TransTech Systems recently submitted comments to the Office of the Assistant Secretary for Research and Technology (OST-R), Department of Transportation (DOT) in response to their Request for Information (RFI) regarding the development of, "a 5-year transportation research and development strategic plan to guide future Federal transportation research and development activities." Our comments/suggestions concerning the need for funding an R&D program aimed at bringing the use of density measurements into the Intelligent Compaction efforts being carried out by FHWA and the world's leading roller manufacturers, since density is the standard measure of compaction used in the highway community for quality acceptance, can be found below.

Docket Number DOT-OST-2016-0044

The following comments from TransTech Systems, Inc. respond to Question 3, "What emerging challenges or opportunities in transportation warrant additional Federal RD&T activities or investments?", and to Question 7, "What knowledge gaps merit additional exploration by the USDOT?" These questions are found on page 17767 on the lower half of column one of the Federal Register/Vol. 81, No. 61/Wednesday, March 30, 2016/Notices.

The points we would like to make with regard to these two questions are related to the current push by FHWA to greatly increase the use and adoption of Intelligent Compaction (IC) roller technologies by state and local DOTs during the breakdown (initial) and intermediate phases in the road paving sequence. This is being done in order to ensure that the target properties of the asphalt layer are more uniform and are more efficiently achieved, thereby producing better quality and longer lasting roads.

The **emerging challenge** referred to in Question 3 is to make IC more widely accepted and utilized. An important way to do this is to include density measurement technology in the suite of technologies that FHWA requires in order to be considered Intelligent Compaction. Since density is the standard measure of compaction used in the highway community for quality acceptance, including this metric capability on IC rollers will logically help expedite the acceptance. Current IC rollers measure stiffness of the freshly laid asphalt during the compaction process and then, with each OEM providing their own methods, develop an Intelligent Compaction Measurement Value (ICMV – stiffness modulus/stiffness index). None of the OEMs agree on the method and no ICMV value correlates to asphalt density. One OEM roller manufacturer claims to measure density directly (which is a marketing tool and is, of course, impossible to do directly without precisely measuring the mass of a known unit volume of asphalt, such as a core), but actually runs stiffness data from a vibratory roller through a neural net, so it is still based on stiffness measurements. On a related note, the use of only stiffness measurements comes with its own issues. These include the fact that there is no way to separate the stiffness of a 2 – 4 inch asphalt layer from the underlying material stiffness, the ICMV values are dependent on roller settings (so all roller settings like speed, frequency and amplitude would have to remain fixed throughout a project in order to compare values), and the fact that stiffness values are highly dependent on temperature, since as asphalt cools, it may appear to increase in stiffness even if it is not increasing in density.

Since roller operators/road construction companies in the United States are paid based on density, a more straightforward method of providing a density value to the roller operator, especially one that is much more closely related to a true density measurement than through trying to extrapolate from stiffness, would seem to be an important area for USDOT to explore. The **knowledge gap** that merits additional exploration, referred to in Question 7, is how to incorporate density measurements into the IC suite of technologies or methodology. At the very least, including such density measurements to augment the current IC method using stiffness would seem to make sense, since this type of sensor fusion could prove to increase the effectiveness of each to help build longer lasting, better quality roads. In addition, since many roller manufacturers (in particular, Bomag, Sakai, Hamm and Ammann) are starting to produce oscillatory or combined oscillatory/vibratory rollers instead of vibratory-only rollers, if this trend continues and expands, stiffness measurements will become less and less viable and technology to measure density without depending on stiffness will become increasingly more important and necessary.

The major **challenge** of including a much more straightforward density measurement into the IC process is to do so in a non-contact, continuous way so that the major points of using IC rollers in the first place, which are to get 100% mat coverage and uniform mat density, can be achieved. This will likely require carrying out R&D projects on a number of test strips using a wide variety of asphalt mix designs at a number of compaction/density levels and will necessarily include taking existing, or emerging, technologies already in use for measuring density in the rolling pattern (such as nuclear density gauges (NDG), non-nuclear density gauges (NNDG), and ground penetrating radar (GPR)) and making them compatible with being attached to a roller such that cost-effective, non-contact density measurements can be taken so as to augment current IC rollers and improve their effectiveness. The type of elaborate testing necessary to bring these non-stiffness technologies into acceptance by the IC community is probably outside of any of these companies's normal R&D/new product development budgets, so it would be very useful and expeditious to provide some type of funding/cost-sharing for the companies that are best suited for this endeavor. Whether such an R&D project is carried out as part of a multi-state/pooled-fund effort or done at a research facility such as the National Center for Asphalt Technology (NCAT), this would be a very important effort and be of great value to the entire highway community.

TransTech Systems, Inc. is an innovative company dedicated to developing, manufacturing, and selling cutting edge, robust instrumentation solutions to the road construction as well as a variety of other industries. TransTech Systems was formed in 1994 to bring new technology to the transportation construction industry. TransTech currently sells handheld asphalt and soil density measurement devices worldwide and is the leader in non-nuclear asphalt density measurement.