



**RETURN RESPONSES TO:  
RETOURNER LES RÉPONSES À :**

Defence Research and Development Canada  
9 Grove Street, Dartmouth, Nova Scotia  
Attn: Jennifer Beamish, Head of Procurement and Contracting

jennifer.beamish@forces.gc.ca  
1-902-407-0356 (phone/téléphone)

**LETTER OF INTEREST  
LETTRE D'INTÉRÊT**

**CLOSING - DATE DE CLÔTURE**

At – à : 14 :00h ADT

On - le : 31 January 2019

<b>Title/Titre:</b> Digital Twin Prototype	<b>Solicitation No – N° de l'invitation</b> 2018-23113
<b>Date of – Date de l'invitation</b> October 26, 2018	
<b>Address Enquiries to – Adresser toutes questions à</b>  Name: Jennifer Beamish Title: Head of Procurement and Contracting Department: Defence Research and Development Canada Address: 9 Grove Street, Dartmouth, Nova Scotia Email: jennifer.beamish@forces.gc.ca	
<b>Telephone No. – N° de telephone</b> 1-902-407-0356	<b>FAX No – N° de fax</b>

**Instructions:** See Herein

**Instructions:** Voir aux présentes

Delivery required - Livraison exigée	Delivery offered - Livraison proposée
Vendor Name and Address - Raison sociale et adresse du fournisseur	
Name and title of person authorized to sign on behalf of vendor (type or print) - Nom et titre de la personne autorisée à signer au nom du fournisseur (caractère d'imprimerie)	
Name/Nom _____	Title/Titre _____
Signature _____	Date _____



**REQUEST FOR INFORMATION (RFI)**  
**DIGITAL TWIN PROTOTYPE – NAVAL VESSEL**

**1. DECLARATIONS**

This is not a bid solicitation, and no contract will directly result from this Request for Information (RFI).

The issuance of this RFI does not create an obligation for Canada to issue a subsequent Request For Proposal (RFP), and does not bind Canada legally or otherwise, to enter into any agreement or to accept or reject any suggestions.

No payment will be made by Canada for costs incurred in the preparation and submission of your response.

There will be no short listing or pre-qualification of firms for purposes of undertaking any future work as a result of this RFI. Similarly, participation in this RFI process is not a condition or prerequisite for participation in any future potential RFP.

Respondents are encouraged to identify, in the information they share with Canada, any information that they feel is proprietary, third party or personal information. Please note that Canada may be obligated by law (e.g. in response to a request under the Access of Information Act and the Privacy Act) to disclose proprietary or commercially-sensitive information concerning a Respondent (for more information: <http://laws-lois.justice.gc.ca/eng/acts/a-1/>).

Respondents are asked to identify if their response, or any part of their response, is subject to the Controlled Goods Regulations.

**2. ACRONYMS & DEFINITIONS**

COTS	Commercial off the Shelf
DRDC	Defence Research and Development Canada
GETS	Government Electronic Tendering System
KWh	Kilowatt Hour
L/s	Liters/ second
LCM	Life Cycle Management
RCN	Royal Canadian Navy
RFI	Request for Information
RFP	Request for Proposal
SHM	Structural Health Monitoring
SPM	Ship Product Model
V	Voltage

**3. PURPOSE**

3.1 This Request for Information (RFI) is intended to provide Defence Research and Development Canada (DRDC) with information to determine a procurement strategy to develop and test a limited Digital Twin Prototype for a Royal Canadian Navy (RCN) HALIFAX Class vessel. The prototype is intended to demonstrate both the benefits and difficulties of developing and using Digital Twin technology for the Life Cycle and Operational Management of RCN ships in the future.

3.2 Respondents are requested to provide the following information in their Responses:



1. Trends in Digital Twin technology pertinent to managing naval platforms, specifically for hull and machinery systems
  2. Available technologies and developing technologies that have or will have the capacity to meet the identified purpose and falls within the scope of the work.
  3. How to prepare cost estimates, timelines, properties and other aspects of the requirement to proceed with a future procurement strategy.
- 3.3 This RFI is being used to gain information to help develop a RFP for developing and testing a limited Digital Twin prototype of a RCN HALIFAX Class frigate to demonstrate the potential of Digital Twin technology for improving maintenance and operational decisions.

#### 4. BACKGROUND

DRDC is beginning a program of work to develop and test Digital Twin technology for the management of RCN naval vessels. Digital Twin technology is in its early stages of development in several industries, including naval platforms. A Digital Twin is a virtual representation (model) of a real entity (naval platform) which, through data acquisition and analysis and computer modelling, reflects the current state of some or all of the platform's systems.

Some of the challenges in developing a Digital Twin Prototype for a naval vessel are:

**Data Acquisition:** What data should be monitored and how to monitor it. Historically the data related to the materiel state of the platform has relied upon manual inspection methods which are laborious and time consuming. This program proposes to include research into improved inspection tools, and processes to facilitate the data requirements of a Digital Twin. Some data acquisition is already planned and is described further below and in Attachment 3.

**Virtual Model:** Commercial Ship Product Models (SPMs) are the most likely candidates for the ship database and some of these are already exploring capabilities similar to Digital Twin for Life Cycle Management (LCM). A SPM such as ShipConstructor, Smart3D, CATIA or AVEVA (and others) can include many ship systems (structure, machinery, propulsion, electrical, piping), and while initially created for ship design and construction, could be, and are being, adapted for LCM. The model will have to manage both detail (eg. specific pump state) and global (sea state, bending moment, operational history) data.

**Model Population:** This may be the most challenging aspect of the Digital Twin technology how to efficiently and automatically transfer the collected data to the virtual model. This step cannot rely on manual population as that would be overly time-consuming and make this approach impractical. An investigation needs to be undertaken to determine how this process is currently being done in other industries, and what is already available in RCN platforms. The issue of data security is of significant importance for naval vessels.

**Data Analysis and Presentation:** The amount of data that could be generated is enormous and broaches the topic of 'Big Data'. For each system that is monitored and fed to the virtual model, the results which are important to each specific client will have to be automatically generated and presented to the user. Such results will need to include historical trend analysis, and prognostic capabilities to predict the future state of the system based on a given operational profile. Automatic alerts must be generated when system performance is changing or when they are reaching limits. Data presentation has to be available for both short-term (immediate information), and long-term (historical information) depending on the need.

The Digital Twin Prototype could provide significant improvements in the following areas:



- Inform operational decisions with real-time platform system capability data and advice
- Inform platform maintenance planning with evidence-based decision capability, improving platform availability and sustainability in a timely, cost-effective manner
- Inform platform employment planners with the current capabilities of their platforms to effectively and safely undertake specific missions
- Inform platform end-of-life decisions with actual platform system materiel states

#### 4. REPLIES TO INVITATION

DRDC intends to undertake this demonstration for the following systems of a HALIFAX Class frigate:

- Hull structure via strain gauge measurements to determine hull condition (fatigue, corrosion) and life expectancy
- A limited set of the power and energy systems (such as fuel consumption, propeller revs, electric power distribution) to determine energy use and availability
- A main machinery component such as the main propulsion diesel or a diesel generator to determine optimal maintenance scheduling

The data collection instrumentation will be supplied by DRDC and installed separately from the Digital Twin development and is described further in Attachment 2.

Responses to the Request for Information are expected to provide;

1. An overview of current technologies and methods that could be used to demonstrate the Digital Twin concept for a Canadian HALIFAX Class frigate.
2. An overview of the future potential for the Digital Twin technologies that, through short-term research and development, have the potential to meet the stated purpose.
3. A written description of the technologies and methods and successful current applications, if available.
4. A written proposal that includes answers to the Specific Questions at Attachment 1. These answers provide information regarding the technical challenges as well as important commercial and budget considerations.

#### 5. FORMAT OF RESPONSES

**Cover Page:** If the response includes multiple volumes, respondents are requested to indicate on the front cover page of each volume the title of the response, the solicitation number, the volume number and the full legal name of the respondent.

**Title Page:** The first page of each volume of the response, after the cover page, should be the title page, which should contain:

- I. the title of the respondent's response and the volume number;
- II. the name and address of the respondent;
- III. the name, address and telephone number of the respondent's contact;
- IV. the date; and
- V. the RFI number.



**Numbering System:** Respondents are requested to prepare their response using a numbering system corresponding to the one in this RFI. All references to descriptive material, technical manuals and brochures included as part of the response should be referenced accordingly.

**Number of Copies:** Canada requests that respondents submit 2 electronic copies (word or pdf) of their responses. Documents can be submitted in either of Canada's official languages.

## 6. SECURITY

There is no security requirement associated with this RFI. However, Respondents should note that potential follow-on procurement activities will require Public Services and Procurement Canada (PSPC) classified clearances of at least REALIABILITY for applicable staff and facilities.

## 7. ADDITIONAL INFORMATION REQUESTS

After review of all the information packages, additional information may be requested by the Contracting Authority to individual respondents.

## 8. NOTES TO INTERESTED RESPONDENTS

- a. This RFI is neither a call for tender nor a RFP. No agreement or contract will be entered into solely as a result of this RFI. This announcement does not constitute a commitment by Canada. Canada does not intend to award a contract on the basis of the notice or otherwise pay for the information solicited. Any and all expenses incurred by the Respondent in pursuing this opportunity are at the Respondent's sole expense.
- b. Any discussions on this subject with project staff representing DRDC or any other Government of Canada representative, or other personnel involved in project activities, shall not be construed as an offer to purchase or as commitment by DRDC or the Government of Canada as a whole.
- c. The documents / information / data collected may be provided as commercial-in-confidence; however, Canada reserves the right to use the information to assist them in drafting performance specifications and for budgetary purposes in consultation with both national and international stakeholders. Requirements are subject to change, which may be as a result of information provided in response to this RFI. Respondents are advised that any information submitted to Canada in response to this RFI may, or may not, be used by Canada in the development of the potential subsequent RFP. The issuance of this RFI does not create an obligation for Canada to issue a subsequent RFP, and does not bind Canada legally or otherwise, to enter into any agreement or to accept or reject any suggestions.
- d. There will be no short-listing of Respondents for the purposes of undertaking any future work, as a result of this RFI. Similarly, participation in this RFI is not a condition or prerequisite for the participation to any potential subsequent RFP.
- e. Respondents responding to this RFI should identify any submitted information that is to be considered as either company confidential, proprietary or if the response contains controlled goods.

## 9. ENQUIRIES



- a. All enquiries and other communications related to this RFI shall be directed, in writing, exclusively to the DRDC Contracting Authority. All enquiries must be submitted to the Contracting Authority no later than fifteen (15) calendar days before the closing date. Enquiries received after that time may not be answered. Because this is not a bid solicitation, Canada will not necessarily respond to enquiries in writing or by circulating answers to all potential suppliers.
- b. Care should be taken by Respondents to explain each question in sufficient detail in order to enable Canada to provide an accurate answer. Technical enquiries that are of a proprietary nature must be clearly marked "proprietary" at each relevant item. Items identified as "proprietary" will be treated as such except where Canada determines that the enquiry is not of a proprietary nature. Canada may edit the questions or may request that the Respondent do so, so that the proprietary nature of the question is eliminated, and the enquiry can be answered with copies to all Respondents.
- c. Changes to this RFI may occur and will be advertised on the Government Electronic Tendering System (GETS) in the form of an amendment. Should such a need arise, it is each interested party's responsibility to verify changes to their responses, if any, to the Contracting Authority.

## 10. LANGUAGE

Responses and consultation are to be provided in one of the two Official Languages of Canada (English or French).

## 11. CLOSING

Responses to this RFI are to be submitted to the DRDC RFI Authority identified below, on or before the date indicated on Page 1 of this document.

RFI Authority:

Name: Jennifer Beamish  
Title: Head of Procurement and Contracting  
Department: Defence Research and Development Canada  
Address: 9 Grove Street, Dartmouth, Nova Scotia  
Telephone: 902-407-0356  
Email: jennifer.beamish@forces.gc.ca

Responsibility for Timely Delivery: Each Respondent is solely responsible for ensuring its response is delivered on time to the correct location.

Identification of Response: Each Respondent should ensure that its name and return address, the RFI number and the closing date appear legibly on the outside of the response.



## Attachment 1 - Specific Questions

### Questions (please support answers in detail)

#### 1. Technical Questions related to this RFI solicitation

- a) What is your understanding of the state of Digital Twin technology as applied to ships?
- b) Describe the most promising technologies that could contribute to developing and testing a digital twin prototype of a naval ship?
- c) Describe the most serious obstacles to overcome in developing and testing a digital twin prototype of a naval ship?
- d) List the Canadian industries would be the most likely to be able to contribute to this project?
- e) Can you describe other important technical aspects that should or must be considered?

#### 2. Technical Questions related to your RFI technique

- a) Describe your company's expertise in designing and developing Digital Twin technology or similar virtual monitoring systems.
- b) Is your Digital Twin technology supported by scientific or engineering manuscripts, patents or standards?
- c) Is your Digital Twin technology a Commercial off the Shelf (COTS) system or does it require development?
- d) Describe other advantages, disadvantages and engineering challenges with your Digital Twin technique?

#### 3. Budgetary and Commercial Questions

- a) What would you estimate as the cost and time frame to design/develop (if needed) validate and supply a working system?
- b) Are there other shared costing initiatives (e.g., government incentives) that could reduce the cost of the work?
- c) Would ownership of the developed intellectual property by the contractor reduce the cost of the work?
- d) Do you have any additional documentation (presentation, report and brochure) relevant to this development effort and can you supply them as part of this submission?
- e) Can you describe other important commercial aspects that must be considered?



## Attachment 2 - Planned Data Instrumentation

### 1- Energy Monitoring

Metering and monitoring of switchboard electrical load distribution, thermal heat recovery potential on a HALIFAX Class frigate. The intent is to meter and monitor the following:

1. The ship's switchboard electrical load distribution lines in the aft and forward compartments (KWh, Voltage versus time).
2. 85-ton chiller set(s), at least one unit while in operation, specifically, inlet and outlet temperatures of the condenser and evaporator and heat rejection coolant flow. (degrees Celsius, flow measurements L/s)
3. Electric generator(s), at least one unit while in operation, specifically, inlet and outlet temperatures of the radiator and heat rejection coolant flow (degrees Celsius, flow measurements L/s)

### 2- Structural Monitoring

The proposed Structural Health Monitoring (SHM) system (to be supplied and installed by DRDC separately from this Digital Twin program) consists of three data collection nodes located in separate compartment locations (midship, forward and aft quarter points) along the length of the ship. At each of the three compartment locations, the intent is to install:

1. Four long-based strain gauges (approximately 1.5-2 meters long). Two will be placed on the weather deck, one on the starboard side, and one on the port side. Two will be placed on #4 Deck, one on the starboard side and one on the port side.
2. Four conventional tri-axial strain gauges will be collocated with the long-based strain gauges.
3. An accelerometer will be installed at the underside of the weather deck on the centerline.
4. Two additional accelerometers are planned for installation at the centerline under the weather deck; one near the bow, the other near the stern.

Three additional conventional tri-axial strain gauges are planned to be installed.

A central PC collocated with other DRDC ship trial equipment will display realtime data, trend data, system alarms and health checking. Each of the three data-logging nodes mentioned above will be connected to the central PC via the existing ship fiber optic network with extensions for SHM sensors as required. In addition ship speed, heading, motions and wave environment will be monitored.