

**JUSTIFICATION REVIEW DOCUMENT
JUSTIFICATION AND APPROVAL FOR OTHER THAN
FULL AND OPEN COMPETITION**

Supply/Service: Purchase Shimadzu Hyper Vision HPV-X2 High-Speed Video Cameras and Correlated Solutions 2D/3D Digital Image Correlation Software package with accessories.

Authority: 41 U.S.C. 1901(e) (2), implemented by FAR 13.501(a) -- Sole Source Brand Name Product, or feature of a product, peculiar to one manufacturer.

[Redacted]

Dan Dougherty
Contracting Officer
Email: daniel.p.dougherty14.civ@mail.mil

[Redacted]
Date: 08/04/2016

[Redacted]

[Redacted]

Reviews: I have reviewed this justification and find it adequate to support other than full and open competition.

Program Manager:
[Redacted]

Legal Counsel:
[Redacted]

**Department of Army
FAR Part 13 Simplified Acquisition Sole Source Justification and Approval for
Other than
Full and Open Competition**

1. Contracting Activity: US Contracting Command – Aberdeen Proving Ground, Adelphi Contracting Division, (ACC-APG-CCAP-SCA), 2800 Powder Mill Road, Adelphi, Maryland 20783.

2. Description of Action: US Army Research Laboratory (ARL), Weapons and Materials Research Directorate (WMRD), Impact Physics Branch (RDRL-WMP-C), 4600 Deer Creek Loop, Building 4600, Aberdeen Proving Ground (APG), MD 21005 requests a firm fixed price contract with Shimadzu Scientific Instruments, 7102 Riverwood Dr., Columbia, MD 21046. The Government projects award for August 2016 and Fiscal Year

(FY) 2016 Army, Research Development Test & Evaluation (RDT&E) funding will be utilized.

- An acquisition plan is not required because this procurement does not meet the threshold at Defense Federal Acquisition Regulation Supplement 207.103(d) (i) (B).
- (Insert approval authority title* approved an acquisition plan in accordance with DFARS 207.103(d)(i)(B) on *(insert date)*.
- the required acquisition plan in accordance with DFARS 207.103(d) (i) (B) is currently awaiting *(insert approval authority title)* approval.

3. Description of Supplies/Services:

CLIN	CLIN DISCRPTION	Estimated Amount
0001	Two (2) each Shimadzu Hyper Vision HPV-X2 High-Speed Video Cameras and DIC Software System with 716 iX-camera and REL lights,	[Redacted]
0002	One (1) each Shimadzu Hyper Vision HPV-X2 High-Speed Video Camera.	[Redacted]

The Government requires three (3) Shimadzu Hyper Vision HPV-X2 High-Speed Video Cameras and one (1) Correlated Solutions 2D/3D digital image correlation (DIC) Software package with the required accessories and peripherals for synchronized operation with the cameras that meet the following specifications:

- Capable of capturing up to 10,000,000 images per second at up to 256 consecutive images
- Zero frame to frame artifacts such as ghosting or gray-value variations.
- Incorporates an FTCMOS image sensor using 32 micrometer pixels
- Capable of synchronization with multiple cameras and illumination devices.
- Exposure time variable in a 10 ns interval from 60 fps to 2 Mfps. 110 ns exposures at 5Mfps, 50 ns exposures at 10Mfps
- High light sensitivity, synchronization with multiple cameras of the same model, exposure time and no image noise.

Period of Performance: Delivery is to be made four (4) weeks after date of award.

4. Authority Cited:

41 U.S.C. 1901(e)(2), implemented by FAR 13.501(a) - Sole Source Brand Name Product, or feature of a product, peculiar to one manufacturer.

5. Reason for Authority Cited:

The Government requires Shimadzu's Hyper Vision HPV-X2 High-Speed Video Camera because it is the only commercially available camera that meets the Government's requirements for capturing up to 256 frames at a resolution rate of 10,000,000 frames per second, high light sensitivity (ASA/ISO 16,000), synchronization and compatibility with multiple cameras of the same model currently owned by ARL WMRD, exposure time and no image noise. In addition, the Shimadzu HPV-X2 camera is the only known camera that is free from frame to frame artifacts, such as ghosting and gray value variations. Ghosting is especially detrimental because the human observer is not able to determine if a feature is real or is an artifact of the camera, causing incorrect conclusions to be drawn.

Furthermore, it is necessary for the Cameras to not require post image editing due to ghosting effects or gray-value variations, which is a replica of the transmitted image or an image offset in position that is super-imposed on top of the main image or bled over from a prior transmitted images. The practical negative effect of ghosting is that the user or any Digital Image Correlation (DIC) software is not able to distinguish between features that are real versus non-real artifacts created by ghosting/noise. In these situations where ghosting occurs other cameras would be useless because there is no known way to "clean-up" the images after the experiment has been completed. The Shimadzu is the only camera with million plus frame rates that does not have ghosting effects.

[Redacted] all of ARL have conducted extensive market research with high speed cameras (See section 8). The market research has identified only one other potential source which is Specialized Imaging's that manufacturers a similar camera called Kirana. After extensive review, use, and technical evaluation, it was determined that the Kirana did not meet WMRD's minimum requirements. First, the maximum frame rate of the Kirana is only 5 million frame per second (the minimum required is 10 million frames per second). Second, the Kirana has a maximum number of frames of 180 (minimum required is 256 frames). Also, both cameras the HPV-X2 and the Kirana were evaluated in a direct side-by-side comparison during ballistic experiments in July 2015 by ARL WMRD. During evaluation the Kirana showed ghosting that generally appeared in all frames but was particularly bad every 10th frame. The ghosting is very detrimental to performing quantitative digital image correlation measurements, which is another component of this purchase. During the evaluation the HPV-X2 did not exhibit any ghosting artifacts.

In addition to the required specifications on the Camera, the Correlated Solutions 2D/3D-Software is essential to ARL's requirements because it allows for quantitative analysis of the experiments. DIC is essentially tracking and Image acquisition software for the HPV-X2 Cameras. Prior to testing, a random speckle pattern is applied to the surface to be recorded by the cameras and this pattern is tracked from frame to frame by the software. Using a pair of calibrated cameras, the movement of the surface (i.e. rigid body motion) and relative movement of the surface (strains) in three (3) dimensions can be tracked. At each pixel in each image the three (3) dimensional displacements, velocities, and strains are calculated by the software. The data can be quantitatively compared to theory and/or simulations. Ghosting causes detrimental effects on the DIC software because the software underperforms and sometimes fails to track the movement (especially the relative movement) of the speckle pattern from frame to frame. The result is the

calculated data from the software is of poor quality (large amount of noise, i.e. error, incorrect data, etc.). The software can also get confused on whether a feature is real or an artifact of the camera. [Redacted].

[Redacted]

The Shimadzu Hyper Vision HPV-X2 High-Speed Video Camera is essential to the govt's requirements and market research indicates other companies' similar products, or products lacking the particular feather, do not meet, or cannot be modified to meet, ARL's needs.

6. Efforts to Obtain Competition:

Based on market research performed by [Redacted] no other vendor other than, Shimadzu Scientific Instruments, Inc. was found to be able to fulfill all of the Government's requirements. One (1) competitor, Specialized Imaging, which manufactures the Kirana, responded to the Sources Sought Synopsis that was posted to FedBizOpps (FBO) on 27 July 2016. The potential vendor's specifications were technically evaluated by the Government and did not meet the minimum requirements of 10 Million Frames per second (Kirana specification is 5 Million FPS). In addition, both cameras the HPV-X2 and the Kirana were evaluated in a direct side-by-side comparison during ballistic experiments in July 2015 by ARL WMRD.

In accordance with FAR 5.201 a synopsis was posted to FBO with a closing date of 18 August 2016. To date no other vendors have expressed interest.

7. Actions to Increase Competition:

ARL has conducted extensive market research to locate other sources with similar capability and no other sources except Shimadzu's HPV-X2 were found to meet the WMRD's minimum requirements. During efforts to obtain competition, Specialized Imaging, showed interest in providing a high speed camera to the Government but after technical evaluation it was determined that it did not meet the minimum requirements.

Currently, there is a Small Business Innovative Research (SBIR) initiative working to develop similar Ultra high speed digital cameras that could potentially meet the Governments requirements in the future. SBIR Topic Number A09-054 entitled "Full Field, Out-of-Plane Digital Image Correlation (DIC) from Ultra-High Speed Digital Cameras". Based on information provided in section five above, effective competition for this action is not anticipated. However, ARL will continue to search the marketplace to increase competition by attending conferences/exhibitions, reviewing trade journals, World Wide Web (WWW) research and through open discussion with industry and academia experts. Before future acquisitions, the market will be continually surveyed to determine whether another manufacturer has emerged that could meet the Army requirements, thus justifying the need for full and open competition.

A high speed camera (other than the brand name Shimadzu) that meets ARL's technical requirement and that is also compatible with the Correlated Solutions software may be considered however, based on the results of market research there are no other cameras that incorporate that software and meet all of ARL's minimum requirements.

8. Market Research:

Market research began on 24 July 2015 by **[Redacted]**. The required high speed camera was searched through querying Government-wide databases of contracts, General Service Administration website, and the Internet. After conducting extensive market research, only one (1) company was found, Shimadzu Scientific Instruments, In., who was able to meet WMRD's requirement.

During July 22-24, 2015, **[Redacted]** performed an onsite evaluation of a Shimadzu HPV-X2 camera during actual ballistic experiments. The camera was loaned by Shimadzu and the Hadland Imaging Corporation during the repair of a separate ARL owned high speed imaging system.

During July 24, 2015 and Aug 10, 2015, **[Redacted]** evaluated a Specialized Imaging Kirana Camera during ballistic experiments. **[Redacted]** performed direct side by side comparisons of the Shimadzu HPV-X2 and Specialized Imaging Kirana cameras. The Kirana is owned by the Government **[Redacted]**. The Specialized Imaging camera as follows:

- The Kirana camera had very noticeable ghosting that repeated every 10 image frames. This camera employs an internal complementary metal-oxide semiconductor (CMOS) detector with an In-situ Storage Image Sensor (ISIS) with a Charge Coupled Device (CCD). This particular design allows light leakage and photo-electron diffusion from the opening in the light shield. This results in dramatic image artifacts and gray value fluctuation that are repeated every 10 image frames.
- The images from the Kirana camera showed ghosting that was repeated every 10 image frames. For example, ghosting is shown below in Fig. 1. Examples of the high quality images from the Shimadzu camera are shown in Fig. 2.

Due to the effects on image ghosting and gray scale fluctuations, the Kirana camera does not meet ARL's requirement for clear imaging.

(a)	(b)
-----	-----

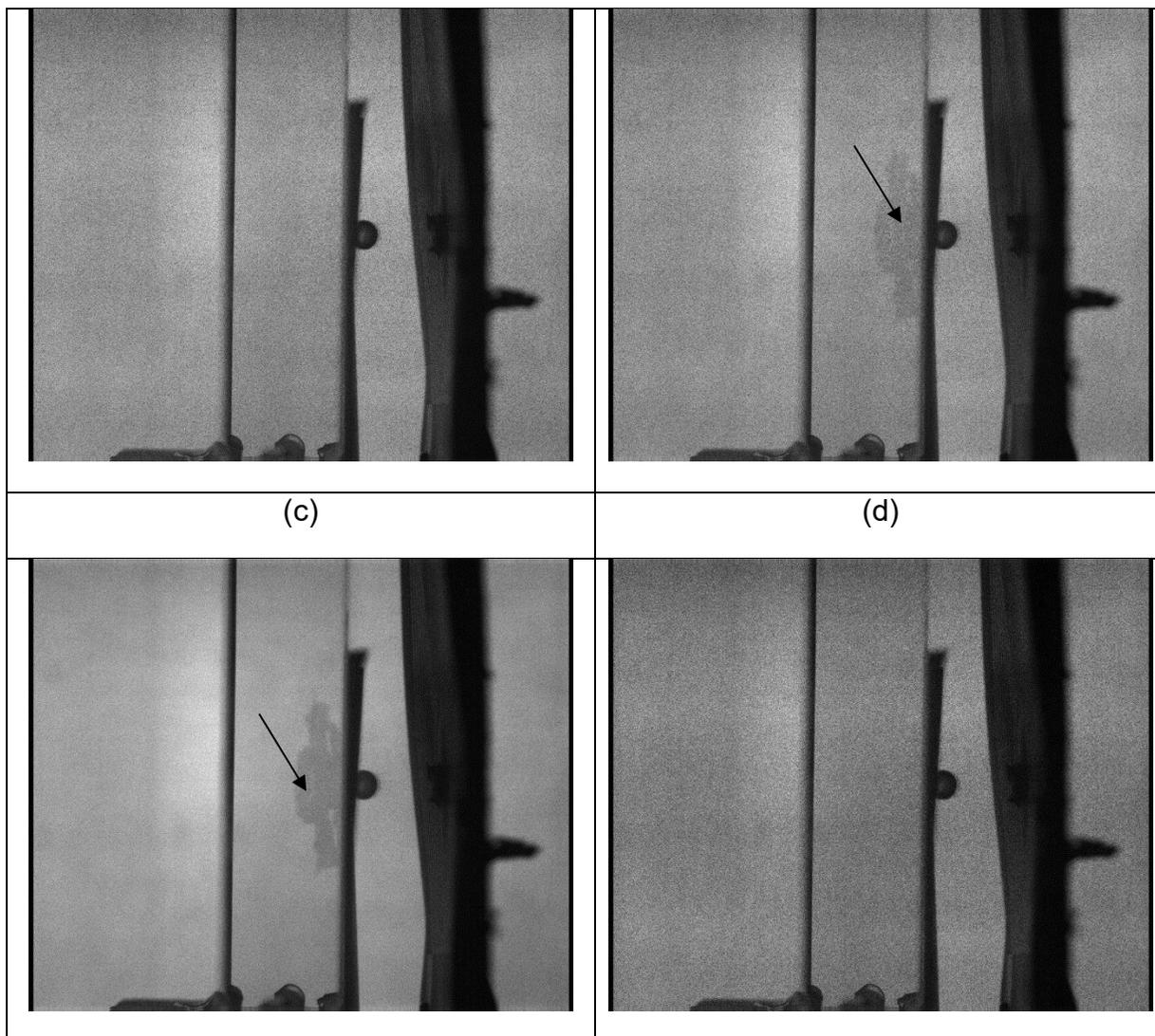


Fig. 1. Example images obtained with the Specialized Imaging Kirana camera showing the ghosting artifact and gray value fluctuations. Image numbers 38, 39, 40 and 41 are shown in (a) through (d) respectively. The black arrows in (b) and (c) show “ghost” features that are not physically present in the image at that time. These are instead an artifact of the detector architecture found on the Specialized Imaging Kirana camera.

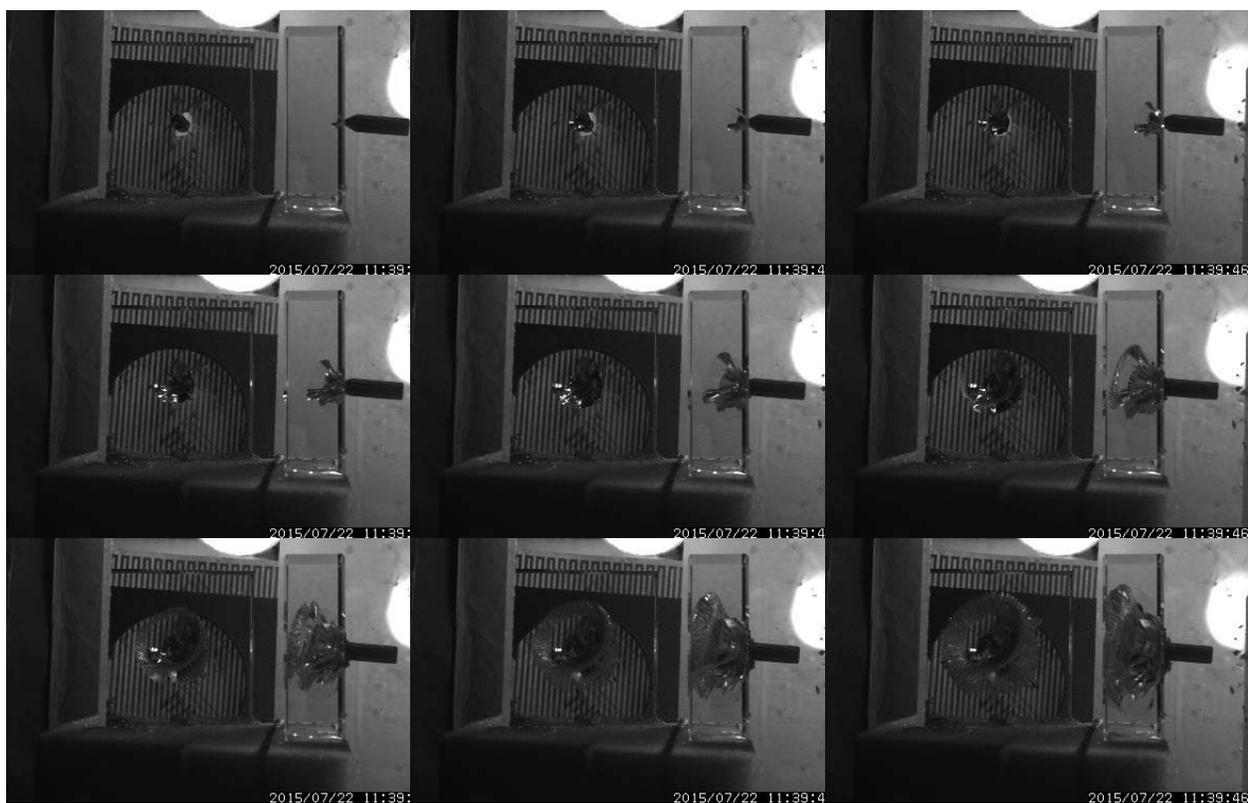


Fig. 2. Example images obtained with the Shimadzu HPV-X camera. Gray values are consistent throughout each of the subsequent images. There is no ghosting present in any image. Dramatic variations in light intensity are possible without oversaturating the detector. In fact, these images show a high intensity flash bulb in the same field of view as the target.

Additional, market research was conducted on 25 April 2016 by **[Redacted]**. The required DIC software was searched through querying Government-wide databases of contracts, GSA, and the Internet. After conducting extensive market research, only one product was found, Correlated Solutions, who was able to meet WMRD's requirement.

ARL already has a SBIR with Correlated Solutions to develop their DIC software and it's used extensively by the Materials and Manufacturing Science Division of ARL WMRD, but IPB also has familiarity with it. Correlated Solutions also has strong relationships with Shimadzu, and the Correlated Solutions software is the only known brand that is able to calibrate and control the Shimadzu X2 cameras within their DIC software.

Market Research was conducted between 01 Feb 2016 to 01 June 2016 by **[Redacted]** Research Chemist, RDRL-WML-C, Aberdeen Proving Ground MD 21005-5066; **[Redacted]**. Market Research was conducted through query of several catalogs and literature, exchanges with knowledgeable people or subject matter experts and extensive internet searches.

Market research was conducted between 01 Jan 2015 to 11 May 2016 by **[Redacted]**. Market Research was conducted through query of several catalogs and literature, exchanges with knowledgeable people or subject matter experts, extensive internet searches, onsite evaluation, and a review of the General Supply Schedule (GSA)

website. High speed cameras from Photron (maximum frame rate of 2.1 Mfps) and Vision Research (maximum frame rate of 1 Mfps) do not meet the requirements because the maximum frame rate for their respective cameras are not high enough. Additionally, these cameras do not have a fixed resolution at all frame rates, like the Shimadzu HPV-X2 has, so the resolution reduces as the frame rate increases. At the highest frame rates, Photron (128x8 pixels) and Vision Research (128x16 pixels) cameras has much lower resolution than the Shimadzu (400x250 pixels) has.

9. Interested Sources: One (1) competitor, Specialized Imaging, which manufactures the Kirana, responded to the Sources Sought Synopsis that was posted to FedBizOpps (FBO) on 27 July 2016. The potential vendor's specifications were technically evaluated by the Government and did not meet the minimum requirements.

In accordance with FAR 5.201 a synopsis was posted to FBO with a closing date of 18 August 2016. To date no other vendors have expressed interest.

10. Other Facts:

a. Procurement History-

Contract: W911QX-16-P-0061

Contractor: Shimadzu Scientific Instruments, Inc,

Award Date: 10 Feb 2016

Competitive Status: Non-competitive

Authority: 41 USC 1901(e) as implemented by FAR 13.501(a); One Responsible Source and No Other Supplies or Services Will Satisfy Agency Requirements.

Reason for Authority Cited: The Government requires Shimadzu's Hyper Vision HPV-X2 High-Speed Video Camera because it is the only commercially available camera that meets the government's requirements for the framing rate, number of consecutive images, resolution at 10,000,000 frames per second, sensitivity, synchronization with multiple cameras, exposure time and image noise. The Shimadzu camera is also the only known camera that is free from frame to frame artifacts such as ghosting and gray value variations and is therefore the only camera that meets the government's requirements. The government would incur greater costs and longer time to edit data before it can be properly analyzed if another camera was purchased. The use of another vendor would not meet the minimum requirements and create duplicate costs and loss of time to the Government. Due to the aforementioned, Shimadzu is the only brand that can meet the Government's requirements.

b. Acquisition Data Availability: The required HPV-X2 Cameras and 2D/3D digital image correlation software are commercial off the shelf (COTS) product. As such, manufacturer product specifications are available from the vendor. Interested sources may compare their own high speed camera specifications to those of Shimadzu's HPV-X2. To date, the Government has determined that only Shimadzu's HPV-X2 and Correlated Solutions 2D/3D-Software software are capable of meeting the Government's minimum requirements.

c. Unusual and Compelling Urgency: Not Applicable.

d. Subcontracting Competition: Not Applicable.

e. Follow on Contracts: Not Applicable.

11. Technical Certification: I certify that the supporting data under my cognizance which are included in the justification are accurate and complete to the best of my knowledge and belief.

[Redacted]

12. Requirements Certification: I certify that the supporting data under my cognizance which are included in the justification are accurate and complete to the best of my knowledge and belief.

[Redacted]

13. Fair and Reasonable Cost Determination: I hereby determine that the anticipated cost or price to the Government for this contract action will be fair and reasonable. The basis for this determination will be a price analysis of prior invoices where the same Shimadzu High Speed Camera sold in the past 12 months and published price.

This determination will be made using the following:

- Cost analysis
- Price analysis
- Should-cost
- IGCE
- Audit:
- Other:

As a part of this basis, certified cost or pricing data:

will be required.

will not be required and the following exception applies (FAR 15.403):

Prices that will be agreed upon are based on adequate price competition.

Prices that will be agreed upon are based on prices set by law or regulation.

A commercial item is being acquired.

A waiver has been granted by the head of the contracting activity (HCA) in accordance with DFARS PGI 215.403-1.

The contract action is a modification to a contract or subcontract for commercial item(s).

The estimated cost of the contract action is less than the threshold for certified cost or pricing data.

[Redacted]

14. Contracting Officer Certification: I certify that this justification is accurate and complete to the best of my knowledge and belief.

[Redacted]

Approval

Based on the foregoing justification, I hereby approve the procurement of the Shimadzu High Speed Camera and 2D/3D Software on an other than full and open competition basis pursuant to the authority of 41 U.S.C. 1901(e)(2) as implemented by FAR 13.501(a), subject to availability of funds, and provided that the services or supplies herein described have otherwise been authorized for acquisition.

[Redacted]

(End of Justification)