at a 4% discount rate yields a present value of \$0.7B over 10 years. The historic costs approach provides a lower-bound estimate of the willingness to pay by political decision-makers based on the costs of direct capability (C) and direct use or delivered outputs (D) combined.

### The present value of costs gives a lower-bound estimate

Taken together, these cost data suggest from a whole-of-life perspective. Ministers have valued the NCF at **\$5.8B** over 30 years. There are two important caveats. 1) the precise value derived depends upon the discount rate used – a 1% change in the rate changes the assessed



value by around 20%. 2) This is a lower bound estimate based on value equals cost, and it doesn't test how much more Ministers would have been prepared to pay for the capability or its use.

## Perspective Two: Scenarios analysis using experts' views

Defence analysts' perspective on the value proposition of the NCF is likely to be different to Cabinet Ministers and ordinary New Zealanders. We developed an innovative approach to assessing experts' views using a methodology not found anywhere in the literature that we can locate. In brief, this approach involves working from an assessed value – the value of deterring attacks on maritime trade over time – and scaling this up to an overall value. This scalar is based on experts' judgements about the relative importance of deterrence compared to other functions of the NCF.

### Deriving a value for deterrence

Our starting point for determining the value of the NCF was to assess the value of its ability to deter future attacks on maritime trade. The potential disruption to merchant shipping was illustrated by five scenarios ranging from a relatively benign environment to generalised warfare between groups of states.

We used a Delphi-type process with twelve New Zealand defence experts outside the New Zealand Government to assign probabilities to the different environments. As a group, they assessed the likelihoods over time as set out in the table below (along with the associated derived deterred trade values). The scenarios cover a range of potential states of the world, different weightings and derived deterrence values. They range from scenario 1, a benign international environment, with a 15% probability where the deterrence effect is negligible, through to a more high-intensity regional conflict, with a 22% probability and the assessed deterrence effect of \$44m p.a., through to Scenario 5 international conflict, with a 15% probability and deterrence effect is worth \$50m p.a. Table 1 shows the data with the likelihood of each scenario, the value if that scenario were the only consideration and the derived value across all scenarios.

**Table 1 Scenarios – likelihood over 30 years and derived values**

| Scenarios            | Likelihood | Value            | Derived value    |
|----------------------|------------|------------------|------------------|
| Benign               | 15%        | Negligible value | Negligible value |
| Regional disturbance | 36%        | \$10.7m p.a.     | \$3.9m p.a.      |
| Regional conflict    | 22%        | \$44m p.a.       | \$9.7m p.a.      |
| Piracy               | 12%        | \$17m p.a.       | \$2.1m p.a.      |
| Global conflict      | 15%        | \$50m p.a.       | \$7.0m p.a.      |

Source: NZIER

### From deterrence value to total value

To move from the assessed deterrence value (\$23m p.a.), which we take as 'known', we used a scalar based on experts' judgements about the relative importance of deterrence (13%) compared to other functions of the NCF. The other functions based on Huxtable et al. (2021) include national protection, deterrence, projection, international presence and



signalling, international order, workforce and industry, and whole-of-government activities. This enables a move from deterrence value to total value.

### Sensitivity of the derived NCF's value to assumptions and to the process

Though innovative, using scenarios in this way is subject to several limitations. Most importantly, any error in the derived deterrence value (\$23m p.a.) would be compounded in estimating the total value. In addition, the approach implicitly assumes a counterfactual of reduced deterrence without the NCF.

Moreover, the derived valuation is very sensitive to the base level of maritime trade – the fall in New Zealand's maritime trade from 2017 to the base year used in 2021 reduced the value by some 30%. Given the deterrence value (\$23m p.a.) and the weighting (13%), it is a matter of simple arithmetic to derive an estimated total value – in this case, \$176m p.a. This derived value would increase to \$237m with 1.0% p.a. maritime trade growth over three decades, \$380m with 2.6% p.a. trade growth, and \$760m with 5.0% p.a. growth.

Using Oxford Economics (2020) ten-year forecast of a 2.6% p.a. increase in maritime trade and a 4% discount rate, the mid-point estimate of the present value of the NCF over a 30-year life span is **\$3.7B**. This estimate ranges between \$3.0B, with no growth and \$4.5B, with 5.0% growth in maritime trade. However, these estimates are conservative as they ignore the benefits to New Zealand from our trading partners, avoiding disruption and any deterrence of risk to coastal shipping (4% of New Zealand's maritime trade by volume). And the focus is on the economic value of deterrence from the disruption in international trade and not the wider social value of deterrence of conflict.

### Perspective Three: New Zealanders' stated preferences – 1000minds DCE surveys

The third perspective assessed ordinary New Zealanders' willingness to pay for the NCF. We undertook a discrete choice experiment (DCE), implemented using the 1000minds DCE survey platform ([www.1000minds.com](http://www.1000minds.com)). A DCE, also known as conjoint analysis, is a popular survey-based methodology for discovering how people feel about a product's various attributes or characteristics or other areas of interest like government policy, as in the present setting.

We ran two parallel DCE surveys simultaneously to explore people's stated willingness to pay for the NCF's capability (N = 1032) and direct use of delivered outputs (N=1002), respectively. Plausible, consistent results emerged from both surveys and based on consistency testing, we are satisfied with their face validity and reliability.

**Table 2 Ranking of the attributes in the delivered outputs survey linked to attributes in the capability survey**

| Delivered Survey Attributes          | Capability Survey Attributes                    |
|--------------------------------------|---|
| Protecting our people = 1            | Defending New Zealand = 1                       |
| Protecting our resource= 2           | Keeping options open = 2                        |
| Promoting free movement of trade = 3 | Supporting our friends in the South Pacific = 3 |
| Supporting our regional partners = 4 | Supporting Australian allies = 4                |
| Supporting global security = 5       | Supporting a safer world = 5                    |

Source: NZIER

Each survey elicited New Zealanders’ preferences by having them repeatedly choose between two attributes (shown in Table 2 above). From each participant's answers (~30 per person), the software determines weights on the attributes, representing their relative importance to the person. One of these attributes was willingness to pay taxes for the NCF, which enables a valuation to be estimated. The defence-specific attributes range from defending New Zealand to supporting our Australian allies and regional partners, including our friends in the South Pacific and wider global security.

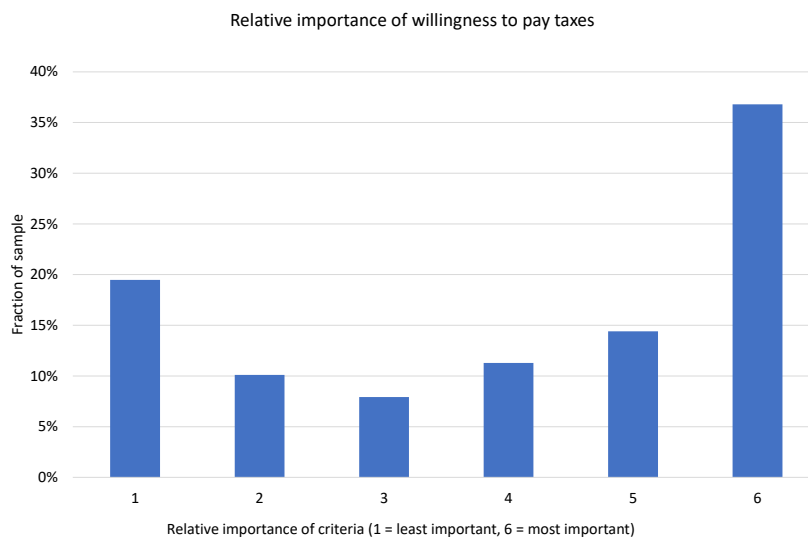
The two surveys bring out complementary overlapping perspectives and provide evidence to answer three questions: 1) what attributes of the NCF do Kiwis most value? 2) which Kiwis value the NCF? and 3) how much do Kiwis value the NCF?

### What attributes of the NCF do New Zealanders most value?

While the two surveys’ questions have used different attributes, some consistent patterns emerged across both surveys. The surveys had a range of attributes relating to the functions of the NCF as well as a tax attribute to assess willingness to pay. Looking at the non-tax attributes:

1. Defending New Zealand is the most important attribute of the NCF
2. Keeping our options open so the country can use our Navy 20 to 30 years into the future” also ranked highly in the capability survey
3. Supporting friends and allies are middle-ranking attributes of the NCF
4. The NCF’s role in global security is the least important attribute.

**Figure 1 New Zealanders sharply divided on their willingness to pay for the NCF**



Source: 1000minds

Willingness to pay tax was a very important attribute (ranked most important in the capability survey and 2nd in the delivered outputs survey). While highly ranked, people were sharply divided on willingness to pay taxes for the NCF: the ‘hawks’ for whom tax was relatively unimportant, versus ‘stoic Kiwis’ where tax was a middling priority and finally



'doves' for whom tax was the most important attribute. Figure 1 shows that for 20% of New Zealanders (the hawks), tax was the least important attribute, while the doves comprise the 35% for whom it was the most important attribute and the 15% for whom it is the second most important.

### Which New Zealanders value the NCF?

The bar chart in Figure 1 reveals the significant variation in how different people value NCF capability and delivered attributes – tax was the most important attribute for some and the least important for others. We undertook regression analysis of both surveys to determine what variables explain the differences in people's views on the NCF attributes. The main finding from the regression analysis was that the variation of people's preferences is not explained by the basic objective socio-demographic characteristics collected – age, gender and regional location. Cluster analysis, however, identified distinct groupings with diverse socio-demographic characteristics but very similar preferences about the NCF.

### Three distinct clusters: hawks, stoic Kiwis and doves

Both surveys had three distinct groupings: 'hawks', 'stoic Kiwis' and 'doves'.

- Cluster 1: hawks – the smallest and tightest cluster, the most willing to fund the NCF and to support attributes directly related to defending NZ.
- Cluster 2: stoic Kiwis – have moderate willingness to pay and are very diverse in the NCF capabilities and delivered activities they support.
- Cluster 3: doves – have the lowest willingness to pay and low mean weights on all NCF capabilities and activities.

Cluster 2: stoic Kiwis – are the largest group in both surveys and almost constitute a majority. No cluster had strong discernible socio-demographic characteristics that were statistically significant. For example, although older people are more willing to fund the NCF, they are not the dominant members of cluster 1 (hawks), and the age effect was not statistically significant.

### New Zealanders' stated preferences show a significant willingness to pay for the NCF

To calculate New Zealanders' stated preferences of willingness to pay for the NCF capability, we looked at the average per person willingness to accept forgoing each of the four NCF capability attributes, added these up and scaled that up by the adult tax-paying population. The resulting valuation of the amount people are willing to accept to forgo the NCF capability was \$570m p.a.

We followed a similar procedure for the delivery survey using the five delivered functions. Unsurprisingly, the willingness to pay for delivered outputs was significantly lower than for capability: \$221m p.a.

Where possible, we took a conservative approach to derive the values. For example, we have used the adult population (4.0 million) to scale the individual estimates rather than the total population (5.1 million): using the latter would increase the total valuations by over 27%.

## The whole-of-life value depends on the discount rate

The estimates reported above are per annum. The present value over the whole-of-life of the platform (assumed to be 30 years) depends crucially on the discount rate selected. (The discount rate is the interest rate reflecting the time value of money). Discounting the annual willingness to pay (WTP) for NCF capability (\$570m) at the current discount rate (5%) recommended by the Treasury yields a present value of **\$8.7B**. Using the lower social time preference rate, say 3%, yields **\$11B**. The mid-point between the two (4%) yields **\$9.8B**.

Taking estimated WTP for delivered outputs (\$221m p.a.) yields a mid-point of **\$3.9B** with a range of \$3.4B (at 5%) to \$4.3B (at 3.0%) over 30 years.

## With offsetting sources of bias

There are two offsetting sources of bias.

First, in principle, the two survey results are independent, and the framework developed for this project suggests we could add the valuations arising from the capability (\$9.8B) and delivery (\$3.9B) surveys. In practice, however, the surveys overlap in terms of their content, and it is implausible that survey respondents distinguish between capabilities and direct use of delivered outputs.

Second, there is a risk of overestimating the total value of the NCF by simply adding up the WTP for all the attributes. WTP estimates are intended to capture the value of (marginal) changes to the levels of one attribute at a time while all the other attributes are constant. Simply summing WTPs across the attributes ignores that cumulative changes to the NCF are likely to yield diminishing returns. In addition, of course, DCE surveys are based on hypothetical, not real, choices. Therefore, valuations need to be interpreted with caution, and the derived valuations need to be interpreted as an upper limit.

## Summary – Pulling it together: what valuations emerge from the three approaches?

Trying to estimate a valuation for the NCF using three different approaches from three different perspectives was a risky research strategy. We expected the different perspectives to yield very different valuations, as we had found that New Zealanders and experts had quite different preferences in the proof of concept phase. We found the economic valuation from different stakeholders' perspectives was of the same order of magnitude when expressed as the whole-of-life cost:

1. Cabinet Ministers' willingness to pay has a mid-point of **\$5.8B** with a range of \$5.0B to \$6.8B.
2. Scenario analysis has a mid-point of **\$3.7B** with a range of \$3B to \$4.5B.
3. Two surveys of the public's stated preferences had mid-points of **\$9.8B** (\$8.7B to \$11B) for capability and mid-point for delivered outputs of **\$3.9B** (\$3.4B to \$4.3B).

Obviously, the values depend on the discount rate chosen, as shown in Table 3 below. The Treasury's social opportunity cost (currently 5%) or social rate of time preference (3–4%).



**Table 3 Valuations from the different perspectives and approaches**

| Perspective             | Annual Value | Present Value (and range)        |
|-------------------------|--------------|----------------------------------|
| Cabinet Ministers       | NA           | <b>\$5.8B</b> (\$5 to \$6.7B)    |
| Scenarios using experts | \$176m p.a.  | <b>\$3.7B</b> (\$3B to \$4.5B)   |
| Public's WTP Delivery   | \$221m p.a.  | <b>\$3.9B</b> (\$3.4B to \$4.3B) |
| Public's WTP Capability | \$570m p.a.  | <b>\$9.8B</b> (\$8.7B to \$11B)  |

Source: NZIER

While the results from three perspectives using three different approaches yield reasonably consistent valuations, it would be misleading to simply rank high to low by valuation. The different valuations are not strictly comparable. Cabinet Ministers' WTP is a lower bound estimate, and the public's WTP is an upper bound estimate. Also, the different approaches measure subtly different dollar values – one measures trade in dollar terms, one measures fiscal expenditure and the third notional tax. But taken together, they suggest different stakeholders all place a significant economic value on the NCF in the range of **\$3.5B to \$10B** over 30 years.

### Research report and background technical paper also available

This overview report summarises the key research findings from the final stage of the project to address the question of the value proposition of the NCF. A more detailed Research Report covers the full research project and includes a more detailed analysis of the research findings. In addition, a technical background paper on interpreting the 1000minds DCE survey and the Fractional Multinomial Logistic Regression Analysis is available from NZIER on request.

The full Research Report discussed in more detail the approaches we adopted from three different perspectives: i) Government Ministers revealed preferences through the ANZAC acquisition and frigate force life extension (section 2), ii) Scenario analysis with defence experts' support (section 3), and iii) the general public through the 1000minds DCE survey (section 4). We summarise our findings in section 5, and the last section on next steps (section 6) sets out the directions for further work.

The Appendices contain a summary of the work undertaken in the earlier stages of the project (Appendix A), our original framework (Appendix B), the results from the initial literature scan (Appendix C), and a description of the historical patterns of the use of the NCF (Appendix D). Appendix E discusses the link between this research and the NZ Treasury's 2021 Living Standards Framework.

### Conclusion – Valuing the NCF is a worthy quest rather than a holy grail

This is leading edge, if not bleeding edge work – nothing of this kind has been attempted anywhere else in the world – although the UK has undertaken a very comprehensive scoping study. In interpreting the research findings, it is important to remember that these results can't be benchmarked or compared.

We have presented our estimated values for each perspective as a range with a midpoint – not a precise point estimate. That is because these are ballpark estimates that are sensitive to key assumptions. For the 1000minds DCE surveys, a key assumption is the population scalar; for scenarios, the weights and assumed growth in maritime trade and, for all cases, the discount rate adopted. There are also technical caveats to be borne in mind with each approach.

This research was technically very challenging and has significantly benefited from the peer review by Dr John Yeabsley of NZIER and the external reviews by Rear Admiral (retired) John Martin, Professor Paul Hansen from Otago University on the DCE survey and Professor Keith Hartley of the University of York. Professor Hartley’s comment on this draft report was:

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**“This is an impressive and pioneering contribution to our knowledge in this important field. The authors are to be congratulated on their novel approach to a completely new and important part of defence economics. Scholars have recognised the challenge of defining and measuring defence output; but this is the first attempt at empirical measurement. Extremely well done is my judgement on the Report.”**

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