NAVY
13.3 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

The responsibility for the implementation, administration and management of the Navy SBIR Program is with the Office of Naval Research (ONR). The Director of the Navy SBIR Program is Mr. John Williams, john.williams6@navy.mil For program and administrative questions, please contact the Program Managers listed in Table 1; **do not** contact them for technical questions. For technical questions about the topic, contact the Topic Authors listed under each topic from **26 July through 25 August 2013.** Beginning **26 August**, the SITIS system (http://www.dodsbir.net/Sitis/Default.asp) listed in Section 4.15.d of the DoD Program Solicitation must be used for any technical inquiry.

TABLE 1: NAVY SYSCOM SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	Activity	Email
N133-147 thru N133-149	Ms. Elizabeth Madden	MARCOR	elizabeth.madden@usmc.mil

The Navy's SBIR Program is a mission oriented program that integrates the needs and requirements of the Navy's Fleet through R&D topics that have dual-use potential, but primarily address the needs of the Navy. Companies are encouraged to address the manufacturing needs of the Defense Sector in their proposals. Information on the Navy SBIR Program can be found on the Navy SBIR website at http://www.navysbir.com. Additional information pertaining to the Department of the Navy's mission can be obtained by viewing the website at http://www.navy.mil.

PHASE I GUIDELINES

Follow the instructions in the DoD Program Solicitation at www.dodsbir.net/solicitation for program requirements and proposal submission. It is highly recommended that you follow the Navy proposal template located at http://www.navysbir.com/submission.htm as a guide for structuring your proposal. Cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings are recommended for all proposals.

Technical Volumes that exceed the 20 page limit will be reviewed only to the last word on the 20^{th} page. Information beyond the 20^{th} page will not be reviewed or considered in evaluating the Offeror's proposal. To the extent that mandatory technical content is not contained in the first 20 pages of the proposal, the evaluator may deem the proposal as non-responsive and score it accordingly.

The Navy requires proposers to include, within the **20** page limit, an option which furthers the effort and will bridge the funding gap between Phase I and the Phase II start. Phase I options are typically exercised upon the decision to fund the Phase II. **The base amount of the phase I should not exceed $80,000 and six months; the phase I option should not exceed $70,000 and six months.**

PHASE I PROPOSAL SUBMISSION CHECKLIST:

The following criteria <u>must be met</u> or your proposal will be REJECTED.

____1. Include a header with company name, proposal number and topic number on each page of your Technical Volume.

____2. Include tasks to be completed during the option period in the 20 page technical volume and include the costs as a separate section in the Cost Volume.

____3. Break out subcontractor, material and travel costs in detail. Use the "Explanatory Material Field" in the DoD Cost Volume worksheet for this information, if necessary.

____4. The base effort should not exceed $80,000 and have a period of performance of six months and the option should not exceed $70,000 and have a period of performance of six months. The costs for the base and option are clearly separate, and identified on the Proposal Cover Sheet, in the Cost Volume, and in the work plan section of the proposal.

____5. Upload your Technical Volume and the DoD Proposal Cover Sheet, the DoD Company Commercialization Report, and Cost Volume electronically through the DoD submission site by 6:00 am ET, 25 September 2013.

____6. After uploading your file on the DoD submission site, review it to ensure that it appears correctly. Contact the DoD Help Desk immediately with any problems.

The Navy will evaluate and select Phase I proposals using the evaluation criteria in Section 6.0 of the DoD Program Solicitation with technical merit being most important, followed by qualifications and commercialization potential of equal importance. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

Protests of Phase I and II selections and awards shall be directed to the cognizant Contracting Officer for the Navy Topic Number. Contracting Officer contact information may be obtained from the Navy SYSCOM SBIR Program Manager listed in Table 1.

One week after solicitation closing, e-mail notifications that proposals have been received and processed for evaluation will be sent. Consequently, e-mail addresses on the proposal coversheets must be correct.

The Navy typically awards a firm fixed price contract or a small purchase agreement for Phase I.

In accordance with section 4.10 of the DoD Instructions, your request for a debrief must be made within 15 days of non-award notification.

CONTRACT DELIVERABLES

Contract Deliverables (CDRLs), typically progress reports, final reports, and initial Phase II proposals should be uploaded to https://www.navysbirprogram.com/navydeliverables/ as required by the contract.

PHASE II GUIDELINES

All Phase I awardees will be allowed to submit an **initial** Phase II proposal for evaluation and selection. The Phase I Final Report and Phase II Initial Proposal will be used to evaluate the offeror's potential to progress to a workable prototype in Phase II and transition technology in Phase III.

The details on the due date, content, and submission requirements of the initial Phase II proposal will be provided by the awarding SYSCOM either in the Phase I award or by subsequent notification. **All SBIR/STTR Phase II awards made on topics from solicitations prior to FY13 will be conducted in accordance with the procedures specified in those solicitations (for all Department of Navy topics this means by invitation only).**

Section 4(b)(1)(ii) of the SBIR Policy Directive permits the Department of Defense and by extension the Department of the Navy (DoN), during fiscal years 2012 through 2017, to issue a Phase II award to a small business concern that did not receive a Phase I award for that R/R&D. The DoN will **NOT** be exercising this authority for Phase II awards. **In order for any small business firm to receive a Phase II award, the firm must be a recipient of a Phase I award under that topic.**

The Navy will evaluate, and select Phase II proposals using the evaluation criteria in Section 8.0 of the DoD Program Solicitation with technical merit being most important, followed by qualifications and commercialization potential of equal importance. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. The Navy does NOT participate in the FAST Track program.

The Navy typically awards a cost plus fixed fee contract for Phase II. The Phase II contracts can be structured in a way that allows for increased funding levels based on the project's transition potential. This is called the Phase II.5 and is accomplished through either multiple options that may range from $250,000 to $1,000,000 each, substantial expansions to the existing contract, or a second Phase II award. For existing Phase II contracts, the goals of Phase II.5 can be attained through contract expansions, some of which may exceed the $1,000,000 recommended limits for Phase II awards. Each SYSCOM has specific guidance for Phase II.5 which can found at http://www.navysbir.com/phaseII5andcpp.htm

DISCRETIONARY TECHNICAL ASSISTANCE – The SBIR Policy Directive section 9(b), allows the DoN to provide discretionary technical assistance to its awardees to assist in minimizing the technical risks associated with SBIR projects and commercializing into products and processes. Firms may request, in their application for Phase I and Phase II proposals, to contract these services themselves in an amount not to exceed $5,000 per year. This amount is in addition to the award amount for the Phase I or Phase II project.

Approval of direct funding for this discretionary technical assistance will be approved by the DON SBIR office if the firm's proposal clearly identifies the need for assistance, provides details on the provider of the assistance and why they are uniquely skilled to carry out this work, and the cost of the required assistance. If the firm requests discretionary technical assistance in a Phase II proposal, they will be eliminated from participating in Navy Transition Assistance Program (TAP) and Navy Opportunity Forum or any other assistance the Navy provides directly to firms.

Phase I awardees that propose more than $150,000 in total funding (Base, Option and discretionary technical assistance) cannot receive a purchase order. The need to issue a Firm Fixed Price (FFP) contract may result in contract delays if the SYSCOM normally issues Phase I awards as purchase orders.

All Phase II awardees not receiving funds for discretionary technical assistance in their award must attend a one-day Transition Assistance Program (TAP) meeting during the second year of the Phase II. This meeting is typically held in the summer in the Washington, D.C. area. Information can be obtained at: http://www.dawnbreaker.com/navytap. Awardees will be contacted separately regarding this program. It is recommended that Phase II cost estimates include travel to Washington, D.C. for this event.

PHASE III - A Phase III SBIR award is any work that derives from, extends or logically concludes effort(s) performed under prior SBIR funding agreements, but is funded by sources other than the SBIR

Program. Thus, any contract or grant where the technology is the same as, derived from, or evolved from a Phase I or a Phase II SBIR/STTR contract and awarded to the company which was awarded the Phase I/II SBIR is a Phase III SBIR contract. This covers any contract/grant issued as a follow-on Phase III SBIR award or any contract/grant award issued as a result of a competitive process where the awardee was an SBIR firm that developed the technology as a result of a Phase I or Phase II SBIR. The Navy **will** give SBIR Phase III status to any award that falls within the above-mentioned description, which includes according SBIR Data Rights to any noncommercial technical data and/or noncommercial computer software delivered in Phase III that was developed under SBIR Phase I/II effort(s). The government's prime contractors and/or their subcontractors shall follow the same guidelines as above and ensure that companies operating on behalf of the Navy protect the rights of the SBIR ompany.

AWARD AND FUNDING LIMITATIONS – In accordance with SBIR Policy Directive section 4(b)(5), there is a limit of one sequential Phase II award per firm per topic. Additionally in accordance with SBIR Policy Directive section 7(i)(1), each award may not exceed the award guidelines (currently $150,000 for Phase I and $1 million for Phase II) by more than 50% (SBIR/STTR program funds only) without a specific waiver granted by the SBA.

TOPIC AWARD BY OTHER THAN THE SPONSORING AGENCY – Due to specific limitations on the amount of funding and number of awards that may be awarded to a particular firm per topic using SBIR/STTR program funds (see above), Head of Agency Determinations are now required before a different agency may make an award using another agency's topic. This limitation does not apply to Phase III funding. Please contact your original sponsoring agency before submitting a Phase II proposal to an agency other than the one who sponsored the original topic. (For DoN awardees, this includes other SYSCOMs.)

TRANSFER BETWEEN SBIR AND STTR PROGRAMS – Section 4(b)(1)(i) of the SBIR Policy Directive provide that, at the agency's discretion, projects awarded a Phase I under a solicitation for SBIR may transition in Phase II to STTR and vice versa. A firm wishing to transfer from one program to another must contact their designated technical monitor to discuss the reasons for the request and the agency's ability to support the request. The transition may be proposed prior to award or during the performance of the Phase II effort. Agency disapproval of a request to change programs shall not be grounds for granting relief from any contractual performance requirement. All approved transitions between programs must be noted in the Phase II award or award modification signed by the contracting officer that indicates the removal or addition of the research institution and the revised percentage of work requirements.

ADDITIONAL NOTES

Due to the short timeframe associated with Phase I of the SBIR process, the Navy does not recommend the submission of Phase I proposals that require the use of Human Subjects, Animal Testing, or Recombinant DNA. For example, the ability to obtain Institutional Review Board (IRB) approval for proposals that involve human subjects can take 6-12 months, and that lengthy process can be at odds with the Phase I time to award goals. Before Navy makes any award that involves an IRB or similar approval requirement, the proposer must demonstrate compliance with relevant regulatory approval requirements that pertain to proposals involving human, animal, or recombinant DNA protocols. It will not impact our evaluation, but requiring IRB approval may delay the start time of the Phase I award and if approvals are not obtained within six months of notification of selection, the award may be terminated. If you are proposing human, animal, and recombinant DNA use under a Phase I or Phase II proposal, you should view the requirements at: http://www.onr.navy.mil/en/About-ONR/compliance-protections/Research-Protections/Human-Subject-Research.aspx. This website provides guidance and notes approvals that may be required before contract/work can begin.

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NAVY SBIR 13.3 Topic Descriptions

N133-147 TITLE: Alternative Materials for Tactical Vehicle Wheeled Hubs

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: Medium Tactical Vehicle Replacement (MTVR) Program, ACAT IC

OBJECTIVE: The MTVR is the current medium tactical cargo vehicle for the Marine Corps. Efforts have been made to reduce the weight of the vehicle, to accommodate extra cargo, to accommodate up-armor kits, and to improve vehicle handling. One area of development is an innovative, advanced material system to replace the currently used mild to medium strength steel in the wheel hubs of the Medium Tactical Vehicle Replacement (MTVR). Currently, the un-sprung weight of the vehicles (the combined weight of all the vehicle hardware not supported by the suspension) is on the order of 3500 lbs. By reducing this weight, the MTVR could gain improved handling characteristics, improved fuel economy and an increase in cargo capacity.

DESCRIPTION: The Medium Tactical Vehicle Replacement (MTVR) Program is the current medium tactical cargo vehicle for the Marine Corps (Ref 1). Efforts are being made to identify areas that could benefit from a reduction in weight to enable extra cargo carrying capacity (e.g. up-armor kits, etc.) as well as improve vehicle handling capability. A reduction in vehicle weight directly equates to an equal increase in the vehicle load capacity. Currently used wheel hubs are made of mild to medium strength steel and the entire assembly (tire and hub) can weigh on the order of 550lbs each. The current wheel hubs are a two-piece bolt together steel disc design. They are 20 x 10 in. hubs that are sized to mount 16.00R20 XZL Michelin tires (Ref. 1). One area of potentially significant weight reduction in existing vehicles is in the wheel hubs. Reducing the weight of the wheel hubs by making them out of a lighter weight advanced material will directly benefit the handling capability of the vehicle by significantly reducing the un-sprung weight of the vehicle. The reduced wheel weight would also translate into better vehicle handling by providing improved wheel acceleration. The weight reduction would also improve the vehicle fuel efficiency (when the vehicle is not filled to maximum cargo capacity). A 35% reduction in hub weight may be able to achieve a 3% increase in fuel efficiency. The current state-of-the-art technology utilizes composite technologies which have been applied to wheels for bicycles, motorcycles and race cars. These wheels are primarily meant for relatively light vehicles used on paved surfaces for non-high-impact loads (Ref. 2-4). By contrast, a wheel hub for an MTVR will need to be capable of supporting up to 10,000 lbs. static vehicle load and operating in a more aggressive operating environment (Ref 1).

This topic seeks to explore innovative, alternative, advanced material systems to replace mild to medium strength steel used in the wheel hubs for the MTVR. The use of composite material systems are encouraged, but approaches are not limited to these types of advanced material systems. Concepts that can provide a weight savings of up to 35% over the currently used steel hub assembly are of a particular interest. Proposers are encouraged to address the benefits of tailorable material solutions so that the hubs could potentially be "tuned" to work with a specific vehicle suspension. The MTVR is expected to operate in a variety of environments and terrains. The hubs need to be able to operate in the temperature range of 125 deg F to -50 deg F. Proposed concepts should be mindful of the added technical challenges to be able to maintain a "mean miles between mission" hardware failure metric of no less than 2700 miles. The hubs will also need to maintain the current Central Tire Inflation System (CTIS) capability as is discussed in Ref. 1 and will need to conform to FMVSS 119, 120, FMCSR 393.75, SAE J267, SAE J1095, SAE J1992, SAE J2014, and applicable Tire and Rim Association, or European Tire and Rim Technical Organization (ETRTO) standards.

PHASE I: The company will develop e concepts for an improved wheel hub by exploring the application of advance materials while meeting the required size and strength requirements for an MTVR as discussed above. The company will demonstrate the feasibility of the concepts in meeting the Marine Corps needs and will establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling, as appropriate, to facilitate the comparison of different concepts to include projected performance, reliability, and maintainability. The contractor shall estimate hardware, installation and maintenance costs. The company will provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risks.

PHASE II: Based on the results of Phase I and the Phase II development plan, the company will develop full-sized prototypes with a scaled level of performance (initial testing will evaluate on-road performance only.) The prototype hubs will be evaluated to determine their capability in meeting the reduced scale performance goals defined in the Phase II development plan and the Marine Corps requirements for the MTVR. System performance will be demonstrated through on-vehicle prototype evaluation and modeling or analytical methods as a means of validating the performance, reliability and maintainability of the prototypes. Evaluation results will be used to refine the prototype into an initial design that will meet MTVR requirements. The company will prepare a Phase III development plan to transition the technology to MTVR use.

PHASE III: If Phase II is successful, the company will be expected to support the Marine Corps in transitioning the technology for Marine Corps use. The company will develop a wheeled hub for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use. A successfully developed wheel hub alternative will follow a dual transition path. Some systems will be integrated onto MTVRs that are deployed in mission areas that would immediately benefit from reduced vehicle weight, while the overall system design will transition into the MTVR program as new vehicles continue to be produced.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The need to save vehicle weight exists on many industrial vehicles, including agricultural, mining, and construction equipment. Additionally, commercial freight vehicles could benefit from a system that reduces wheel assembly and vehicle weight.

REFERENCES:
1. http://www.oshkoshdefense.com/products/6/mtvr

2. http://www.compositesworld.com/news/carbon-revolution-reports-first-one-piece-carbon-fiber-wheel

3. http://www.stormingmedia.us/07/0772/A077211.html

4. http://www.researchgate.net/publication/222579398_Development_of_carbonepoxy_structural_components_for_a_high_performance_vehicle

5. MTVR Rim and Wheel drawings (3), posted in SITIS 8/12/13.

KEYWORDS: Advanced materials; MTVR; Tactical Vehicle; Wheel hub; Reduced Weight; Maneuverability; Fuel Efficiency

N133-148 TITLE: Adaptive Diesel Engine Control

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: Program Management Offices Medium Tactical Vehicle Replacement (ACAT IC)

OBJECTIVE: The objective is to reduce the volume of fuel consumed by the MTVR engine during mission operations by 15-25% over current fuel consumption while increasing the power output of the engine by 5-10% over current engine rated capability. These goals will be reached thru modification of the Caterpillar C12 or similar engine enabling full and independent control of diesel engine components allowing the engine to operate at maximum efficiency across the full spectrum of engine loads.

DESCRIPTION: Since the initial inception and fielding of the Medium Tactical Vehicle Replacement (MTVR), the expected mission of the truck has evolved (Ref. 1). Vehicle modifications have included the addition of a larger alternator to support a greater array of onboard electronics and increased equipment loads, as well as increased vehicle weight due to up-armoring. These modifications have required the truck engine to operate at two different load levels. First, the engine must operate at high-power, calling on over 400 BHP to climb slopes, accelerate under full payload, or traverse soft soils. Second, the engine must operate for long periods of time at a low capacity while the vehicle is parked to support generation of electricity and HVAC functions in the cab drawing 10 – 20 BHP. The MTVR currently uses a Caterpillar C-12 electronic control, Adam III Diesel engine. The C-12 Diesel engine is an inline 6 cylinder turbo charged diesel truck engine with 729 in3 of displacement. The C-12 Diesel engine operates over a range of 1200 to 2100 RMP and provides a maximum of 425 BHP at 1600 RPM, and provides a maximum of 1550 LB-FT of torque at 1200 RPM. Control over the diesel combustion cycle is currently limited by the mechanical linkage between engine rotation, valve actuation and fuel injection. Current state of the art controls only allow the engine to be optimized for maximum fuel efficiency (minimization of power out per mass of fuel consumed) at a single operational point (Torque versus engine speed) (Ref. 2). Optimization of a single operation point does not meet the need of current MTVR operational practices. Concepts that remove the mechanical linkage could allow greater control over the combustion cycle and are of particular interest (Ref. 3). Increased combustion cycle control could allow adaptation of control strategies that responds to engine load demands. This adaptation will result in multiple optimized fuel efficiency operational points for the engine. These multiple operating points may be achieved thru cylinder shut down, fuel injection profile shaping or other means made possible by higher levels of combustion cycle control.

The MTVR program is interested in innovative approaches to provide maximum engine control adaptability of the C12 or similar engines to the loads required during various engine operating conditions. The goal of this topic is to reduce the volume of fuel consumed by the MTVR engine during mission operations by 15-25% over current fuel consumption while increasing the power output of the engine by 5-10% over current engine rated capability. Proposers are encouraged to explore both hardware and control software modifications. All modifications will be compatible, mechanically and electronically, with existing MTVR drive systems components and not compromise the MTVR's current environmental operation requirements. All vehicles and their components shall be capable of operating in the temperature range of 52°C (125°F) to -32°C (-25°F) without the use of Arctic kits or additional operator procedures, and to -45.5 °C (-50°F) with the use of Arctic kits. At ambient temperatures of -32°C (-25°F) and above, the engine shall be capable of starting, reaching and maintaining normal coolant temperature range, and attaining smooth operation at idle speed within thirty (30) minutes with the operator inside the cab, without external devices and with the transmission in neutral. All variants shall be capable of being stored at 66°C (150°F) without damage.

PHASE I: The company will develop concepts to enable maximum adaptability of the current C12 or similar engines to be able to efficiently adapt to varying load requirements as dictated during the performance of its mission. The company will demonstrate the feasibility of the concepts in meeting MTVR needs and will establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by analytical modeling, as appropriate. The company will also perform an analysis of potential effects on existing systems reliability, maintainability and durability. The company will provide a Phase II development plan with performance goals and key technical milestones and that will address technical risk reduction. The contractor will propose engine hardware modification and control software development required to provide maximum adaptability of the engines operating cycle to requested engine work.

PHASE II: Based upon the results of Phase I and the Phase II development plan, the small business will develop a scaled prototype for evaluation in a representative environment. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the MTVR requirements as stated above. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters and will also include engine dynamometer testing to demonstrate fuel consumption improvements. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements. The company will prepare a Phase III development plan to transition the technology to MTVR use.

PHASE III: If Phase II is successful, the company will be expected to support the Marine Corps in transitioning the technology for MTVR use. The company will develop a final prototype for evaluation to determine its effectiveness in an operationally relevant environment such as an over-the-road demonstration. A final MTVR modification kits and instructions will be developed. A final kit production verification test and operational test would be performed to verify equipment install process and performance. The modification kit would then be available for application to the MTVR fleet. The company will support the Marine Corps for its test and validation to certify and qualify the system for MTVR use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The commercial diesel industry has a need for higher level control of the diesel combustion process in order to increase operational efficiency for diesel engine applications. These applications include, but are not limited to, commercial trucking, power generation, mining and agriculture. Commercial trucks operate under a wild variety of engine loads based on payload weight the vehicle is carrying, as well as overnight idle operation during driver rest periods on long hauls. In the power generation industry, diesel engines powering generators could self-adjust to the load required on the generator and mitigate the need for large battery packs to load level generation. Finally, in the agricultural industry, diesel engines are used in a wide variety of equipment typically used for multiple functions during a season; the adaptable engine will again allow the engine to adjust to the required load for a given task.

REFERENCES:
1. http://www.oshkoshdefense.com/products/6/mtvr

2. Vance, E., Giordano, D., Rogers, J., and Stewart, J., "Demonstration of Power Improvements on a Diesel Engine Operating on Multiple Fuels," SAE Technical Paper 2010-01-1318, 2010, doi:10.4271/2010-01-1318.

3. Tai, C., Tsao, T., Schörn, N., and Levin, M., "Increasing Torque Output from a Turbodiesel with Camless Valvetrain," SAE Technical Paper 2002-01-1108, 2002, doi:10.4271/2002-01-1108.

4. Specification Sheet for C-12 diesel engine, uploaded in SITIS on 9/4/13.

KEYWORDS: MTVR; C12 Engine; Fuel Efficiency; Engine Control; Engine Optimization; Diesel Combustion Cycle

N133-149 TITLE: Development of On-board Weight and Center of Gravity Measurement System for Tactical Vehicles

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: Program Manager Medium & Heavy Tactical Vehicles (PM M&HTV)

OBJECTIVE: The objective of this effort is to develop an innovative, cost-effective and reliable on-board weight and center of gravity (W&CG) measurement system for tactical vehicles.

DESCRIPTION: Tactical wheeled vehicles routinely carry payloads of varied configurations to support the operating forces' diverse missions. To ensure safety while maximizing payload capacity, it is imperative that the system weight and center of gravity (W&CG) be accurately and conveniently determined. During transport, appropriate W&CG need to be maintained to avoid overloading a vehicle's axles or lift and tie-down restraints. Similarly, W&CG data is necessary to preserve a vehicle's dynamic stability during operation. As an example, the vehicle's W&CG, particularly vertical and lateral CG, need to stay below a certain limit to prevent rollover or braking failure. Additionally, for a vehicle equipped with a stability control or warning system, accurate W&CG data are required for the system to function effectively. Current methods to determine W&CG for tactical vehicles involve the use of truck scales, weight tables, and suspension methods for CG. However, these are not field-expedient and often inconvenient if not inaccurate or incomplete. Truck scales, for instance, are not readily available to the operating forces except at selected ports or maintenance facilities. The scales alone also do not provide vertical and lateral CG. Computing a system's W&CG using literature is limited by the availability of highly specific data on a respective system's CG as well as the relative positions of payloads. The later may need to be measured on-site. Suspension or other similar methods to determine CG typically have to be carried out by skilled technicians in a properly instrumented facility, e.g., Aberdeen Test Center. These currently available methods limit the availability of reliable W&CG data, which greatly affects the Marines' ability to safely optimize payloads.

Presently, technologies exist that could effectively automate the collection of some W&CG data. Commercially available systems such as Onboard Truck Scales (Ref 1) offer to provide on-demand weight information using a network of pressure or strain sensors attached to a vehicle's suspension system. More advanced systems, such as those proposed for on-board aircraft weight and balance apparatus (Ref 2) could, in addition to weight, compute longitudinal and lateral CG using additional load and incline sensors along with a suitable computer algorithm. For vertical CG, which remains challenging to measure, there are potential approaches that involve using dynamic input, e.g., system axial accelerations, and analyzing system modal frequencies (Ref 3). These advances present opportunities to develop a novel and effective W&CG measurement system; however, considerable technical challenges remain. Most notably, on-board CG measurement technology, particularly for vertical CG, is still in early stage of development and primarily intended for aircraft use. More research and development are needed to fully mature or expand these concepts, and adapt them to military vehicle applications.

The US Marine Corps seeks innovative approaches toward the development of an on-board system to measure weight and longitudinal, lateral, and vertical CG of tactical vehicles (Ref. 4-5). Proposed concepts should include necessary hardware, software, and user interface to enable automatic, real-time or near real-time capturing and reporting of W&CG. The measured W&CG should be within 3% of the vehicle actual W&CG. Additionally, the research and development should address system robustness against military vehicles environmental and operational conditions (Ref. 4-5) Proposals that address a low maintenance and acquisition cost, simplicity in design and operation, employ open architecture design principles, and demonstrate as ease of integration into the host vehicle are of a particular interest.

PHASE I: The company will develop concepts for an on-board W&CG measuring system for tactical vehicles. Using a Medium Tactical Vehicle Replacement (MTVR, Ref 4-5) as the baseline platform, demonstrate analytically and/or experimentally the system can automatically measure and report the vehicle's weight and center of gravity in real or near-real time. Provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risk reduction.

PHASE II: Based on the results of Phase I and the Phase II development plan, develop a detailed design and performance specification. Fabricate a prototype system and demonstrate experimentally that target performance is met at different payload configurations. Demonstrate experimentally that the prototype system can withstand the vehicle specified environmental and operational conditions. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements. Prepare a Phase III development plan to transition the technology to Marine Corps use.

PHASE III: If Phase II is successful, the company will be expected to support the Marine Corps in transitioning the technology for Marine Corps use. Collaborate with government and industry partners to produce and integrate the W&CG system in a tactical vehicle (MTVR) for evaluation to determine its effectiveness in an operationally relevant environment. Demonstrate manufacturability and cost reduction. Support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology can be applied to civilian trucks and other commercial fleets to maximize load-carrying capacity while maintaining or enhancing transport and operation safety.

REFERENCES:
1. "Wireless Truck Scales". Truckweight. 2011. Smartscale Technologies Inc. 08 March 2013 <http://www.truckweight.com/EN/New/index.html>

2. Long, Michael and Gouette, Geoffrey. "On-Board Aircraft Weight and Balance System". US Patent 7,967,244. June 28, 2011.

3. Cummins, Josh et al. "Automated Estimation of an Aircraft's Center of Gravity Using Static and Dynamic Measurements". Proceedings of the IMAC-XXVII, February 9-12, 2009 Orlando, Florida USA.

4. "Medium Tactical Vehicle Replacement: MTVR." Oshkosh Defense. 2013. Oshkosh Corporation. 08 March 2013. http://www.oshkoshdefense.com/products/6/mtvr

5. Reference removed by TPOC because the web page is not available at this time.

6. MTVR pictures provided by TPOC, 12 pages, uploaded in SITIS 9/5/13.

KEYWORDS: on-board measurement system; CG measurement; weight measurement; optimal payload; MTVR; tactical wheeled vehicles