To: U.S. DEPARTMENT OF EDUCATION
Re: Assessment RFI response

Date: 17 January 2011

The IMS Global Learning Consortium (IMS – imsglobal.org) is pleased to provide this response to the Request for Information (RFI) on Assessment Technology Standards. IMS is a non-profit member consortium funded and resourced by 160 industry organizations from around the world. IMS specifications and standards have been uniquely focused on educational and learning technology since the origins of IMS in EDUCAUSE around 1995. IMS work features the most widely used assessment, learning content, learning application, student system, and ePortfolio standards around the world. IMS has also provided a majority of the specifications used in the U.S. government-funded SCORM standards.

IMS provides only "open-licensed" specifications, meaning that all IMS specifications are free to obtain and free to use. IMS uses standard copyright on specifications, which is the accepted mechanism for helping to enforce interoperability from published specifications. IMS also provides as standard practice numerous ways to customize, tailor, profile, and extend its specifications, including technical tools and a public profile registry to accomplish this. IMS also provides more rights than standard copyright by providing a license that allows distribution of IMS specifications for registered parties. In addition, IMS today provides much more than specifications in order to make the implementation of interoperability easy – even for relatively non-technical organizations.

Over the last five years IMS has focused attention on "raising the bar" for the education technology sector in terms of creating high quality standards that result in significant adoption and strong interoperability in practice. In November 2009 the IMS Board of Directors provided a pledge to guarantee interoperability to the U.S. Department of Education. We are pleased to once again make this pledge, but now updated to include the important area of assessment. This is based on our work over the last 15 months on the Accessible Portable Item Profile (APIP), developed under the guidance of eight U.S. states, as well as continued progress on the world's most widely used assessment specification, IMS QTI (Question and Test Interoperability). The renewed pledge letter follows this introduction.

In this RFI response we provide details of how to utilize the IMS standards to implement the requirements of the Race to the Top Assessment (RttTA) program. While the standards presented apply to much broader requirements, IMS has performed a detailed analysis of the requirements of both the PARCC and SBAC proposals. IMS has also helped lead a public workshop on APIP held in Washington D.C. on December 7, 2010, at which consortia representatives attended. SBAC has already expressed a strong interest in requiring APIP conformance. PARCC is considering it. Additional discussions are in progress.

The IMS standards, including APIP, are significant not only because they provide the foundation for an innovative market with low barriers to entry, but also because they enable the type of assessment required to enable a world class curriculum, such as the

Common Core State Standards (CCSS). The CCSS or other advances in teaching and learning require actionable assessment that can occur throughout the student experience. The goal of good assessment is to increase learning. The IMS standards discussed in this RFI response provide a strong foundation to enable a wide range of formative and summative assessment options. They decrease the burden of teachers, students, and administrators. They enable timely information to teachers, students, parents, and administrators, and better information than is typically available today. The IMS standards cut across the traditional summative assessment and online learning. They are already broadening the market for innovative learning applications and interventions.

IMS standards are also notable because open source and open content providers in the educational segment around the world have favored them. IMS has many members and collaborators that have pioneered open source or open content business models in education. This includes Sakai, Moodle, OLAT, A Tutor, OpenLearn (Open University UK), and MIT Open Courseware, among many others. Because of this, IMS truly bridges the worlds of proprietary and open. Educational technology leaders are excited about the latest IMS work because it truly provides a basis for "write once, run anywhere," without becoming locked in to a proprietary <u>or</u> open source framework. IMS standards enable the blending of open and proprietary content.

The IMS process provides a fair venue in which both collaborators and competitors can come together voluntarily to develop and adopt high quality standards. While the work of IMS represents tens of millions of dollars of investment from mostly private sources, the U.S. Department of Education has the opportunity to greatly influence the work of IMS. A great example of this has been APIP in which the leadership of eight U.S. states has leveraged and shaped the work of IMS. IMS provides a great opportunity for the U.S. Department of Education to influence and leverage the work of our successful public-private partnership that is providing standards that fit so nicely with what the Department is seeking to achieve. Indeed, it is difficult to find more effective venues for development and adoption of learning technology standards than IMS, where the investment of 160 member organizations of all sizes and types has led to usage by literally tens of thousands of organizations around the world. Department participation would help to ensure the success of IMS work even further than has been achieved to date.

We feel that it is important to point out, in these challenging economic times, that government working <u>with</u> IMS (and other standards consortia) is substantially more efficient in terms of taxpayer investment than creating new government managed standards activities. We believe that APIP is a great example of this as well as the interaction between SCORM and IMS in the early years of SCORM (1999 – 2004). Both APIP and SCORM have benefitted from tens of millions of dollars of mostly private and global investment in IMS. And, IMS continues to maintain and evolve specifications used in SCORM to better meet the needs of the education segments around the world. It also needs to be noted that government projects are typically devoid of the required intellectual property protections (for end users of the standards), clearly designated processes, voting rights, and sustainable models that standards consortia already have in place and are expert at managing. IMS offers a full lifecycle of activities around

standards development, adoption, professional development, maintenance and evolution that are sustainable without major or recurring taxpayer investment. Particularly in the assessment area it is certain that there will need to be continued evolution to support emerging technologies, such as mobile devices. In short, working with IMS is proven to provide tremendous leverage, and it is very expensive for government to replicate similar activities. We are hopeful that this RFI and subsequent work will lead to a close partnership between IMS and the U.S. Department of Education that minimizes taxpayer investment and maximizes return.

Following the pledge letter, we provide answers to all of the questions provided in the RFI. IMS has invested substantial effort in creating these RFI responses to explain our relevant standards and our processes, but we are happy to provide further information and examples on request.

Many of the questions in the RFI relate to specification and standards development processes and policies. Perhaps our processes and those of standards consortia in general, may not be well understood. "How" standards organizations operate is a very specialized topic and perhaps there is misinformation from competing entities. So we have tried our best herein to explain why the IMS approach is an essential fit for the needs of our segment, based on many years of experience and evolution. Diversity of standards and standards organization policies is healthy. IMS respects the operating policies and procedures of all legally formed standards consortia and bodies. Therefore, IMS provides responses to this RFI purely with respect to IMS. We do not feel it is our place to criticize other standards organizations or bodies. Generally speaking, the commitment on the part of the supporters of standards organizations and bodies provide ample evidence of the viability and effectiveness of such organizations. IMS is proud of how well our processes have worked and are working, but we are always looking for ways to improve. Achieving collaboration among competitors on a voluntary basis is complex. It should be noted, however, that IMS is very open to evolving its processes further if other approaches are shown to produce a better result.

IMS is also aware that there is a significant amount of confusion with respect to how standards such as IMS, SIFA, and PESC may fit together in the U.S. context. IMS is hopeful that better coordination among standards activities may be achieved, and we are encouraging this. IMS is confident that any technical obstacles to bridging between the IMS standards and data standards such as SIFA and PESC are minimal. We are confident that this will happen as the adoption of standards from all such organizations increases in the market. IMS looks to the Department of Education to provide some guidance, along with U.S. states and districts, as to what integrations need to occur and why. We believe that with such guidance the members of the various consortia will respond. The U.S. Department of Education must also be an advocate for standards, as this will increase market interest.

IMS is not providing any proprietary responses to this RFI. Since many of the questions are related, many of the answers reference other answers. Therefore, it is requested that the U.S. government republish this document in its entirety. We do not want the responses to any one question to be taken out of context.

IMS is supportive of the U.S. Department of Education's vision and historic work in improving the U.S. education system and we look forward to providing additional support. Specifically as it relates to assessment, IMS believes that the U.S. Department of Education is in a position to help provide leadership to not only the U.S., but also the world as it relates to assessment interoperability. This is because the combination of question and test, accessibility, content, and enterprise interoperability that IMS have been developing for many years are ready to be combined and leveraged for RttTA and other U.S. needs. This is a great opportunity to both leverage existing work and to "give back" to the international community that has supported much of this work. We are hopeful that the U.S. will join other leading nations around the world involved in IMS, including the UK, The Netherlands, South Korea, European Union, Norway, Canada, New Zealand, and Australia, as well as the many U.S. states and districts now getting involved, in helping to further the application of technology and standards to improve education. For further information or questions about any portion of the RFI response, please contact Rob Abel of IMS: rabel<at>imsglobal.org

On behalf of the IMS Board of Directors and IMS Membership,

Rob Abel

Chief Executive Officer
IMS Global Learning Consortium

January 17, 2011

Mr. Arne Duncan
Secretary of Education
U.S. Department of Education
400 Maryland Avenue, SW
Washington, D.C. 20202

Cc:
Jim Shelton, U.S. Department of Education

Dear Secretary Duncan,

The IMS Global Learning Consortium (IMS – imsglobal.org) Board of Directors is pleased to provide you with an update to our pledge letter dated November 27, 2009 in support of educational technology interoperability. In the referenced letter the IMS Board made the following commitment to you and the U.S. Government:

The IMS Global Learning Consortium will guarantee that e-Learning resources (such as online courses, resources, labs, simulations, or other educational resources) that incorporate the IMS Common Cartridge and/or Basic Learning Tools Interoperability (LTI) standards will be re-usable in systems that are certified to conform to these standards. IMS GLC will provide support to project participants, including end-user institutions, to implement this guarantee.

In the interim between today and when this pledge was made we are pleased to report that IMS has made outstanding progress in enabling a vital, open, and innovative market for educational technology and content, spanning the range of business models for such products. IMS has now issued over 35 conformance marks, with many more in progress (the list of conformant products is publically available at imsglobal.org/cc/statuschart.html). IMS has also been working with eight U.S. state assessment agencies for 15 months to apply IMS interoperability standards for accessible assessment items that has leveraged literally tens of millions of dollars prior investment from mostly private sources from all over the world. This new standard is referred to as APIP (Accessible Portable Item Profile). It is currently in public review phase and ready for initial implementation. Also, IMS is working directly now with U.S. districts to guide and apply the IMS standards.

As a result of the progress made on APIP and some other core IMS work, namely student information system interoperability standards called Learning Information

Services (LIS), the IMS Board of Directors is prepared to update our pledge as follows:

The IMS Global Learning Consortium (IMS) will guarantee that digital learning resources, applications, or systems (such as online courses, resources, labs, simulations, assessments, assessment/homework applications, interventions, other educational resources, or learning management systems) that incorporate the IMS Common Cartridge, Basic Learning Tools Interoperability (LTI), Accessible Portable Item Profile (APIP), or Learning Information Services (LIS) standards will interoperate with systems/applications that are certified to conform to these standards. IMS GLC will provide support to participants of U.S. Department of Education programs, including end-user institutions and states, to implement and stand behind this guarantee.

IMS offers our support to help ensure that investments that the U.S. Department of Education will make across K-20 achieve the greatest possible return. IMS provides a sustainable model for standards development, adoption, professional development, maintenance and evolution without the need for major or recurring taxpayer investment. It is a collaboration of committed stakeholders of all types and sizes that are willing to invest to enable a vital educational market.

All IMS standards are freely available and free to license, and require no special software or hardware. IMS support is based on a voluntary membership model. Through the support of a relative few organizations (160 as of today), tens of thousands of organizations around the world benefit. IMS standards enable the blending of open source content and platforms with proprietary models. IMS enables educational resources and learning platforms of all types to interoperate across the broadest possible spectrum of uses, in an integrated manner so that faculty, teachers, students, parents and administrators have a seamless, integrated experience.

The pledge IMS is making is NOT a marketing device. It is a statement of our resolve to bring credible, high quality interoperability to the education segment for the benefit of all participants. IMS standards released in the last several years undergo rigorous testing and support from an unparalleled worldwide community. Our conformance programs are not simply "logo programs." They represent our commitment to ensuring interoperability through the best possible testing, technical support resources, and ongoing support for users.

IMS is an example of a very successful non-profit public-private partnership that minimizes the amount of taxpayer investment from participating nations and states while achieving huge leverage. APIP has been a great case example of such leverage. The U.S. Department of Education, can participate in shaping the work of IMS along with states and districts. Government organization participation in IMS already

includes organizations from the UK, The Netherlands, South Korea, the European Union, Norway, Canada, New Zealand, and Australia. Relatively small investments in IMS will reap huge benefit and leverage for the U.S. Government. IMS has formal collaborations with many standards organizations around the world and is ready to play our part in helping to ensure that numerous standards organizations can work together to support the needs of U.S. education.

We encourage you or your staff to contact the IMS Chief Executive Officer, Dr. Rob Abel, so that our non-profit organization can work closely with the Department of Education to help the U.S. achieve its historic goals. Rob can be contacted at rabel@imsglobal.org or by phone at 407-792-4164. We will be pleased to provide more information as well.

Respectfully,

On Behalf of the IMS GLC Board of Directors

Rob Abel, Ed.D., Chief Executive Officer of IMS
Mark Armstrong, Vice-President, Higher Education Product Development, Oracle
Jeremy Auger, Chief Operating Officer, Desire2Learn
Curtiss Barnes, Vice President, Strategic Market Development, Cengage Learning
Timothy Beekman, President & Co-Founder, SAFARI Montage
Jim Behnke, Chief Learning Officer, Pearson Education
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Julie K. Little, Ed.D, Vice President, Teaching, Learning, Professional Development, EDUCAUSE
Mark Stiles, Head of Learning Development and Innovation, Staffordshire University, Chair of the JISC-CETIS Board

IMS Global Learning Consortium Facts

From Innovation to Learning Impact

IMS Global Learning is a nonprofit member organization that strives to enable the growth and impact of learning technology in higher education, K-12, and corporate education worldwide. IMS GLC members are leading corporations, higher education institutions, school districts and government organizations worldwide that are enabling the future of education by collaborating on interoperability standards and major adoption projects for the digital support of education and learning. IMS GLC also sponsors Learning Impact: a global awards program and conference that recognizes the impact of innovative technology on educational access, affordability, and quality.

IMS Global is supported by over 160 organizations – the world's leaders in educational and learning technology, including leading learning technology product suppliers and publishers, leading educational institutions, districts, and state systems, and leading government organizations around the world.

Originating in 1995 from EDUCAUSE, IMS GLC has since approved and published some 20 standards that are the most widely used learning technology standards in the world. Widely used IMS GLC standards include meta-data, content packaging, common cartridge, enterprise services, question & test, sequencing, competencies, access for all, ePortfolio, learner information, learning tools interoperability, resource list, sharable state persistence, vocabulary definition, and learning design. These standards have been used widely in higher education, K-12 education, and corporate training around the globe. All IMS GLC standards are available free of charge via the IMS GLC web site and are used without royalty by thousands of organizations around the world.

IMS GLC also works directly with institutional members, via the IMS Campus program, to achieve effective large-scale adoption of leading edge technology to achieve strategic mission goals.

The annual Learning Impact conference and the associated Learning Impact Awards (LIAs) focus on the latest educational technology trends and recognizing scalable innovation that has achieved or has the potential to achieve significant improvement in educational access, affordability, and quality.

For more information, including the world's most comprehensive set of learning technology interoperability standards, information on the annual Learning Impact conference and awards program, and free community resources for learning technology leaders, visit www.imsglobal.org.

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RFP Questions and Answers

3.2.1 Current Landscape. What are the dominant or significant assessment technology standards and platforms (including technologies and approaches for assessment management, delivery, reporting, or other assessment interoperability capabilities)? What is the approximate market penetration of the major, widely adopted solutions? To what degree is there significant regional, educational sub-sector, or international diversity or commonality regarding the adoption of various technology standards and capabilities, if any?

IMS Question and Test Interoperability (QTI) is a freely available and freely licensed interoperability specification for the exchange of test items, tests, and results reporting. Access to all currently supported IMS specifications, including QTI, is available free of charge here: http://www.imsglobal.org/specifications.html

QTI has been in wide use in online learning platforms around the world since the release of version 1.2.1 in 2003. QTI version 2 has been in wide use in assessment technology platforms around the world since its release in 2004.

The following examples illustrate the large-scale usage and viability of QTI:

- ETS uses QTI to deliver and update 64,000 test items to its network of partners serving U.S. states.
- Pearson VUE uses QTI as the foundation of its processes with partners to put assessments online
- Pearson, McGraw-Hill, and other major publishers normally make textbook questions available in QTI format
- Most learning management systems (Blackboard, Moodle, Desire2Learn, etc) are capable of importing and running QTI items and tests

The following factors must also be considered in terms of the future adoption of QTI:

- An inhibitor to adoption of QTI in the past was the lack of strong conformance certification, which has now been corrected
- IMS Common Cartridge, which includes support for QTI, is seeing rapid adoption by most learning management platforms and content providers in the e-Learning space
- Classroom platform providers are now working aggressively to adopt the IMS standards led by SAFARI Montage and SMART technologies

The current focus of IMS on QTI is QTI v 2.1, which has been in pubic draft status since 2006. The long period of public draft status for QTI v2.1 from 2006 to the present should not be interpreted as a drawback. IMS significantly raised the bar in terms of the amount of interoperability testing required to achieve public final status on all of its specifications between 2006 and the current time (this was done to deal with the lack of interoperability being achieved in practice from educational technology interoperability

standards in general, as is discussed in detail in this RFI response). The QTI community worldwide needed some time to adjust and reorganize to meet these demands. The last 18 months have resulted in tentative approval of one conformance profile and approval of a second is expected in early 2011. This is expected to result in QTI v2.1.x achieving final public status by the end of Q1 2011.

QTI v2.1 is also being adapted, along with some other IMS specifications, for the Accessible Portable Item Profile (APIP) project. APIP combines QTI with some other IMS standards to achieve interoperable items that enable computer-delivered assessment for students with special needs (see the answer to 3.2.28 for an in depth discussion of the accessibility features provided by APIP). The initial work on APIP was funded by a U.S. DoEd Enhanced Assessment grant. The APIP standard has been developed with input from eight state assessment divisions, with Minnesota in the lead. The APIP draft is currently available for public input and initial implementations at:

http://www.imsglobal.org/community/forum/categories.cfm?catid=110

In addition, the Minnesota Department of Education has launched an APIP site on behalf of the participating states here:

http://education.state.mn.us/MDE/Accountability_Programs/Assessment_and_Testing/APIP/index.html

While the question asks for market share information, it is literally impossible to provide such data because IMS standards are completely voluntary and use of them does not require membership in IMS or any other affiliation with IMS. What we can say is that many prominent U.S. suppliers and publishers that are dealing with online learning or assessment technology have significant experience with QTI. And, if asked to provide items and tests in QTI format, will claim that they can do so. ETS (Educational Testing Service) currently uses QTI v2.x to distribute and update large banks of items to their associated vendors around the U.S. It is important to note that IMS does not "track" the usage of QTI. There is no specific software purchase required by a district or state to implement QTI, as with something like SIF (Schools Interoperability Framework). All IMS specifications are similar to those from leading standards organizations such as W3C in that the specifications are built into and largely invisible to the buyer – other than the functionality and interoperability they provide.

QTI is clearly the dominant assessment interoperability standard in use around the world as well. QTI workgroup leadership currently comes from the UK, Germany, and South Korea. QTI is currently being adopted as a national standard in South Korea. QTI is currently the focus of a major collaboration between the K-12 and higher education segments in the Netherlands. For the past 5 years, QTI has been the most frequently downloaded specification from the IMS web site – featuring 1000's of downloads per year. The Onyx assessment platform from Germany features a full open source implementation of QTI v2.1 (see http://www.bps-system.de/ for more information).

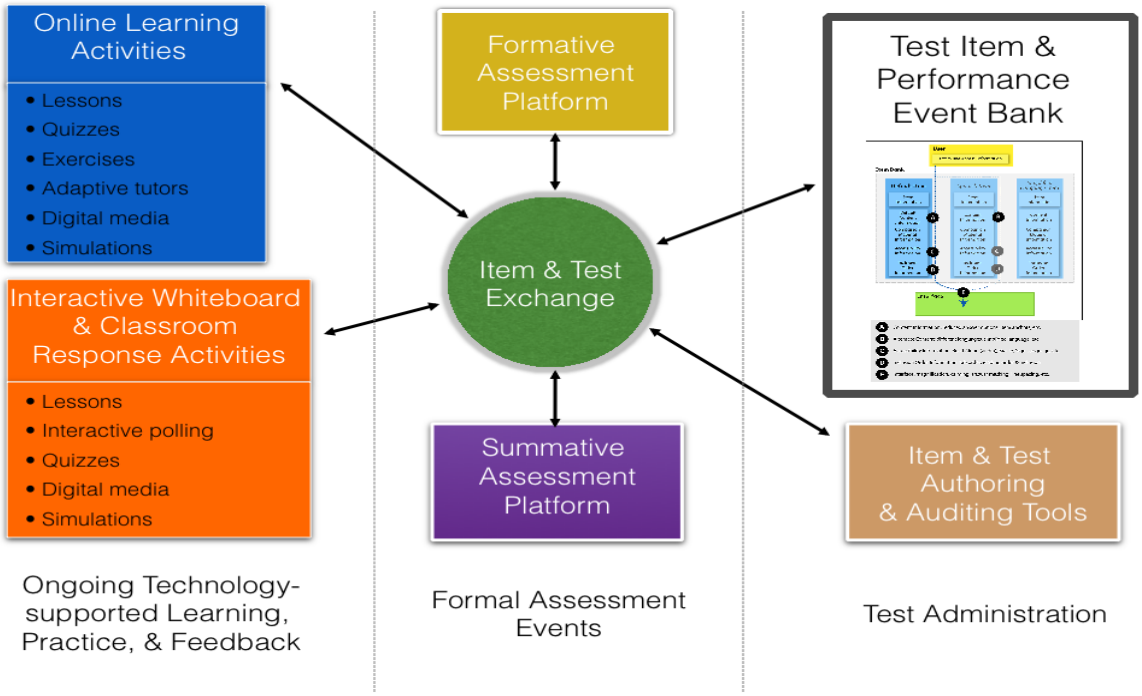
With APIP, and also with the public final version of QTI v2.1.x in early 2011, IMS will provide conformance testing and conformance marks that will provide tracking of the number of conformant products (those that go through the conformance testing process

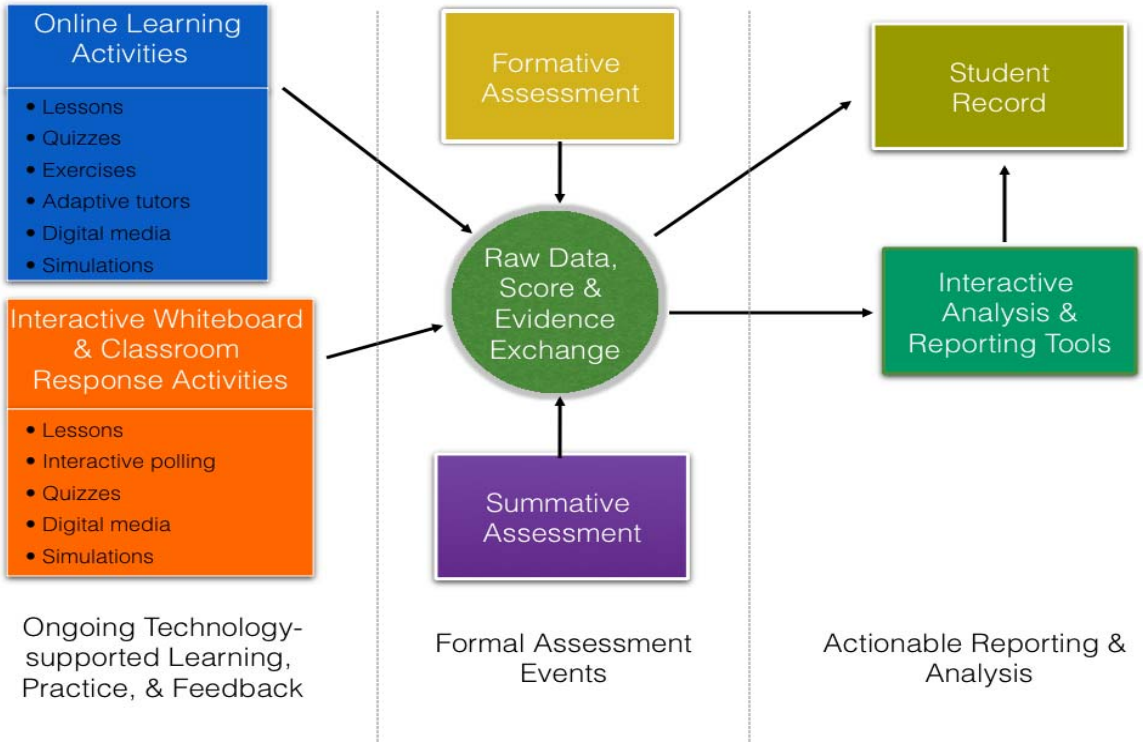
– however, the process is voluntary – IMS cannot force suppliers that use the specifications – which are free – to go through the conformance testing process). This is possible because both APIP and QTI v2.1.x will provide "conformance profiles," that is, constrained subsets of the wider specifications that can adhere to stringent testing, which have not been previously available for QTI. Please see the answers to 3.2.2, 3.2.5, and 3.2.6 for an in-depth discussion of the role of conformance testing.

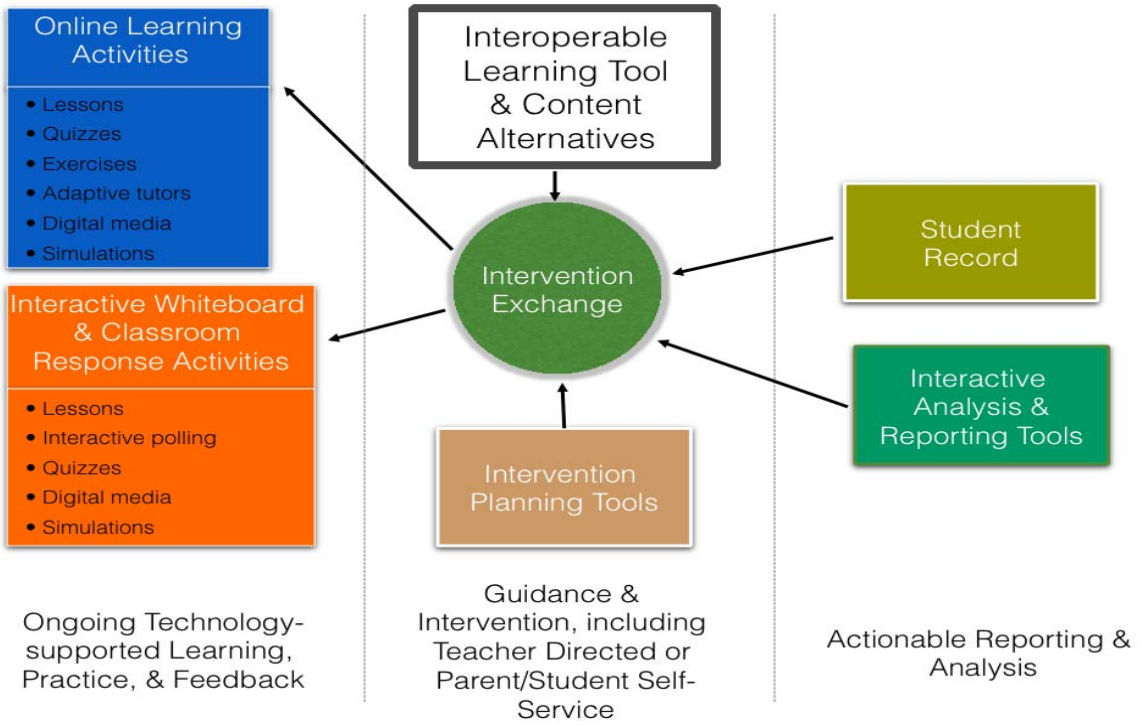
QTI v1.2.1 also has a conformance profile included as part of the IMS Common Cartridge – which, as a newer IMS specification, does include conformance certification. The products shown on the Common Cartridge conformance matrix page that are Common Cartridge compliant can run an interoperable version of QTI v1.2.1. See the conformance matrix here: http://www.imsglobal.org/cc/statuschart.html

The conformance matrix shown at the above URL is also significant because it relates to the critical issue of supporting assessment interoperability throughout an "integrated system of instruction and assessment" which is required to support the balanced assessment requirements of the Common Core State Standards (CCSS) and achieve the potential of RttTA. In order to achieve use of interoperable assessments throughout formative, summative, and intervention strategies, interoperability must go beyond item and test interoperability. Diverse digital learning content and applications must provide interoperable results reporting that enables a diagnostic student record created from data that comes from a wide range of formative and summative tools. And, interventions must adapt based on the same interoperable data.

The range of interoperability requirements to support the Common Core and the RttTA projects are depicted in the following series of three figures.




Online Learning Activities
• Lessons
• Quizzes
• Exercises
• Adaptive tutors
• Digital media
• Simulations
Interactive Whiteboard & Classroom Response Activities
• Lessons
• Interactive polling
• Quizzes
• Digital media
• Simulations
Formative Assessment
Raw Data, Score & Evidence Exchange
Summative Assessment
Student Record
Interactive Analysis & Reporting Tools
Ongoing Technology-supported Learning, Practice, & Feedback
Formal Assessment Events
Actionable Reporting & Analysis


Online Learning Activities
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Interactive Whiteboard & Classroom Response Activities
• Lessons
• Interactive polling
• Quizzes
• Digital media
• Simulations
Interoperable Learning Tool & Content Alternatives
Intervention Exchange
Intervention Planning Tools
Student Record
Interactive Analysis & Reporting Tools
Ongoing Technology-supported Learning, Practice, & Feedback
Guidance & Intervention, including Teacher Directed or Parent/Student Self-Service
Actionable Reporting & Analysis

The IMS Common Cartridge and Learning Tools Interoperability (LTI) specifications were designed to enable a vendor-neutral platform to enable interoperability of assessment and learning systems and tools. For instance, using LTI, a wide array of formative assessment and homework applications can be used as part of the assessment process and also be used to assign interventions from summative events. LTI provides the interoperability protocol to report results in QTI format, and, most importantly, make it easy for a district or state to "plug-in" tools from diverse suppliers that are seamless for the teachers and students. Common Cartridge plays the same role with respect to digital content that comes from a wide variety of educational publishers or other sources. Thus, the combination of APIP, QTI, Common Cartridge, and Learning Tools Interoperability enable a full set of interoperable assessment and interventions throughout the student experience.

Please see the answer to 3.2.12 for a discussion of how results can be captured and accumulated into a "diagnostic student record" across the range of formative, interim, through-course and summative experiences.

3.2.2 Timelines. Approximately how long would it take for technology standards setting and adoption processes to obtain a technology standard that meets many or all of the features or requirements described in this RFI? What are the significant factors that would affect the length of that timeline, and how can the impact of those factors be mitigated? More specifically, would the acquisition of existing intellectual property (IP), reduction or simplification of specific requirements, or other strategies reduce the time required to develop these technology standards and processes?

Before delving into the answer for this question it should be noted that there can be a wide range of interpretations of the term "technology standard." At one end of the spectrum, an XML schema or an application programming interface (API) could each be "claimed" to be "a standard." However, most interoperability standards consortia or bodies would not consider these adequate to achieve strong interoperability in practice across a wide range of programming platforms.

For instance, in the first case, some organizations simply publish XML schemas for various data "objects," claiming that these provide enough information for interoperability. However, the overwhelming majority of specifications and standards setting bodies around the world, including IMS, know that a schema by itself does not provide enough information for interoperability. Robust interoperability specifications must describe what applications need "to do" with the data represented by the schemas in a wide variety of "use cases." These use cases and the resulting data interactions (and thinking through them) define the functionality that is ultimately obtained through the interoperability specification – such as the ability to exchange and analyze item statistics. Years of experience of standards organizations has shown that publishing of XML schemas that are not thoroughly vetted and tested with well defined use cases across a wide variety of programming platforms will result in weak interoperability in practice.

In the second case, any number of vendors will claim that their APIs establish open specifications. While in many cases these provide a starting point for open specifications, the obvious issue is control by a single vendor and to what degree will other market participants converge on and agree to use them. The other major issue is that by definition an implementation in only one programming language or framework cannot be a standard. A standard needs to be neutral with respect to the implementation approach so that it can support a diversity of implementation platforms now and into the future.

Market share leaders, such as Apple, Amazon, and Google have used their leadership in segments outside education to establish dominate APIs that are compelling to use because of the large market that partners can tap into. Sometimes these types of activities can lead to specifications and standards that are managed by standards bodies

once they become mature. Adobe PDF is an example of a vendor specific work that has evolved to an ISO/IEC standard. However, most often such activities remain controlled by a single vendor as part of their "platform strategy" to help dominate a market. IMS and other well-established standards bodies have defined processes by which suppliers can bring forth their intellectual property into a community process that protects end users from that supplier having an unfair advantage. However, given the success of companies like Google and Apple in permeating their proprietary "platform strategies," these large organizations typically will not engage in a standards process unless compelled to do so. In the education segment, the U.S. Department of Education and other government entities around the world can help to bring great efficiency and innovation to the market by helping to influence large suppliers in supporting the education segment by being willing to participate in standards activities.

Standards consortia, such as IMS, rely on a member-based community process to develop and bring to market specifications and standards. While this process is not appealing to some organizations, especially those that feel they can establish a de facto "standard" with their proprietary approach, or otherwise short cut the process, it has several admirable features. First, it requires industry organizations to show commitment by bringing resources to the process. Therefore, it is easy to tell how much commitment there really is in a set of standards by simply looking at the investment being made in it by the contributing organizations. Second, the process requires all participants to play by the same rules, including protecting against an IP (Intellectual Property) advantage of any party. Third, each participating organization has one vote, regardless of size. Fourth, if the preceding features are managed correctly, the resulting specifications enable new market participants and innovation from a wide range of suppliers. This is enabled because the resulting work is freely available community property that any organization can exploit to lower the barriers to market entry. Finally, standards consortia that feature high quality work often have their specifications adopted by other specification and standards bodies around the world. IMS has uniquely distinguished itself among a plethora of organizations developing specifications, standards, and reference models in learning technology by being the only organization that has had its work adopted formally by ISO/IEC and the IEEE, probably the two best known "for fee" standards publishing authorities worldwide. This reflects the high quality of IMS work.

However, because standards consortia have well-defined processes, working in a standards consortium can sometimes frustrate those that would prefer to simply "do it their own way." However, there are few, if any, examples of standards, de facto or otherwise, created by "fiat" that have succeeded in the market, other than the aforementioned efforts by large suppliers with a significant market share advantage. A professionally managed standards process does not enable a single organization or a few individuals to coopt the process for their advantage. Again, it is very easy to determine which standards consortia are meeting the market needs as they will garner more investment from their member organizations. A large number of organizations will typically not invest substantial resources into a voluntary process that is not balanced and not providing a level playing field. Therefore, successful standards activities and consortia must be able to achieve high quality technical work and also attract a critical mass of support and participation from the market.

Finally, it is important to distinguish between consortia that involve a contractual relationship between each member organization and the standards organization and those that do not. There are numerous activities around the world where parties come together and claim that they are developing "standards" or "specifications." However, if there is not a legal contract between a participating organization and the standards organization then there is no way for the standards organization to enforce the balanced process. Substantial standards organizations such as IMS can, for instance, sanction members if there is an apparent violation of the rules.

With that as background to how standards consortia operate, we will now address the time required to develop a quality, strongly supported, interoperability specification or standard.

There are several factors that require "time" in the development of quality specifications that result in high levels of interoperability. We first describe the phases of an interoperability standards development from scratch. We then describe a streamlined process that can be achieved based on the application of existing specifications, such as is occurring with APIP currently. This later scenario is the one that can be followed to meet the needs of RttTA. But, we describe the full process for the edification of the Department of Education.

First, a **critical mass of motivated market participants** must be gathered and then agree upon the scope of what interoperability problem they are attempting to solve. The term "critical mass" should be interpreted as including some number of organizations generally perceived as market leaders and having the resources and intention to follow through on the implementation of the specifications. This first phase can complete in a relatively short time, perhaps 60 days, if the proposed activity is well defined to start. If it is not well defined, this first phase may take much longer. In addition, the more global the scope of an activity, the longer it will take. Therefore, good judgment must be used in terms of choosing the scope.

Second, there must be enough time for technical experts from the organizations involved to do the **technical work required to formulate the specification**. Historically, even under the most favorable circumstances, this process needs about one year to complete the technical work and come to agreement. This is true even if a substantial amount of technical work has already been completed upfront because it is the process of agreement and synchronization among the parties involved that takes time. However, this does not mean that it takes a year before some benefits of the standards development activity begin to accrue to the industry. If the specification development activity involves real commitment from the involved partners, they are typically "building" prototypes, and in some cases, shippable products that contain the initial attempts at the standards. This early prototyping is required, along with consortia-sponsored testing demonstrations, to see if the desired level of interoperability can be achieved in practice. Such demonstrations also help to garner interest from the many industry organizations that may be watching to see if the proposed work is viable. This second phase is completed when a draft specification, backed by prototypes that demonstrate viability and commitment of some leading market participants, is ready for release to a wider audience to gain more serious and committed implementers.

Third, **a conformance testing approach must be refined and finalized**, based on the input from the committed implementers. The time required to develop the tests, test software, code libraries, or other tools needed to support conformance testing depends greatly on the scope of the standard. The more complex the specifications, the longer it will take to develop conformance tests that are effective. The goal here is to provide tools that allow organizations to self-test their implementations and if they "pass" achieve a high level of certainty that they will in fact work with other interoperable products. It is up to those implementing organizations that are most committed to a standard to bring resources that will help make this happen. This third phase may require a couple of months to a full year or more to complete. In the IMS process implemented since 2006, IMS typically releases conformance testing of complex specifications in phases. This allows the market to adopt core pieces first and then evolve to greater complexity. It should be noted, however, that the best pieces to start with are not readily obvious until after the more complex, full specification has been developed and prototyped to some level. This provides an "architecture" within which the phased release of components can fit.

It is IMS's philosophy (since 2006) that specifications in our segment must start providing a much higher level of quality and much higher level of support for conformance before they should be considered mature enough for "public draft" status (the point at which the public is invited to invest resources reviewing and building). This is because the education industry and e-Learning industry have been fraught with numerous specifications, standards, and reference models that have not provided strong interoperability in practice. As a result, the usefulness of these specifications, standards, and reference models has been very limited in practice. There has been much investment in obtaining conformance certifications to achieve qualification for RFPs that have requested them, but which have not resulted in strong interoperability. This systemic problem has greatly reduced the credibility of e-Learning and educational technology specifications to the point where the majority of suppliers generally stay uninvolved in such activities until forced to achieve compliance for RFPs, as noted. The net result is a large number of "conformant" products that do not interoperate. Therefore, since 2006, IMS has set a much higher bar in order to meet the needs of the marketplace, and to rebuild the confidence that market participants have in interoperability specifications. Common Cartridge was the first standard in our industry that met this high bar. Next has been Basic Learning Tools Interoperability. APIP and QTI will be next.

In the IMS process, conformance is typically finalized in conjunction with the "public draft" phase in which the public can fully participate in implementing and providing feedback. Once this third phase is completed, the documents are voted upon to achieve "final public" status. This designates an approved version of a specification that can be fully supported for strong interoperability and evolved going forward based on market needs.

The fourth phase is the **ongoing maintenance and revision and professional development to support adoption** of the specification and all supporting materials based on usage subsequent to achieving public final status. This is an ongoing process that requires a strong governance process and the participation of market-leading,

committed organizations. Specifications that are useful to the industry will have a long evolution. Therefore, the maintenance and revision phase for a popular specification is just as intensive in many respects to the initial development over a period of many years. New versions that include new functionality will need to go through the same steps outlined above, albeit in an abbreviated time frame (again, depending on the scope of such new versions). "Bug fixes" can occur in a much shorter time frame – within days, weeks, or months, depending on the severity. Management of backward compatibility is a major issue.

The fifth phase is the possible **adoption of the consortium-developed standard by other standards organizations** to improve the reach and distribution even further. As mentioned earlier, IMS has achieved adoption of some of its specifications by ISO/IEC and IEEE. IMS's current philosophy is to work primarily with ISO/IEC as the organization that can publish IMS standards with the involvement of leading national bodies from around the world. Working with such bodies for adoption of specifications can typically take two years or more. However, very little is typically changed during the process. Most changes involve enhancement for globalization and harmonization with other related specifications. A very high quality specification "going in" is required in order to be fully accepted. Support for IMS specifications in a venue such as ISO/IEC provides further evidence that IMS work is used around the world by many organizations and countries that have never formally participated in IMS directly.

One can see from the above set of process requirements that a high quality specification that has significant industry support can take two or more years to achieve public final release if done from scratch. More importantly, the specification support processes must be in place for the long term. Please note that the time factors for initial development have everything to do with establishing a committed community in a very bottoms-up approach. It is this cooperative element that takes time. A single industry organization, such as Google (or any single vendor), can develop its own "standard" in probably half this time and attract a large number of participating organizations – as described above – however, with significant non-competitive ramifications.

In terms of reducing time frames to achieve high quality standards that meet the needs of the RttTA, the participants are very fortunate to have the existing APIP and QTI work to draw from. While the same steps as detailed above are required, times can be significantly reduced because what is involved is the "profiling" or "tailoring" of existing specifications. The specifications involved in APIP already have tens of millions of dollars of investment in development and conformance support. The other key element is that the specifications involved already have a high degree of industry awareness and implementation experience. In addition, the eight states involved in APIP have already been working for over a year on key scope issues. **Therefore, it is very possible to mold the APIP and QTI evolution process around the timeframes needed for the RttTA projects.** It is very likely that a strong base of industry organizations will participate given the importance of the projects.

In addition, the technical work required to finalize the specifications can be accelerated further by securing funding for consortium staff to do much of the work that we might normally be dependent on industry organizations to do. The use of qualified consortium staff to do much of the technical work accelerates the time between review

cycles and also provides expertise on bringing specification pieces together that have traditionally been worked on by separate work activities within the consortium. This is exactly what has happened in the case of APIP where a small investment in IMS technical staff to pull together the technical work resulted in three IMS specifications being applied to the APIP standard. The resulting work leverages the conformance testing software already paid for by the IMS members for use with those existing IMS specifications. **As a result, IMS could begin providing conformance testing for APIP in 30-60 days, and is already proceeding to set up an APIP conformance process and community.**

Evolving APIP to the needs of RttTA requires very close interaction with willing participants from the RttTA consortia. This is so IMS and the interested IMS membership can make sure to tailor the IMS work appropriately. The caution here is against developing the interoperability standards separately from the RttTA projects and then forcing the work upon them. The U.S. will achieve the best results by bringing the work of the RttTA projects together with the appropriate standards consortia to fulfill their needs in a pragmatic fashion. By working with the standards consortia the underlying specifications will also be improved. As it relates to APIP and the evolution of APIP, much attention will need to be given to the scope of what can be supported in the standard, versus supported as "extensions." For instance, the way in which innovative item types are supported via standards will need to be considered carefully. Some innovative item types may be supportable using QTI (content interoperability), others may be best supported using LTI (application interoperability). These options are discussed further throughout this RFI response.

Government entities can provide strong incentives to accelerate the processes of all types of standards activities by simply being involved in the process and representing a strong requirements perspective. Many leading government organizations from around the world participate in IMS in this way and sometimes provide technical support as well. One of the challenges with the U.S. system is a lack of funding sources for state leaders and technical staff to become involved directly in standards activities. The APIP project has shown that a small amount of federal grant investment supporting state run activity can create enormous leverage and rapid progress. Additional U.S. federal support to continue the state collaboration already established in APIP would be a wise investment going forward and ensure the resources needed to help the APIP states continue their collaboration.

3.2.3 Process. What process or processes are appropriate for the adoption, modification, or design of the most effective technology standard in a manner that would answer many or all of the questions in this RFI? We are interested in learning the extent to which the uses of one or another process would affect the timeline required to develop the technology standards.

The process asked for here is already discussed in the answer to the previous question. In general, the process time for a community process is related to the number of committed and serious organizations involved in the implementation. This is because if more parties are directly involved it generally takes more time to coordinate an approach that works for the majority. The process to achieve a high quality standard also requires iteration – which is why a critical mass of committed parties is essential over an extended period of time. Drawing from a body of existing work, as has been the case with APIP, significantly decreases the time required if all the other process requirements are still met. However, a quality specification development process must go through the process phases laid out in the previous answer. There are no substitutes for these phases.

For the RttTA requirements, the APIP standards could be used to establish initial conformance requirements almost immediately. Evolution of the current version of APIP may be required to include some additional scope as needed to achieve the full set of interoperability requirements shown in the diagrams in the answer to 3.2.1, to fully achieve the potential of the Common Core State Standards. **However, the majority, if not all of the evolution is based on existing specifications and can be completed in 6-18 month timeframe, depending on funding sources available and cooperation of the RttTA consortia.** More details can be provided upon request.

In addition, Common Cartridge and Learning Tools Interoperability are available for immediate use by RttTA with very strong adoption in industry. Any evolutions of these specifications for the needs of RttTA are expected to be straightforward.

In summary, IMS already has in place rapid and high quality processes for adapting the IMS work for the needs of RttTA. This can be done with a minimum of taxpayer investment and in a completely sustainable fashion. The role of the Department of Education that would be most helpful is one in which the Department promotes the availability of the standards and provides input in terms of the requirements to supplement that being received by the RttTA consortia and APIP states. A small amount of funding to support end-user gatherings and IMS staff would help to accelerate the work, as was the case with APIP to date.

3.2.4 Intellectual Property. What are the potential benefits and costs to the Federal Government, States, and other end-users of different IP restrictions or permissions that could be applied to technology standards and specifications? Which types of licensed or open IP (e.g., all rights reserved, MIT Open License, or Gnu Public License) should be considered as a government technology standard? How should openness relating to the IP of technology standards be defined and categorized (e.g., Open Source Initiative-compatible license, free to use but not modify, non-commercial use only, or proprietary)

The primary threat to open use of standards is the potential violation of intellectual property (IP) that may be violated in implementing the standards, primarily patents or licenses. Many standards consortia around the world, including IMS, have gone to great expense to adopt formal IP rights (IPR) policies that make "a best effort" at protecting implementers and users of consortium-developed interoperability specifications from licenses or patents that might potentially underlie an open specification. These IPR policies have very specific procedures that workgroup participants must follow so that they cannot "game" the standards-setting process - a term used to describe how one participant may eventually charge for use of their underlying IP or in some other way restrict the use of the standard. Such processes require those involved in developing a standard to make specific pledges with respect to any IP they may be contributing to a workgroup – so that the members can consider such pledges in approving or disapproving the work. They also require participants to disclose any IP that they are aware of that may cause users of the standard to infringe upon IP, such as patents or licenses. Each reader of the specification is also requested, albeit on a voluntary basis, to submit any IP violations they might be aware of. In other words, there is the distinct possibility that a specification may violate IP that does not originate from any of the project participants. The IMS IPR policy is available to the public here:

http://www.imsglobal.org/ipr/imsipr_policyFinal.pdf

Note that in order to enforce such a policy, there must be a contractual relationship between the participating organization and the consortium as noted in the answer to question 3.2.2.

The above issue is the primary IPR issue that those who get involved in standards consortia or use the works of standards consortia are concerned with, including government representatives. Such policies are only a "best effort" – it is generally not considered possible to know for a fact that an interoperability specification will not impinge on some party's IP, because the possibilities are not all known. But, such policies are the "state of the art" with respect to standards development and most large corporations will not participate in a standards development activity or use a standard that does not include such protection. Having such a policy in place is absolutely essential to a sustainable open standards activity that is free from IP threats. When a group of industry leading organizations comes together under an IPR policy it is

extremely difficult to imagine a situation where the work will be successfully challenged in terms of IP violations. Industry leaders bring a wealth of industry knowledge and IP portfolios that can be used to defend the openness of standards developed by the consortium.

While one might think that minimizing IP threats could come simply from the individuals or organizations participating in a specification development activity making IP pledges, this is not the case. This is because, as discussed above, IP threats can come from many potential sources, including those not involved. Therefore, the strength of a standards consortium that features participation and commitment by industry leading organizations is an essential protection for open standards.

A less significant issue in the IP realm is the IP claimed on the specification documents themselves. Almost all interoperability specifications worldwide are published under the copyright of the standards organization that produced it. IMS follows this policy. For specifications whose purpose are interoperability, copyright appears to be the most appropriate vehicle, as having specifications that can change has large ramifications on interoperability and the resulting confidence that market participants have in it. It should also be noted that interoperability standards published by IMS have a built in capability to be tailored for a wide variety of purposes. IMS standards are widely used around the world because they are easily extensible and customizable. IMS standards typically include many defined ways to extend them and also many fields that can be designated as optional. These features and processes are discussed further in the answer to 3.2.5.

However, IMS believes that a simple copyright by itself is too restrictive and does not promote the type of distribution and open community engagement we wish to see around the world. Therefore, IMS also provides a click through license that provides additional rights to redistribute the IMS specifications (which would not be permitted under a normal copyright). In return for this privilege the license requests that implementers of an original product that incorporate the specifications to register into the free IMS public community. The purpose of this is to help understand who are the users of IMS specifications. There are thousands of IMS specification downloads every year and yet we have only 160 member organizations. A majority of users of IMS specifications are not IMS members. Therefore, knowing who the users are can help us provide support and otherwise address their needs. The IMS license does not restrict usage by product companies, including open source providers, and end users. To prove this point, IMS has a very strong base of support from open source products around the world.

While IMS generally follows the lead of larger standards consortia on such issues, IMS has also been a leader in experimenting with Creative Commons type licenses for the specifications. However, as discussed previously in this RFI response, achieving strong interoperability in practice has been the most significant challenge in the educational technology and e-Learning segment. Organizations that are serious supporters of interoperability consortia want processes that are optimized to achieve strong interoperability and that the market can readily support. Publishing specifications that can be changed significantly by any subsequent party is not consistent with achieving strong interoperability. Strong interoperability implies a final authority on the work.

However, IMS will continue to experiment with possible approaches that may improve dissemination and interoperability. IMS is open to any process that will improve results in the marketplace.

Deviation and derivation of IMS work, however, have not been lacking. It happens everyday around the world. Local or even individual supplier customization of IMS specifications is very active. "Googling" of various IMS specifications reveals significant activity on many IMS specifications around the world. Sadly, there has been relatively little feedback back into the standards consortia from such activities, such as the type of feedback that an open source community engenders. This is because the users of specifications are using the derivation capabilities built into the specification – and they may generally see a specification as a device to solve a current problem, rather than something that they need to be involved with on an ongoing basis. The answer to question 3.2.5 references the open community profiling process that IMS has invested in to enable community profiling with direct feedback to the consortium. In general, IMS feels that our current processes provide good incentives for industry participants to stay involved in the standards activities over the long run. This is absolutely essential for sustainability of standards developed for emerging technology markets. The need for evolution is a certainty in such situations. This is the case for educational technology today, including assessment.

It cannot be overemphasized that the education technology segment must address some past systemic problems associated with standards development activities that are more beneficial to the individual participants in the standards activities than to the industry at large. In other words, there has been a plethora of standards development activities, mostly staffed by consultants who did not represent major industry participants. It should be noted that a position that standards should be free of copyright is very advantageous to consultants. A proliferation of derivative works means a proliferation of standards setting activities that consultants are paid to monitor and participate in. This can include working on the same specification in many different activities around the world. A proliferation of standards activities provides the appearance that progress is being made with standards. However, a proliferation of non-interoperable derivative works is a serious disincentive to segment participants, who find it more difficult to achieve the primary objective – interoperability. And, a proliferation of such activities provides no long term sustainability for the standards themselves, only for the individuals who are expert at following them. A proliferation of non-interoperable derivative works also means the need for more consulting time to help with the implementation of the resulting non-interoperable products that are bought. Creative Commons or other alternatives more liberal than copyright enable the "business model" of consultants – namely that everything else should be free except the cost for their services. Standards consultants will often voice the opinion that they should have free, open access to all standards activities being performed in any organization at any time. Again, this provides an advantage to consultants who can provide paid for services for monitoring the work of many standards organizations.

While the voice of independent experts is certainly one that should be heard during the appropriate public review periods or otherwise sought out, the educational technology space needs more active leadership from leading supplier and end-user organizations

providing experts who are actually market participants (as opposed to standards consultants). This includes government organizations. Standards development must be open to the voices of individual experts. But, this does not mean that anyone is an expert. Effective experts need to represent organizations that are stakeholders in the market and have significant experience in the domain. Experts who primarily represent understanding of specifications to support their own interests in being paid to develop specifications or consult on interoperability projects are not sufficient to move the industry forward. Therefore, standards organizations must provide processes that not only protect against an unfair advantage being obtained by a major supplier, but also a consultant who, while perhaps well intentioned, has some naturally occurring conflicts of interest in maintaining their own source of revenue. IMS believes that we have made enormous progress in attracting a much more balanced set of participants to our standards activities by putting in place process checks to ensure there are market-leading, committed participants in all phases. If this cannot be achieved, we do not pretend to have a viable standard. We go back to the drawing board and find out where the problem is.

The conclusion of IMS to these situations is the same as the vast majority of highly effective standards consortia around the world. A standard copyright on specifications seems to be the best policy to date to engender the interoperability that our members hold IMS responsible for. Copyright also enables explicit agreement among standards organizations in terms of derivative works. This seems to work well for the needs of interoperability specifications and the health of interoperability consortia in general. Standards consortia should partner when there is a clear win-win for both organizations. IMS has many such agreements that establish strong partnerships among standards organizations. Ultimately, this serves the consortium members well because it results in a very directed body of work with strong interoperability characteristics. It also avoids confusion and minimizes the possibility of legal dispute in the future. However, IMS will certainly evolve our processes if more effective ones emerge that produce better results.

Finally, in the experience of IMS, it is not unusual for governments to openly publish work that have been procured by government for the good of the public. For instance, Becta has published certain works under an open license:

http://www.nationalarchives.gov.uk/doc/open-government-licence/

Such as license makes sense for works that a government has procured and can legitimately claim to have a majority ownership stake in. This has certainly not typically been the case with industry-developed standards in the past, since sustainability of a standard means that the industry must "own it." Even if a government was to entirely fund a standards development activity of some sort, if would typically make sense to then partner with an established standards consortium to achieve greater industry participation and sustainability. Becta, for instance, has in fact promoted this approach in working with IMS (it should be noted that Becta was a member organization of IMS while it was still functioning).

3.2.4.1 Existing Intellectual Property. What are the IP licenses and policies of existing assessment technology standards, specifications, and development and maintenance policies? Are the documents, processes, and procedures related to these IP licenses and policies publicly available, and how could the Department obtain them?

The previous answer addresses the issue of standards-related IP. In terms of the policies and procedures of IMS, IMS provides the following documents online for public access.

Certificate of incorporation:

http://www.imsglobal.org/certificateofincorporation.pdf

Bylaws:

http://www.imsglobal.org/IMSbylaws2004.pdf

IMS IPR (intellectual Property Rights) policy:

http://www.imsglobal.org/ipr/imsipr_policyFinal.pdf

Information on the IMS Copyright and License:

http://www.imsglobal.org/usingimsdocuments.cfm

IMS member organizations must sign a legal contract that expresses the willingness to abide by these processes.

The Department of Education may also find the resources made available by Gesmer Updegrove, LLP (IMS legal counsel) useful in regards to understanding how specifications and standards activities operate and are organized:

http://www.consortiuminfo.org/

3.2.5 Customizing. Can assessment tools developed under existing technology standards be customized, adapted, or enhanced for the use of specific communities of learning without conflicting with the technology standard under which a particular assessment tool was developed? Which technology standards provide the greatest flexibility in permitting adaption or other enhancement to meet the needs of different educational communities? What specific provisions in existing technology standards would tend to limit flexibility to adapt or enhance assessment tools? How easy would it be to amend existing technology standards to offer more flexibility to adapt and enhance assessment tools to meet the needs of various communities? Do final technology standards publications include flexible IP rights that enable and permit such customizations? What are the risks and the benefits of permitting such customization within technology standards? When would it make sense to prevent or to enable customization?

Generally speaking, IMS and other leading standards consortia's published works do not restrict implementations of products. To achieve conformance marks, products must pass the appropriate tests. But, submitting to conformance testing is voluntary. And, if a vendor decides to go in a different direction than the standard, then the standard consortium has nothing to say on that – other than the vendor should not misrepresent their work as being compliant to the standard. If the vendor decides to implement functionality above and beyond the standard – such as additional APIs or functionality – the standards organization has nothing to say about that. The work of IMS makes no claims on any product implementation. IMS simply provides guidance on how to implement and conform to IMS standards and that is all IMS is concerned with. IMS serves as the conformance authority on IMS standards only – anything above and beyond that is the supplier's choice.

Therefore, implementing the standards does not limit innovation. The standards provide a "greatest common factor" of interoperability to which the majority of the market can conform. It is hoped and expected that suppliers will innovate above and beyond the current standard. Some of those innovations may eventually be folded into a standard as it evolves. So, vendors can use interoperability standards and still be free to innovate. For example, while APIP prescribes an exchangeable format for assessment items, suppliers will have many ways they can distinguish their assessment platforms, using the exact same data. For instance, while any APIP compliant platform will be required to support certain accommodations, how they support them may be more innovative in one platform than another. IMS is expert at drawing the line at what is essential for wide spread support for interoperability while leaving room for product innovation over and above the standard. Having processes for working with industry to understand where this line needs to be drawn and how it evolves over time is something that IMS is expert at.

In addition, IMS standards are widely used around the world because they are easily extensible and customizable. IMS standards typically include many defined ways to

extend them and also many fields that can be designated as optional. IMS has invested significant resources to enable any party to extend an IMS standard and publically post it for all potential users. See:

http://www.imsglobal.org/profile/

IMS has encouraged this because it is a way for the IMS community to benefit from such customizations. Such experimentation and customizations help IMS to determine where the greatest common factor of interoperability exists and how to enable a platform for distributed innovation in terms of emerging tools.

IMS has also legally partnered successfully with many other standards and government organizations around the world. Such partnerships typically involve an agreement to cooperate to evolve a body of work for the mutual benefit of the stakeholders of both organizations. IMS provides information to the public on what our policies are and why they are set up in the way they are:

http://www.imsglobal.org/usingimsdocuments.cfm

IMS has numerous government organizations outside the U.S. who have scrutinized the IMS polices and procedures and have deemed them to be acceptable. IMS has federal government-sponsored organizations that are voting members in Australia, Europe (pan-European partnership of European ministries of education), New Zealand, Norway, South Korea, The Netherlands, and the United Kingdom.

Government working with IMS provides high leverage and a sustainable model for innovation. For instance, SCORM has benefitted from extensive use and customization of IMS specifications (much of the SCORM specifications are word for word extractions of IMS specifications). However, in recent years the U.S. Department of Defense Advanced Distributed Learning Initiative (ADL) has chosen not to engage in IMS. As a result, IMS work has greatly surpassed SCORM with respect to the innovation needs of the education segment, driven by a whole new generation of technology, and is seeing a large upswing in adoption versus SCORM in the education segments worldwide. IMS believes that is has been able to successfully leverage the investment made in IMS specifications from organizations around the world and the lessons learned from SCORM. In this way, IMS and other standards consortia like it, provide a very valuable public service that sustains the specifications well beyond the needs of any one government project. Therefore, when government organizations engage in standards consortia they are truly contributing to the public good in a sustainable way with minimal requirement for taxpayer investment. These are best looked at as long term partnerships.

Therefore, whereas customization can occur outside the standards venue, it is questionable that this is the most effective and efficient way for government entities to operate. We feel that it is important to point out, in these challenging economic times, that government working with IMS (and other standards consortia) is substantially more efficient in terms of taxpayer investment than creating new government managed standards activities. It also needs to be noted that government projects are typically devoid of the required intellectual property protections (for end users of the standards),

clearly designated processes, voting rights, and sustainable models that standards consortia already have in place and are expert at managing. IMS offers a full lifecycle of activities around standards development, adoption, professional development, maintenance and evolution that are sustainable without major or recurring taxpayer investment. This includes making sure that new releases are backward compatible with previously adopted work. IMS has all the processes in place to provide strong interoperability and backward compatibility, while enabling experimentation in terms of customization. Supporting such activities requires a robust, ongoing investment.

It should also be noted that there are many cases of competing derivative works going on within standards bodies. Larger standards organizations such as the IEEE and ISO/IEC typically have many strands that are competing. For instance, there have been and are many competing standards in the IEEE that build off of network standards such as TCP/IP or UDP. In other words, competition in standards has not been in any way restricted by standards organizations policies and procedures. Standards organizations maintain a fair process in which healthy completion can occur that is eventually decided by the marketplace. Therefore, derivations can be pursued within the standards organizations themselves. Open standards consortia, such as IMS, are committed to supporting healthy competition on a level playing field. This includes competition in standards, as well as the products that support them.

3.2.6 Conformance and Testing. Do existing technology standards or technologies include specifications or testing procedures that can be used to verify that a new product, such as an assessment tool, meets the technology standards under which it was developed? What specifications or testing procedures exist for this purpose, e.g., software testing suites, detailed specification descriptions, or other verification methods? Are these verification procedures included in the costs of the technology standards, or provided on a free or fee-basis, or provided on some combination of bases?

All IMS specifications worked on from 2006 forward have detailed conformance requirements developed and documented as part of the process (as explained in the answer to 3.2.2). The lack of strong interoperability has probably been the single most negative factor in achieving high rates of adoption of standards and specifications in the education segment. In the final analysis, specifications must deliver on interoperability while making life easier for the implementers and users of the specifications. IMS has found that the industry does not believe that the conformance certifications provided from other standards efforts in our segment have been adequate. Therefore, as explained in the answer to 3.2.2, IMS has invested heavily in providing both development support and conformance testing to achieve strong interoperability in practice.

IMS has historically been a very forward-looking organization in that IMS specifications are typically attempting to enable significant types of new interoperability that can enable new product categories or expansion of existing product categories. For this reason, IMS has featured the involvement of some of the world's leading learning technologists and their supporting organizations. Agreeing on conformance testing specifics for forward-looking specifications can be difficult because there may not be a critical mass of implementers ready to "go to market." IMS has addressed this challenge by working to establish conformance testing at the appropriate phase in the lifecycle of a specification. Many of the IMS specifications that feature strong conformance testing today are based on years of prior implementation experience that has now attracted a sufficient number of supportive organizations. We believe we have reached this phase for QTI and APIP.

For the needs of RttTA, as discussed previously in this RFI response, IMS is in the process of rolling out APIP conformance testing and can easily adapt the process as needed within a few months time. APIP conformance testing will include the following components:

- Automated software facilitated conformance validation of APIP items and tests using IMS's public and free online validator – see http://validator.imsglobal.org/ - that was developed with and is supported by IMS member investment
- Conformance self-test sequences for valid and invalid items and tests to designate delivery platform conformance

- Conformance self-test sequences for valid to designate authoring platform conformance

All of these tests will be based on the successful Common Cartridge and Basic Learning Tools Interoperability conformance processes. They reflect a very large investment made by the IMS community. IMS will also establish an APIP Alliance (see further discussion of Alliances below) community to provide development samples and support, in addition to conformance. Alliances typically feature test harnesses of supplier-provided software to enhance the confidence of results. IMS provides ongoing maintenance and evolution of the specifications and the resulting test support.

Since 2006 the IMS membership has experienced dramatic growth. One of the reasons this growth has occurred is because IMS has become more effective at balancing its body of forward-looking work with the current needs of the marketplace in achieving strong interoperability. Conformance testing is absolutely essential to fulfilling this value proposition. In addition, ongoing support for conformance coming from IMS as a neutral party that can work across competing suppliers is absolutely essential. In November 2009 the IMS Board of Directors sent a pledge to U.S. Secretary of Education Duncan expressing a guarantee of interoperability. In response to this RFI, IMS is repeating and updating this guarantee (see pledge letter on pages 5-7 of this RFI response). IMS urges the U.S. Department of Education to seize upon this moment to become supportive of interoperability consortia such as IMS, which will only further our success in supporting the industry.

As discussed previously in this RFI response, any organization can implement IMS specifications, as they are free and are free to license. In addition, any organization can influence IMS specifications by providing feedback during various public review periods in the process. IMS allows workgroups to establish public review at the points in the process at which they are useful. However, because of the need to protect users of the specifications from IPR that may be owned by commenters, such commenters are required to submit to the IPR policy if the comments are made early on in the review process. Therefore, most public review periods typically occur when the work is near completion when fears of IPR manipulation have been lowered.

IMS provides official conformance marks for those organizations that are willing to submit to testing and participation in specification-specific communities that IMS calls "Alliances." Alliances are partially supported through very small annual dues – ranging from $250 to $3000 per year – depending on the size and type of organization. Annual dues have been established to support the Alliances because these are ongoing communities to which IMS staff provides a large amount of support. Conformance is just one thing provided by the Alliance. A large amount of implementation resources and support are also provided. The value and return on investment in joining an Alliance is very large for an organization that has serious interest in implementing a specification. The work of the Alliances is heavily subsidized by the Contributing Member organizations in IMS, which pay much larger annual dues and also contribute a large amount of voluntary time and supporting work. In return, the IMS Contributing Members have the voting privileges in IMS, including election of the governing Board of Directors. Contributing Member dues are also scaled based on size and type of organization so that small organizations are not prohibited from participating. IMS also

accepts qualified "invited experts" from around the world who have demonstrated their ability to participate effectively in standards development. This mixture of participation options provides a fair way for organizations to receive additional benefits from the IMS work for their support. Such voluntary support is critical to the success of standards. Ultimately, the support that standards organizations should be in proportion to the value they provide to an industry. Government can play a critical role in encouraging such support.

3.2.7 Best Practices. What are best practices related to the design and use of assessment interoperability technology standards? Where have these best practices been adopted, and what are the general lessons learned from those adoptions? How might such best practices be effectively used in the future?

IMS QTI and all IMS specifications include extensive documentation on use cases and best practices. These can be found available free to the public as part of each specification document series:

http://www.imsglobal.org/specifications.html

For instance, the best practices for using QTI v2.1 can be found at this URL:

http://www.imsglobal.org/question/index.html

The APIP public draft documents, including best practices, are available in a special public forum on APIP here:

http://www.imsglobal.org/community/forum/categories.cfm?catid=110&flcache=7743342&entercat=y

It is fair to say that IMS QTI is itself a best practice in assessment interoperability. QTI has been used by a majority of commercial assessment software and learning management platforms, including Respondus, QuestionMark, Blackboard, ANGEL, WebCT, Moodle, Desire2Learn, eCollege, Pearson, ANGEL, ACT, Cambridge Assessment, Measured Progress, Houghton Mifflin Harcourt and ETS. An attempt to record some of the usage of IMS QTI in commercial products is shown here:

http://en.wikipedia.org/wiki/QTI

IMS cannot endorse the accuracy of this Wikipedia article, but it does appear to record at least some of the commercial activity that IMS is aware of. QTI has each year been the most widely downloaded IMS specification as well as the most important in member surveys (in 2010 tied with LTI for the most important).

Many organizations also use QTI as an internal interoperability specification that they have adapted as needed, including ETS and Pearson. As mentioned earlier in this RFI response, because IMS has not had formal QTI compliance in place (expected first quarter of 2011), the tracking of usage has been through word of mouth only. However, it is fair to say that thousands of colleges, universities, and schools around the world are using products that contain some level of support for QTI.

As far as the needs of RttTA are concerned, there are several areas of best practice in terms of applying assessment technology standards that are emerging in discussions held to date with states and suppliers. These areas of best practice include:

1. Enable interoperability support across formative and summative assessment activities of all types.

2. Allowing both a content interoperability mechanism (such as QTI) and a "black box" application interoperability mechanism (such as LTI).
3. Moving away from costly paper-based approaches as soon as practical.
4. Including support for accessibility needs of students.
5. Carefully considering how "innovative item types" are to be supported via interoperability. The key question is are these best supported via a QTI extension approach or an LTI black box approach? It is important that the interoperability not limit innovative item types.
6. Require strong conformance testing and certification of products that a standards consortium will stand behind. This is the type of conformance that IMS is providing today for Common Cartridge and Basic LTI and plans to provide for QTI and APIP in the near future.

3.2.8 Interoperable Assessment Instruments. What techniques, such as educational markup or assessment markup languages (see also http://en.wikipedia.org/wiki/Markup_language), exist to describe, package, exchange, and deliver interoperable assessments? How do technology standards include assessments in packaged or structured formats? How can technology standards enable interoperable use with resources for learning content? How can technology standards permit assessment instruments and items to be exchanged between and used by different assessment technology systems?

IMS Question and Test Interoperability (QTI) is a "mark-up language" that was developed explicitly for the purpose of exchanging items, tests, and results and has been widely used for this purpose. QTI is by far the most used open standard for this purpose. In fact, there is no other widely recognized open standard for this purpose, There are many supplier-specific formats in use. Some are modeled after QTI and some are not. However, these are not community developed open standards and none have been vetted as suitable for broad market application. The QTI specifications are publically available at:

http://www.imsglobal.org/specifications.html

QTI is widely used and has a broad and deep experience base. For example, ETS uses IMS QTI to exchange 64,000 test items on a periodic basis with its partners serving various U.S. states.

To address the issue of including assessment content along with other digital learning materials, IMS has created the Common Cartridge standard. Common Cartridge includes a profile (a well-defined, testable subset) of QTI as one of its constituent specifications. Therefore, assessment items and tests can be included along side digital materials. This means that a wide variety of learning or course management platforms can deliver and report results from 3rd party online assessments. Common Cartridge and QTI are also based on the IMS Content Packaging specification. IMS Content Packaging is the most widely used learning content specification in the world. IMS Content Packaging version 1.2 is nearing completion as an adopted ISO/IEC standard.

Another option for achieving interoperable digital learning content that includes assessment capability is to use IMS Learning Tools Interoperability (LTI). Many suppliers favor this approach because it enables application-to-application exchange of data without the need for portability of content. Content interoperability is not always possible using standards. For instance, content may contain proprietary adaptive sequencing that a supplier sees as a key aspect of their unique value proposition. Such sequencing cannot be represented by an open standard until it becomes widely used and non-proprietary. Past attempts to define open standards for sequencing have largely failed for this reason (such as in SCORM). A better solution is to define interoperability between a launching system (like a learning management system or an assessment platform) and a 3rd party application containing the adaptive sequencing. The interoperability consists of the launching parameters and the returned assessment

results or updated learner profile. LTI accomplishes this type of interoperability. LTI also enables such applications to be hosted anywhere in the cloud and enables collaborative applications where assigned cohorts of students are working together. The requirements for using LTI in supporting the Common Core State Standards to achieve an interoperable Student Diagnostic Record are discussed more in the answer to 3.2.12.

> 3.2.9 Assessment Protection. For this RFI, "Assessment Protection" means keeping assessment instruments and items sufficiently controlled to ensure that their application yields valid results. (See also paragraph below, "Results Validity.") When assessment instruments or content are re-used or shared across organizations or publicly, are there capabilities or strategies in the technology standards to assist in item or instrument protection? What mechanisms or processes exist to ensure that assessment results are accurate and free from tampering? Do examples exist of public or semi-public assessment repositories that can provide valid tests or assessments while still sharing assessment items broadly?

This question concerns policy more than technology. There are many ways to assess students and some are more valid then others. But, if we wish to allow students and parents to assess progress on their own we need to enable self-service assessment that is valid. The U.S. states will need to grapple with this complex issue as they decide which systems and tools need to interoperate to provide effective formative and summative assessment.

The interoperability issues here are that the standard should provide detailed data reporting to allow for item analysis. Item analysis is the process that educators and assessors use to determine the validity of a question in terms of measuring knowledge or skill. QTI provides this support.

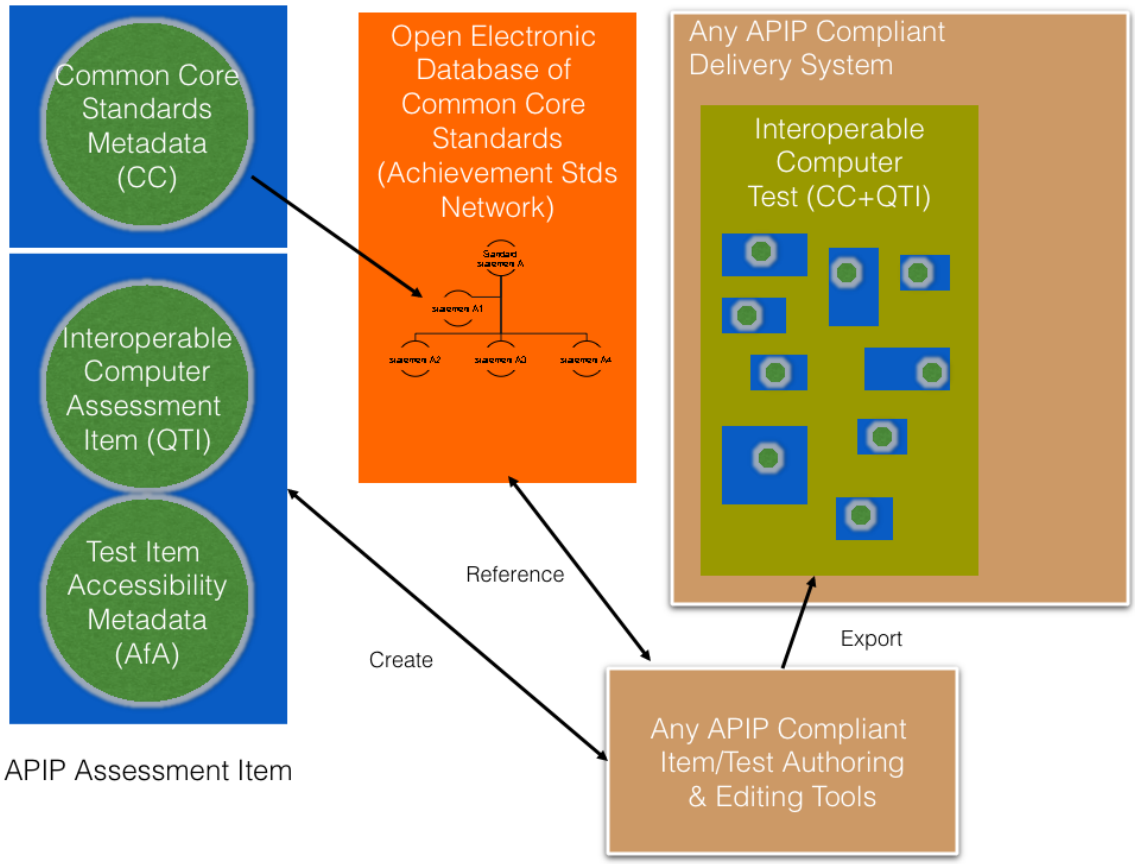
However, standards need to also allow for reporting of proficiency per an agreed upon set of curricular standards, such as the Common Core State Standards (CCSS). One of the key interoperability issues is the need to "tag" assessment items, as well as the student record, according to the curricular standards they apply to. A key feature of the Common Cartridge and its associated application to APIP is to provide the ability to perform this sort of tagging in an interoperable way. While the Common Cartridge can reference any structured representation of curricular standards, it is the opinion of IMS that states and suppliers are best served by collaboratively referencing the same unambiguous open source achievement standards' identifiers. The only such database of publicly available standards' IDs that IMS is aware of is the JES & Co.'s Achievement Standards Network (ASN) that has been funded by the U.S. National Science Foundation.

The ASN (www.acheivementstandards.org) has **five distinct components:**

1. A repository of academic standards each with its own Uniform Resource Identifier (URI)
2. An input tool, enabling direct input of standards documents into the repository
3. Viewers and web services to access the standards
4. A resolution service that resolves the Uniform Resource Identifier into machine readable text
5. A network of organizations that share, use, develop tools and leverage the

technical advantages of the ASN in improving education

The figure below illustrates the potential item "assembly" process using APIP and ASN. Please note that APIP is more fully described in the answer to 3.2.28 on accessibility. An APIP compliant item/test authoring tool creates an APIP item per the specification and "tags it" with the accessibility information (using Access for All metadata – see answer to question 3.2.28) and also with the Common Core State Standards (CCSS) references (using the Common Cartridge construct for curriculum standards tagging). CCSS are accessible both in human and machine readable formats through the ASN at no cost..[1] Items are assembled into tests as needed by the authoring tool and exported for use into any APIP compliant test delivery system. The delivery system may be an "assessment system" or it may be a learning management system or other formative learning tool. More details can be provided upon request.



It may also be of interest here that Common Cartridge provides an authorization mechanism on any portion of a cartridge, including assessment materials. This provides a standards-based mechanism to protect the access and use of assessment materials if desired.

[1] See http://www.eschoolnews.com/2010/08/16/jes-and-co-announces-the-inclusion-of-the-common-core-state-standards-in-the-achievement-standards-network-asn/

3.2.10 Security and Access. In what ways do technology standards provide for core security issues, such as access logging, encryption, access levels, and inter-system single-sign-on capabilities (i.e., one login for systems managed by different organizations)?

Achieving single sign-on and an overall seamless experience for students and teachers is a key foundational step for interoperable assessment across formative and summative environments. Learning technology standards are generally not replicative of more widely accepted security and access standards. Standards that achieve seamless authoritative provisioning of users across a federation of systems is a complex topic. There are a variety of options available including SAML, Shibboleth, OpenID, and OAuth. They all have various strengths and weaknesses and many times more than one are used together to achieve specific goals. The open IMS platform of standards features the Learning Information Services (LIS) standard and Learning Tools Interoperability (LTI) standard, both of which work in tandem with these federated identity solutions to enable single sign-on and reporting relative to specific individuals as required. LIS and LTI focus on the data and service exchanges among cooperating learning related systems, such as assessment systems, learning management platforms, student systems, and learning tools.

For example, the New York City of Department of Education is architecting use of the IMS standards on their new iLearnNYC project in conjunction with SAML. They are currently in the process of determining, as a practical manner, how content and application providers can also have a choice in terms of the range of standards that can be supported.

In general, the interchanges among these systems in terms of authoritative identity, single sign-on, and reporting are dependent on the desired IT architecture. The IMS standards allow a wide variety of scenarios to be achieved without need for additional hardware or software. IMS does not dictate the use of one identity solution over another. Standards for identity have evolved and will continue to evolve outside the education segment and then be applied to education. Therefore, education-specific standards for assessment must be capable of adapting to a variety of alternatives. IMS standards meet this requirement. See the answer to 3.2.13 for a more in depth discussion of how LTI and LIS can cooperate to achieve a range of scenarios.

When using APIP to cover accessibility issues (see 3.2.28), it is necessary for the assessment delivery system to provide accessibility features based on the student profile. In addition, connecting item results to specific student identities is essential for item analysis. Therefore, there needs to be a way for a delivery system to identify a student and access their profile. The best solution for combining the more widely accepted interoperability standards for security and access with the IMS standards is likely to be state specific depending on architectural constraints currently in place. IMS is prepared to provide support and consultation to the RttTA consortia and states to architect an appropriate solution.

> 3.2.11 Results Validity. For this RFI, "Results Validity" means protecting the statistical validity and reliability of assessment instruments and items. How can interoperable instruments be managed to ensure they are administered in a way that ensures valid results? Are solutions regarding assurance or management of validity appropriate for inclusion in technology standards, or should they be addressed by the communities that would use the technology standards to develop specific assessments?

Assessment validity is largely an issue of process as opposed to technology. There are technologies developed for online learning and testing, such as lockdown browsers, that can provide a controlled online environment working in conjunction with identity management software. As discussed in the answer to the previous question, the standards using for access and security must be selected from those that are widely available in the marketplace, based on architectural constraints. And, as with the answer to the previous question, the learning technology interoperability standards employed must support connection of identity to test delivery and item analysis. The suite of IMS open standards, including APIP, QTI, Common Cartridge, LTI, and LIS fully support a wide variety of scenarios in this regard. More information is available on request.

3.2.12 Results Capture. How can technology standards accurately link individual learners, their assessment results, the systems where they take their assessments, and the systems where they view their results? How do technology standards accurately make these linkages when assessments, content, and other data reside across numerous, distinct learning and curriculum management systems, sometimes maintained by different organizations?

Much of the answer to this question has already been covered in previous answers. To summarize what has been covered so far, the technology standards must be able to:

1. Work in conjunction with a variety of federated identity management standards used in the marketplace
2. Provide item and test results associated with a specific student
3. Provide item and test results associated with a specific curricular standard, such as CCSS
4. Enable a variety of interoperable exchanges, some of which require exchange of the content of items and tests and some of which require the exchange of a student profile and results reporting by curricular standard
5. Address the accessibility needs of students and state officials

The IMS standards discussed in this RFI response provide support for all of the above requirements as they currently exist with perhaps some adaptation for RttTA.

In addition, the standards must enable and encompass student progress reporting standards that can cut across a wide variety of systems. IMS suggests that existing standards, such as the Gradebook portion of IMS LIS/LTI, IMS ePortfolio (including the Learner Information Profile – LIP – see http://www.imsglobal.org/ep/index.html), and open source curricular standards IDs (such as those provided by the ASN) be used to create an interoperable Diagnostic Student Record (perhaps on par with the Permanent or Persistent student record). A potential approach is illustrated in the figure below (excerpted from a whitepaper that is being published under the auspices of the Gates Foundation to help address a common vision of assessment reform). More detail can be provided upon request.

The PARCC consortium has plans to improve the flow from K-12 to higher education (there are many higher education institutions that are members of the PARCC consortium). The student record shown below could play a key role in this regard. To achieve the full potential of this, colleges and universities could work to provide additional profile dimensions beyond the Common Core that are indicators of readiness for various college tracks and programs. More information can be provided on request.

Potential Common Core Compiled Electronic "Gradebook" Construct for an Individual Student and Single Common Core subject (Based on typical Learning Management System Gradebook construct from IMS LIS/LTI) – used standalone or leading to potential use in a "Diagnostic Student Record"

Diagnostic Student Record

- Transcripts
- Assessment Scores
- Gradebook compilations
- Evidence

Gradebook Compilation for Common Core Subject Area

	Activity 1	Activity 2	Activity 3	. . . .	Activity N
Activity weight for distributed assessment X	Relative weight	.	.	. . . .	.
Activity weight for distributed assessment Y	.	.	.	. . . .	.
Common Core Area A (with link to ASN database)	.	.	.	. . . .	.
Common Core Area B (with link to ASN database)	.	.	.	. . . .	.
Common Core Area C (with link to ASN database)	.	.	score	. . . .	.
Common Core Area D (with link to ASN database)	.	.	.	. . . .	.
Common Core Area E (with link to ASN database)	.	.	.	. . . .	.
Activity evidence	.	Link or media	.	. . . .	.

3.2.13 Results Privacy. How do technology standards enable assessment results for individual learners to be kept private, especially as assessments results are transferred across numerous, distinct learning systems? How can such results best be shared securely over a distributed set of systems managed by independent organizations that are authorized to receive the data, while still maintaining privacy from unauthorized access?

This question relates very closely to 3.2.10, Security and Access, and we refer the reader to our answer there. Ultimately, it is the system architecture that is designed to meet the security requirements.

The IMS standards support a variety of privacy approaches in a very elegant manner. IMS Learning Information Services, typically implemented by the authoritative student system, works in conjunction with an identity management system, storing authoritative records associated with student IDs. It is not unusual for the student system to use LIS to share student IDs with some of the enterprise systems that must also be aware of the linkage between and individual and their results. However, IMS Learning Tools Interoperability (LTI) provides for exchange of rosters of students and cohorts into associated learning content and tools. This is done based on IDs that are generated independently from the unique authoritative student ID. This is done in this way because it may not be appropriate for such content or tools to be able to know the authoritative ID of a student. In other words, LTI can provision a student into a tool for an intervention and can report back the results associated with that student to a learning management system, portal, or even the student system without the tool ever knowing what the official ID of the student is. This prevents the tool from storing persistent data associated with that student to protect their privacy. Using IMS LTI, LIS, or both in cooperation enable a wide variety of privacy protection scenarios.

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3.2.14 Anonymization. Do technology standards or
technologies permit or enable anonymization of assessment
results for research or data exchange and reporting? How
do various technology standards accomplish these tasks?
For example, where a number of students take a test, can
their answers be anonymized (through aggregation or other
techniques) and shared with researchers to examine
factors related to the assessment (e.g., instructional
inputs, curriculum, materials, validity of the instrument
itself) without revealing the identity of the learners?
Is this an area where technology standards can help?
```

Yes, this "use case" is easier to accomplish than associating the data with the student IDs as discussed in the previous questions. It simply requires excluding the student identification from the data at the appropriate point in the processing (or, never making the association at all). IMS QTI provides a wide variety of alternatives in terms of aggregating data. However, specific scenarios need to be discussed with the RttTA consortia to make sure their needs are supported.

3.2.15 Scoring and Analysis of Results. How can technology standards be used for the scoring, capture, recording, analysis or evaluation of assessment results?

3.2.15.1 Results Aggregation and Reporting. How can technology standards enable assessment results to be aggregated into statistical or other groupings? How can technology standards provide capabilities for results (aggregated or raw) to be reported across multiple technology systems? For example, if a learner takes an assessment in one system, but the results are to be displayed in another, how do technology standards address transferring results across those systems? How do technology standards address aggregation of results for a number of learners who are assessed in one system and whose results are displayed in yet another technology system? Can anonymization controls be included with aggregation and reporting solutions to ensure individual data privacy and protection (see also 3.2.14 above).

As discussed in the responses to previous questions, QTI provides extensive results reporting that enables item analysis. This is one of the features of QTI that makes it exceptionally well suited for educational assessment. Results reporting for QTI v2.1 is covered in this publically available document:

http://www.imsglobal.org/question/qtiv2p1pd2/imsqti_resultv2p1pd2.html

QTI was explicitly developed to allow the authoring, banking, delivery, and analysis of items and tests to occur across multiple systems. That was the primary use case considered. QTI provides mark-up for scoring of items and tests (see the overview of QTI, including figure in section 2 here):

http://www.imsglobal.org/question/qtiv2p1pd2/imsqti_oviewv2p1pd2.html).

To provide flexibility in terms of analysis, raw item data is made available in a standard format for reporting purposes. Thus, the raw data is interoperable.

As discussed in the answer to 3.2.14, data can be analyzed with or without user IDs. As discussed in the answer to 3.2.13, IMS LTI allows assessment alternatives in which even the delivery system is not aware of the student ID – allowing for a full range of privacy concerns to be addressed.

Again, further discussions will need to occur with the RttTA consortia to ensure that the IMS work will meet their specific needs.

3.2.16 Sequencing. How do technology standards enable assessment items stored within an assessment instrument to be sequenced for appropriate administration, when the assessment consists of more than a single linear sequence of items? For example, how do technology standards address computer-adaptive assessments? How are the logic rules that define such sequencing embedded within a technology standard?

IMS QTI provides interoperability constructs for both adaptive items and adaptive tests. An adaptive item is one that changes according to user input and scoring. An adaptive test is one in which the items presented are adaptive based on scoring of prior questions. QTI provides "built in" some relatively simple sequencing that allows specification of preconditions and branching. See section 14 in this document:

http://www.imsglobal.org/question/qtiv2p1pd2/imsqti_infov2p1pd2.html

QTI is widely used for computer-adaptive testing based on these constructs. QTI enables a delivery platform completely separate from the authoring platform to deliver and adapt tests and items, including providing feedback to the user as needed. This was the primary use case.

IMS also has two other specifications that describe sequencing in an interoperable manner. One is IMS Simple Sequencing, which was developed primarily to support single-learner sequencing (as used in SCORM). The other is IMS Learning Design, which was developed to support sequencing of pedagogical activities, including group collaborations. Either of these specifications could be used to provide more sophisticated interoperable sequencing as needed. However, it should be noted that more complex sequencing places significant requirements on the delivery platforms that are very difficult to achieve – limiting the number of suppliers that may be able to meet this bar. And, in doing so, there is still no guarantee that all possible adaptive sequences could be handled.

Therefore, it is recommended that RttTA start with the sequencing available in QTI, with perhaps minor modifications as needed and support more complex adaptive items or tests using an LTI interface. LTI allows the sequencing authoring and delivery engine to occur as a seamless part of the assessment system, but include sequencing that is not describable by any existing standard. This is why LTI is the recommended approach for interfacing with subject specific formative assessment and homework tools, sometimes referred to as "adaptive tutors." As per the discussion in the answer to 3.2.12, an interoperability construct, such as the IMS gradebook, needs to be agreed upon to support interoperable results reporting according to curricular standards. Otherwise, adaptive authoring and delivery systems can import APIP assessment items or tests and output QTI raw data as described previously. The appropriate combination of these approaches should be capable of meeting the requirements for use of innovative items called for in both the SBAC and PARCC RttTA proposals. However, future discussion with the consortia is required.

Once the basic interoperability foundation has been established, IMS would then recommend looking at the potential application of IMS Learning Design to address a standard for pedagogical sequencing. IMS Learning Design has been used extensively outside the U.S., including special emphasis on the interaction between QTI and Learning Design, some of which is captured here:

http://www.imsglobal.org/question/qtiv2p1pd2/imsqti_intgv2p1pd2.html

3.2.17 Computer-Driven scoring. How do technology standards permit, enable, or limit the ability to integrate computer-driven scoring systems, in particular those using "artificial intelligence," Bayesian analysis, or other techniques beyond traditional bubble-fill scoring?

QTI provides for very flexible scoring mechanisms to be employed on both an item by item and test basis. QTI supports evaluation of standard expressions as well as the ability to provide custom expressions for scoring. Please read the QTI specifications for more details.

In the context of RttTA, using Bayesian analysis would typically be a way to analyze raw item results to attempt to understand the "latent" variables that cut across assessment items. In the case of RttTA, this would be to understand the level of proficiency in the overarching skills defined by the CCSS. In order to achieve this level of analysis, what is required from the interoperability standards is the ability to tag items according to the CCSS standards using public curricular standards IDs (as discussed in the answer to 3.2.9). As discussed previously, APIP and Common Cartridge fully support this capability. Also, as discussed previously it is possible to use an interoperable gradebook (from LTI & LIS) that can be provided by "black box" assessment tools that provide an estimate of proficiency according to the CCSS or other state standards. Storage and later analysis of the correlation of such scores and results obtained on other summative tests can provide analysis of which formative tools or interventions are most effective. The IMS standards enable this approach, but discussion with the RttTA consortia is required to adapt the appropriate solution.

Artificial Intelligence (AI) in assessment typically relates to two unrelated areas. One is the use of AI techniques to sequence assessment items to assess proficiency in one topic before moving on to the next. An emerging set of "adaptive or cognitive tutoring" programs claim to make use of various AI techniques. Generally, they are considered to be proprietary, meaning that the most effective interoperability is most likely through an LTI launch and interoperable gradebook discussed previously.

The second area, which appears to be the reference to AI in the winning PARCC RttTA proposal, involves the use of natural language processing to assessment of extended response items (textual responses). QTI allows the inclusion of such scoring engines either during delivery or post analysis. And, there are also engines available commercially that do this sort of processing, such as the eRater® scoring engine provided as part of the ETS Criterion writing evaluation and tutoring system. Such engines can be incorporated using the IMS standards. Further discussion with the RttTA consortia will be required to understand their exact needs.

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3.2.18 Formative, Interim, and Summative Assessments.
What technology and technology standards exist that
support formative, interim, and summative assessments?
What technology standards support non-traditional
assessment methods, such as evidence, competency, and
observation-based models?
```

As described in the answer to question 3.2.1, the IMS standards mentioned in this RFI were specifically designed to provide interoperability across the full spectrum of assessment and intervention activities. The answer to 3.2.1 contains three diagrams that illustrate the requirements for item/test, results, and intervention (content and application/tool) interoperability that cut across a range of systems. Interoperability that supports less than these scenarios will not succeed in opening up the market to innovative approaches from a wide range of suppliers with diverse business models. As described in the SBAC and PARCC proposals, there is a need to look at assessment and assessment systems differently in the context of the Common Core. The IMS standards not only enable this to happen, but have a high level of adoption among existing industry participants – virtually ensuring that they can succeed in helping to achieve this lofty goal.

Both SBAC and PARC are also very clear that a wide variety of assessment events must be supported, including formative and interim assessments, along with summative assessments. Please note that the figures contained in section 3.2.1 indicate the requirement for exchange of "evidence" as well as scores. It should be noted here that QTI supports the tagging of items with rubrics for scoring. QTI "items" could detail assessment activities that are not computer based. More discussion with the RttTA consortia is required to consider this possibility.

As detailed in section 3.2.12, IMS recommends development of an interoperable student diagnostic record that stores evidence associated with various assessment activities – some of which are performed and graded online, some of which are not. IMS believes that the availability of such a record has the potential to significantly improve personalization of learning and intervention. To enable the diagnostic record, IMS provides the core gradebook reporting construct from LTI/LIS. In addition, the IMS ePortfolio specification and related specification on reusable competency definitions (IMS RDCEO - see http://www.imsglobal.org/competencies/index.html) may be useful.

Finally, it should be noted that the essential key to analyzing resulting data according to the Common Core State Standards requires non-restrictive access to a single open and free electronic database of the CCSS that all suppliers can commonly reference, such as the ASN. The IMS standards provide the ability to do this.

3.2.19 Learning and Training. What applications or technology standards exist that can apply assessment results to support learning and training? Are there technology standards or applications that support more than one of the following: early learning, elementary/secondary education, postsecondary education, job training, corporate training, and military training?

The IMS standards are focused on the requirements of the education segments, such as those summarized in the answer to 3.2.12, but the specifications are silent on the specific market they could address. Some of the IMS specifications referenced herein were developed first to support corporate and military training, such as IMS Content Packaging. The former version of IMS Learning Information Services (LIS) was developed to support interactions between corporate HR systems and learning systems. There are many similarities among the segments. QTI can be used to support training and has in fact been used and is being used for that purpose.

The need for adaptation of specifications for different segments and regions is one of the reasons that IMS has invested heavily in free and open tools for profiling that can both serve such communities and serve the needs of the IMS members that funded the original work. This is discussed in detail in the answer to question 3.2.5.

A major challenge in attempting to create specifications and standards that are supposed to "cut across" all segments and regions is that it greatly increases the scope and complexity of the specification. IMS is one of the few organizations that has been able to take such a wide perspective and provide specifications that have been successfully tailored to segments and regions. However, the other major challenge then comes from the level of interoperability obtained across such customized versions. History has shown that the level of interoperability obtained is low. A third challenge is that the supplier communities are generally different in the K-12, higher education, and training segments, along with regional variations, and it is not easy to bring the required participants together much less get them to agree.

However, despite these challenges, IMS is finding very strong support across the higher education and K-12 segments for the IMS work described in this RFI. Educational and assessment scenarios tend to be pretty consistent across K-20. Therefore, the good news is that it does appear that the same standards can be used across higher education and K-12.

The primary difference in higher education as it relates to assessment standards is the need to establish the core competencies that various academic programs are meant to deliver (versus having them available from states or other sources such as in the Common Core state standards). IMS has done work on how to use IMS standards to provide these constructs from a standards perspective, but the mapping from K-12 curricular standards to higher education and career readiness (or military training readiness) is a field that requires substantial work. The technology standards can accommodate the curricular standards and the relationships between them easily once

those relationships are determined.

With respect to P-3, it should also be noted that it is expected that young children may require paper-based assessment approaches until such time as user interfaces for computer-based assessments are validated. This is not considered a major challenge as there are many existing paper-based assessment solutions readily available. It is possible that the QTI standards could be extended to support direct generation of paper-based tests. This possibility needs to be explored further as needed. QTI has already been shown to work well on mobile devices (see 3.2.27).

3.2.20 Repositories. What technology standards-based assessment instruments, questions, or item banks (or repositories and learning management systems) are used to manage and deliver assessments?

As discussed in the answer to question 3.2.1, IMS does not track the usage of its specifications, which are implemented inside products and somewhat transparent to users. However, the following examples illustrate the large-scale usage and viability of QTI:

- ETS uses QTI to deliver and update 64,000 test items to its network of partners serving U.S. states.
- Pearson VUE uses QTI as the foundation of its processes with partners to put assessments online
- Pearson, McGraw-Hill, and other major publishers normally make textbook questions available in QTI format
- Most learning management systems (Blackboard, Moodle, Desire2Learn, etc) are capable of importing and running QTI items and tests

The following factors must also be considered in terms of the future adoption of QTI:

- An inhibitor to adoption of QTI in the past was the lack of strong conformance certification, which has now been corrected
- IMS Common Cartridge, which includes support for QTI, is seeing rapid adoption by most learning management platforms and content providers in the e-Learning space
- Classroom platform providers are now working aggressively to adopt the IMS standards led by SAFARI Montage and SMART technologies

IMS also has a long history of our work being adopted by digital repository suppliers, including Giunti Labs, Harvest Road, and the Learning Edge (Equella) – all of whom implement IMS specifications. In addition, IMS specifications have frequently been implemented using open source repositories. One example is the use of the MIT Open Courseware (OCW) project using IMS specifications to implement their content repository. IMS specifications have also been widely implemented in the Fedora and Plone open source platforms for use in higher education. IMS will be pleased to provide examples as required.

IMS also has developed and supports the Digital Repositories Specification (see http://www.imsglobal.org/digitalrepositories/index.html) and the Resource List Specification (see http://www.imsglobal.org/digitalrepositories/index.html) which specifically address the interoperability among learning systems and repositories.

Educational repositories from around the world are regular entries into the annual IMS Learning Impact Awards and they feature use of the IMS specifications. World leading examples can be found by exploring the past LIA winners accessible here: http://www.imsglobal.org/learningimpact2011/awards.html

3.2.21 Content Lifecycle. How can technology standards be employed to support an assessment content lifecycle (creation, storage, edit, deletion, versioning, etc.)?

There are many available standards outside of the learning technology space that address content lifecycle and content management issues, such as WebDAV (Web Distributed Authoring and Versioning). So, IMS has not had to replicate such capabilities with IMS standards. IMS provides metadata fields that can be used to store versioning information. The answer to the previous question details IMS's experience in working with repository and learning management system providers (learning management systems typically include a content management component).

```
3.2.22 Interfaces and Services. What interoperability
specifications for application program interfaces (APIs) or
Web services interfaces to assessment management, delivery
and tracking systems have been developed? How are they
organized? What are the best practices related to their
design and usage? How broadly have they been adopted, and
what are the lessons learned from those who have designed
or implemented them?
```

As discussed in the answer to question 3.2.2, there is a common misperception that APIs can be standards. Most interoperability standards organizations would not consider APIs to be "standards." APIs are programming platform specific. Interoperability standards need to be capable of being implemented in any programming language. Otherwise the market usage is severely restricted.

However, the question reflects an important issue with respect to adoption of standards. The overwhelming majority of any market is interested in how to easily implement standards. Therefore, standards organizations provide superior value if they can support implementation by providing APIs, example code, and code libraries (in a variety of popular programming platforms). IMS is a member of the Web Services Interoperability (WSI) consortium (which has recently been absorbed into OASIS). IMS has been a pioneer in providing guidance on how to implement the IMS standards using web services since 2005 when we began publishing a document series on this that is still being maintained and evolved (please see http://www.imsglobal.org/gws/index.html).

The IMS Alliances, discussed in the answer to 3.2.6, provide not only support to receive conformance marks, but a wide variety of resources that simplify implantation (including IMS staff consultation). Each Alliance builds out a development community around one or more specifications, much like an open source community. In fact, most of the software developed for the Alliances by members or others is made available as open source software under an Apache 2 license that enables use for commercial or other purposes.

In summary, APIs and code libraries are key to the implementation of standards. IMS explicitly addresses providing this support in our standards development processes. Even greater support is expected in the future (as the Alliances are relatively new - about 2 years old). IMS has found that providing such support is extremely effective – making it possible to implement specifications easily. We have seen this happen in the adoption of Common Cartridge and Basic Learning Tools Interoperability. They are also essential for effective evolution and maintenance.

QTI features many open source activities around the world that enable its adoption. These include:

http://qtitools.caret.cam.ac.uk/

http://www.bps-system.de/cms/index.php?id=25

http://technosophos.com/content/question-and-test-interoperability-qti-and-drupal-quiz

http://sourceforge.net/projects/apis/

3.2.23 Internal Transparency and Ease of Use. Are there technology standards and communication protocol implementations that are "human readable?" What are the benefits and risks of "human readable" technology standards? Some technology standards are not comprehensible without tools to unpack, decode, or otherwise interpret the implementation data resulting from use of the technology standard. Other technology standards, such as HTML, RTF and XML, are largely readable by a reasonably sophisticated technical user. RESTful-designed web services are often specifically intended to be readable by, and even intuitive to, such users as well. We ask commenters to consider the extent to which various technology standards possess native "human readability" and comprehensibility.

Most interoperability specifications are human readable at some level, while at other levels they are translated to be machine-readable. IMS provides human readable standards and also machine-readable translations, sometimes referred to as "bindings" (typically XSD files). Once again we caution against the idea that a specific implementation in a specific programming platform, such as REST, can be a standard. It can only be, at best, one implementation of a standard. A standard must be neutral with respect to the programming platform.

Different programming platforms are optimized for different purposes. REST is a type of programming methodology. It is extremely intuitive and easy to use for lightweight web applications. SOAP is an implementable WSI standard. SOAP is complex, but generally considered necessary to meet the security concerns of enterprise applications. IMS is committed to supporting many implementation approaches, including REST, SOAP, and .NET (an application framework favored in some operating systems). IMS work has been implemented across the spectrum, which is what a good standard enables.

So, the standards must be human readable at the top level, but must also be implementable in a variety of bindings, web services standards and frameworks, and programming platforms. IMS has broad and deep experience in creating standards that meet these requirements and has already proven that our work can be supported across evolving web technologies. While a RESTful-designed web service is a useful way to implement a standard, it is not a substitute for the underlying standard.

IMS has developed a world class process to enable development of specifications in human readable form using UML (Unified Modeling Language). This is especially effective because from UML a wide variety of bindings and implementations can be developed, as well as conformance tests. UML is human readable but also machine interpretable – enabling both good understanding and rapid implementation of bindings.

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3.2.24 Discovery and Search. How is the discovery of items
or instruments (or other elements) handled within a
technology standard or technology? For example, are there
search APIs that are provided to permit a search? How are
metadata exposed for discovery by search engines or others?
```

IMS has been a pioneer in the development of metadata standards for learning. The last update of the IMS metadata standard was in 2006 and can be found here:

http://www.imsglobal.org/metadata/index.html

Metadata is used extensively in almost all IMS specifications. IMS has had extensive experience with other metadata standards such as IEEE LOM and the Dublin Core. IMS standards such as Common Cartridge apply and adapt the metadata standards as needed. Metadata is often very region specific. So, the IMS standards allow for regional customization of metadata.

IMS has also pioneered the Vocabulary Definition and Exchange (VDEX) standard that enables easily setting up and using domain specific metadata or other specification vocabularies. VDEX can be found here:

http://www.imsglobal.org/vdex/index.html

Metadata includes a wide variety of attributes that can be searched on. Typically these searches are performed by application-specific systems that are designed to look for learning materials, such as educational object repositories or learning management systems. Numerous examples can be found by exploring the past LIA winners accessible here: http://www.imsglobal.org/learningimpact2011/awards.html IMS will be pleased to spend time with the U.S. Department of Education to understand these world leading examples from the UK, Europe, Singapore, Australia, South Korea, and elsewhere. The RttTA projects will need to consider their requirements for search carefully to select from a wide variety of available products and approaches. IMS can provide guidance to help find the best option for the needs of RttTA.

As discussed earlier (see 3.2.9), a key parameter for classifying assessment items in RttTA will be the curricular standards that an item applies to, in this case the CCSS, and possibly additional state specific standards. IMS standards provide support for this type of metadata tagging. However, the curricular standards must also include unique public IDs and be made available in a free, publically available database and with no use restrictions, such as the ASN (as discussed in the answer to question 3.2.9).

The primary issue with the use of metadata for learning materials over the last decade has not been the searching, but rather the ability to create the metadata. This is more of a process issue than it is a technology issue. Processes must be put in place so that metadata is added during the authoring process. Authoring tools that make this easier should be explored and encouraged. It is possible that an education-specific page-ranking algorithm (ala Google) could be constructed to help with automated creation of metadata. Government organizations around the world can help by encouraging large

dominant suppliers such as Google to engage in educational technology standards activities for the common good of improving education search and access around the world.

3.2.25 Metadata. What kinds of metadata about assessments (i.e., information describing assessments) are permitted to be stored within technology standards or technologies? How do technology standards accommodate structured data (such as new State curriculum standards) that were not anticipated when the technology standard was designed? How are metadata describing unstructured (such as free-text input) and semi-structured data incorporated within assessment technology standards?

Please see the answer to the previous question. There are no restrictions in terms of defining the metadata needed for assessment instruments and items. The draft APIP standards enable supporting as much metadata information as the RttTA consortia require. IMS metadata is easily extended and customized to specific domains, based on 10 years of experience.

As discussed previously in the answer to question 3.2.9, APIP and Common Cartridge are designed for tagging with curricular standards. The curricular standards themselves are not part of the APIP or Common Cartridge specifications. They are made available from, maintained and updated in a separate open source achievement standards database such as ASN. The IMS metadata contained in APIP and Common Cartridge provide a standardized way to resolve to an achievement standard ID, known as an URI (Uniform Resource Identifier) and return the achievement standard's descriptions (like the standard's text, its state, grade, subject, etc.) that contains the standard in the database. Thus, any database of curricular standards can be supported if they adhere to simple linked data specifications. The access follows some simple rules. This allows the curricular standards to evolve compatibly yet separately from the learning technology standards.

Free text input can easily be contained in metadata fields. The XML tags defined in the metadata specification provide the structure for how to interpret the metadata, including free text fields as needed.

3.2.26 Recommendation, Rating, and Review. Do technology standards or technologies permit rating, review, or recommendations to be incorporated within an item, instrument, or other element? If so, in what ways? How are conflicting ratings handled? Do technology standards or technologies permit “reviews of reviews” (e.g., “thumbs up/down” or “Rate this review 1-5”)? Is the rating or review system centralized, or are multiple analyses of the rating data permitted by distributed participants?

Yes, this is simply a matter of defining the appropriate metadata as discussed in the answers to the two previous questions.

Whether or not analysis of metadata is centralized or distributed is purely a function of the system design, not the metadata standards. It can be done either way.

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3.2.27 Content and Media Diversity. What types of diverse
content types and forms of assessment content exist that
extend beyond traditional paper-based assessments
translated to an electronic delivery medium? We are
interested in learning more about electronic delivery and
interaction media, such as performance-based assessments,
games, virtual worlds, mobile devices, and simulations.
```

This is not a question about standards. IMS standards support any or all of the assessment options listed above. As discussed previously, the interoperable are one of two types:

- Assessment content interoperability: Where actual assessment items or instruments are exchanged along with raw results data with an assessment engine that can interpret the standard formats (APIP, QTI, Common Cartridge, etc.)
- Assessment application interoperability: Where a "diagnostic student record" is exchanged both potentially as input to and/or output from the tool that summarizes proficiency per an accepted framework such as the CCSS, from a launching platform to a "black box" assessment application

Hybrid designs are also possible. IMS APIP, QTI, and LTI provide all the interoperability options required to support these approaches.

Some of the most sophisticated and useful assessment applications that have been highlighted as winners in the annual IMS Learning Impact Awards (LIAs – see http://www.imsglobal.org/learningimpact2011/awards.html) are a new breed of formative assessment/adaptive tutoring/homework applications provided by major publishers, testing organizations, and entrepreneurial start-ups.

As far as mobile platforms are concerned, IMS QTI has already been shown to be useable on a wide variety of mobile platforms. For instance, see:

http://www.linkaffiliates.net.au/idea10/events/lia10.html#f5

http://www.slideshare.net/peterbuck/ims-qti-engine-on-android-to-support-offline-mobile-learning

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3.2.28 Accessibility. How do technology standards ensure
that the platforms are accessible to all persons with
disabilities? How can technology standards ensure the
availability of accommodations based on the individual
needs of persons with disabilities? What factors are
important to consider so that accessibility capabilities
can be included within an interoperable technology
standard, both for end-users, as well as operators,
teachers, and other administrators? How are issues
related to Universal Design for Learning (UDL) relevant
to standards for accessible use? How can technology
standards provide for, improve, or enhance Section 504
and 508 of the Rehabilitation Act compliance for
assessment technology?
```

IMS has been developing the Access for All interoperability standards for accessible learning content for about eight years now. Access for All has been published as an ISO/IEC Standard and there is an ongoing partnership between IMS and ISO/IEC to collaborate on this work. Access for All is unique in that, while handling accommodations for special needs, it is really a comprehensive framework for personalizing the user experience based on their preferences. Therefore, Access for All is as applicable to assistive technologies as it is to general web user interface adaptation, including to mobile devices. Therefore, Universal Design is the underlying principle of Access for All. The Access for All team has also had an active liaison with W3C, working to get some aspects of Access for All supported in HTML 5.

The latest public final Access for All specifications can be found here:

http://www.imsglobal.org/accessibility/index.html

APIP utilizes Access for All in conjunction with QTI and Common Cartridge to provide an interoperability format for exchange of items that support accessibility. The eight U.S. state assessment organizations leading the charge on APIP have considered a wide breadth of accommodations that could be supported and also those that should be supported in the near term based on availability of technology and feasibility of implementation. The summary conclusions of the APIP work to date are summarized here.

APIP specifies support for accessibility related to three cooperating aspects of assessment delivery:

1. Digital item content format- The required components of the APIP Item Standard include the provision of accessibility information for text only, graphic only, text and graphic, and non-visual audio representation of item content, and Braille representation of item content.
2. Student information files- The required components of the APIP Personal Needs Profile (PNP) Standard include: magnification, contrast, foreground color,

background color, overlay color, audio text, audio graphics, non-visual audio, Braille, auditory calming, masking, breaks, and extended time.

3. Digital test delivery system- the test delivery system must be able to provide the following accessibility features: magnification, reverse contrast, alternate fore and background colors, color tinting, auditory calming, masking, text only read aloud, graphic only read aloud, text and graphic read aloud, non-visual read aloud, Braille delivered via a refreshable Braille display.

APIP also enables a wider array of optional accessibility features as captured in the following table:

Available APIP Optional Elements

	Student Information	Item Content	Delivery System
Audio Directions	X	X	X
Tactile Graphics	X	X	X
American Sign Language (ASL)	X	X	X
Signed English	X	X	X
Alternate Language (specify languages)	X	X	X
Keyword Highlighting	X	X	X
Keyword Translation (specify languages)	X	X	X
Flagging	X		X
Guided Reader	X		X

For application to RttTA, the SBAC and PARCC consortia may wish to reconsider the required accessibility features for APIP based on their needs or implementation constraints. It is important to note that some of the APIP states are already requesting APIP in RFPs.

APIP specifically addresses accessibility issues for educational assessment and are compatible with 504 and 508 stipulations. APIP enables a much broader implementation to support persons with disabilities using technology as it relates to educational assessment. APIP is hoped to reduce some challenges associated with accurate and fair assessment of students with disabilities.

For the latest information on APIP, you can also visit the State of Minnesota web site:

http://education.state.mn.us/M...esting/APIP/index.html

3.2.29 English Learners. How do technology standards ensure that assessment platforms support the assessment, reporting of results, and other capabilities related to the assessment of English learners?

The use cases for APIP fully support and are meant to encompass the needs of English learners. See the answer to the previous question to learn more about APIP and how it works.

3.2.30 Transparency. How do the organizations that develop assessment technology standards approach development and maintenance activities? Is it common for such work to be performed in an unrestricted or open public forum? Are there examples of organizations conducting technology standards development through private (e.g., membership-driven) activities? Are the final work products produced through standards-development activities made publicly available in a timely manner? If not, when or for how long is it necessary to keep these products private? What circumstances require, justify, or benefit from protecting trade secrets or intellectual property?

Non-profit member standards consortia are legally organized, private corporations that can organize their work activities as their governing boards and by-laws permit. They are heavily motivated to organize such work to achieve maximum involvement from all industry participants in order to improve the adoption of such work. Most of these organizations, including IMS, see some benefit to a mix of public feedback with private development. IMS sees one of its primary roles as "opening up the market" using standards. As such, the member organizations of IMS invest substantially to not only develop the standards, but to make them easy to adopt by smaller organizations or even individuals.

What is the appropriate balance between public and private work to achieve maximum benefit in terms of speed, market feedback, and adoption?

First, it must be recognized that it is literally impossible for ALL work to be done in public. This would create an undue burden on organizations and on the participants. Such a requirement for public openness would surely kill leadership in workgroups due to the overhead it would add. Some standards organizations choose to tout "openness" because they feel it gives them some advantage. However, can it really be assured that every meeting comment is accurately captured and disseminated? The reality is that individuals who are leading and facilitating activities are always making decisions about what should be publically shared and what should not. No organization or human activity can be totally "open." A decision has to be made about what should be publically available and when. A half-baked idea that is published to the public for feedback is a waste of everyone's time.

However, standards activities can be made to be "fair" in that the rules are clearly published, scrutinized, and followed by all voluntary participants. This has been the backbone principle of member consortia, of which there are a great diversity, for many years now. Establishing and following clear policies and procedures is what makes a standards activity transparent – not a proliferation of public dissemination that is mostly noise. The U.S. government should not favor any model that is legally sanctioned by U.S. corporate law over any other such model. Government employees would not seem to be qualified to pass judgment on legally organized corporations, including endorsing one type over another.

From the IMS perspective, openness in the formation of interoperability specifications is somewhat similar to openness in open source communities. An open source community provides value to those involved once there is a baseline of tangible work to collaborate on. Most open source communities provide benefit to a wide range of potential users, but still retain control for the centralized body of work to a smaller number of organizations (or even individuals) with the largest commitment and vested interest in the work. However, the burden is also on the standards activity to ensure that the work is not dominated by a small number of parties. IMS believes that similar to an effective open source community, the committed leaders of a specification work activity need to determine when a specification is ready for broader collaboration. That is, at what point can a specification really be considered to be a viable standard that a broader community should be asked to pay attention to? But, the difference with an open source community is that standards consortia must establish clear rights for the participants in terms of governance that extends well beyond a concentrated core of individuals or organizations.

The answer to question 3.2.2 on timelines lays out the phases of a well-managed standards development process. IMS has a member voting process and written policies and procedures that define how IMS work is approved. This process is rather flexible to accommodate a wide variety of needs for different types of specifications and different needs of the body of work in development. However, the IMS process is typically wide open during the initial scoping phase and then narrows down to a committed set of specification developer organizations. The wider member community must provide approval for the finished work, and this includes a public review period or periods..

An IMS work activity only proceeds with commitment from member organizations, which tests the viability and market need of a scope (note that IMS members include suppliers, end user organizations, and government organizations). The committed workgroup then must be given the time required to hammer out the initial specifications and initial implementations to prove some viability. The extreme details of the work are typically closed to the public during the initial development. During this time a workgroup and IMS typically provides documents, presentations, and other artifacts for public review (such as through the IMS public forums in which any individual can provide feedback on the IMS work, past or present), and they typically do so at many venues open venues. Once there is an initial technical approach that is adequately captured and shown to be viable through initial testing, the feedback circle is gradually opened. After this is achieved, IMS then recruits additional members or other parties to test the viability further and understand how conformance can be achieved.

IMS does not typically deem it as appropriate to issue a specification for public draft status until such time as the technical viability has been proven and some leading market participants have showed serious commitment. In fact, standards organizations that issue draft documents before such hurdles are met are equivalent to an open source community claiming they have a solution to a problem when in fact all they have is a very, very, very rough idea of what a viable solution might be. This does not happen in open source communities, and should not happen in “standards” communities whose work is considered “official” by many industry participants. It must be understood that

a "viable standard" is not simply a technical approach – it requires commitment from industry leaders demonstrated through active participation.

IMS finds that our approach works very well and can be adapted to a wide variety of scenarios. Some specifications can benefit from wider input earlier – especially more tentative specifications – and those can be accommodated in our process. Also, the public dissemination and distribution requirements of various partnerships that IMS has with other organizations can also be accommodated. In addition, the very high level of quality of our public draft specifications improves the reputation of interoperability standards and achieving the "strong interoperability in practice" that has been challenging for our segment in the past. The growth of IMS in the years since these new processes have been put into place is a testament to their effectiveness.

The bottom line is that an interoperability standard is only as good as the amount of adoption achieved in the marketplace. There are many approaches that can be tried to achieve strong adoption, and those that work best may be different in different segments and different regions around the world. The IMS process is very adaptable to different needs. In all cases though the IMS process involves serious market participants in a rule-based, negotiated process to arrive at the best of innovation and interoperability. Open standards consortia such as IMS operate using clearly published processes that are legally committed to by the participants and involve designated rights of participation. This is the foundation of transparency. Holding occasional open meetings and having public access to documents or using social networks is a component of arriving at a high quality specification – but it does not mean that the processes are transparent. It is the establishment and operation according to legal participation and voting processes that is absolutely critical to achieving transparency for a standards activity. A declaration that a specification activity is "open" because there is a public listserv or other social network is incorrect. Transparency as it relates to standards requires written processes and policies for conducting development among organizations and making decisions. IMS has a proven track record in this regard.

It is interesting to note that there has been no shortage of standards activities in the learning technology segment in recent years featuring a wide variety of models. We have not seen a model that has had as much positive impact on the public good while maintaining and growing support from serious industry organizations as the IMS model (which is generally the proven model of many non-profit standards organizations in other segments worldwide). The net result of the IMS process has been wide benefit to implementers of learning technology worldwide. While the IMS process retains some benefit to the IMS member organizations, the overwhelming majority of organizations that have implemented IMS specifications have never been IMS members. IMS has a free public community of over 20,000, yet we only have 160 organizations officially affiliated with IMS of which about 95 are the voting members. It is difficult to find parallel examples where the investment of so few has benefitted so many. This is especially true because the IMS work is forward looking and has literally introduced many new concepts in learning technology around the world. IMS has accomplished this with minimal public investment and substantially surpassed public funded activities like SCORM during the same timeframe.

For maintenance and evolution of specifications IMS provides both public and private activities. In addition to the open publishing of the IMS specifications, IMS has a set of open public forums in which comments are accepted and support is provided to any party – see http://www.imsglobal.org/community/forum/latesttopics.cfm?forumid=11 . IMS also provides private development communities called "Alliances." An alliance is much like an open source community in which tools and code are provided to help with specification implementation. The Alliances are partially supported through very minimal annual dues of $500 - $3000 per year. Since IMS staff provides support directly to the Alliance participants and there are many tools and software provided from IMS member investment in the Alliance, the annual dues do not pay for the cost. The operation of the Alliances are heavily subsidized by the IMS members. However, IMS has found the dues of the Alliances to be useful because a dues paying organization is typically much more committed to a body of work. Thus the participation in the Alliance helps to gauge the true support for a body of work in the marketplace.

3.2.31 Participation. Does the development of assessment technology standards depend on membership fees from individuals and organizations who wish to contribute to development and maintenance activities? Are there requirements for "balance" within membership across different constituencies? What are the cost and structure of such memberships? Are there viable alternative methods for generating revenue necessary to conduct the work? What are the most realistic and useful ways to generate participation, fund work, and ensure public access to a technology standards-setting process?

IMS features a membership model for support of standards development, evolution, and maintenance. However, the public is also invited to participate at many points in the process, as described in the answers to 3.2.2, 3.2.4, 3.2.6, and 3.2.30.

Volunteer consortium membership is the proven way for industry to create viral, bottoms-up interoperability standards that follow a fair process. A membership model is the most transparent model as it is easy to ascertain the level of commitment to the organization by looking at dollars and resources members are willing to invest in an organization and their work and the agreement to abide by the rules means that all decisions are tracked. The members are the equivalent of the investors in the organization. As discussed previously, the work of IMS primarily benefits non-members, as there are many more non-members than members that utilize the IMS work – because it is free and free to license. In fact, IMS regularly provides staff support to non-members as well as members. IMS, therefore, is a very viral model in which a relatively small number of organizations (160) provide voluntary financial support to create work that benefits tens of thousands of organizations around the world. However, we do think it is very fair for those who benefit from and believe in the IMS work to become members and show their support for and commitment to our important work. It is part of being a good citizen and contributing leader of the global educational industry. But, there is no way to force such support. A good model, however, encourages member support because otherwise the work will not get done. A membership-based model is much more efficient in terms of taxpayer expenditures than a government led standards activity, such as SCORM, which is also substantially less open and transparent than a standards consortium such as IMS.

As discussed in the answer to the previous question, a standard is only as good as the commitment to it in the marketplace. It is organizations that are major market participants that must make that commitment. This is why membership-based revenue models have been the most successful model for developing and maintaining interoperability specifications. Membership fees vary widely according to the value such organizations can deliver to the members (for instance, standards development is only one third of the value that IMS provides to member organizations). But, generally speaking, the membership dues are a small percentage of the greater financial commitment that is required from organization to support implementation of standards. IMS membership dues vary from $250 to $55,000 U.S. per year depending on the type

and size of organization. Even so, IMS and many other organizations feature participation from invited experts as discussed in the answer to the previous question for free. Educational institutions formed IMS and thus the dues schedule significantly favors such organizations versus commercial interests.

Thus, with a membership model it is relatively easy to tell if a standards organization is providing value. Simply look at the membership dues collected and the commitment from the membership in terms of implementing the work. Those organizations that are collecting more dues are also usually achieving higher level of implementation commitment. This is because most organizations consider the issue of investment in implementation in conjunction with the membership dues before they join. The only case counter to this is when the dues are set so low and non-consequential that organizations may join just to more closely follow activities or achieve a vague marketing return, rather than being truly committed to the success of the standards. However, this will show up in terms of the net revenues of the organization, which will still be much lower than standards organizations that deliver superior value.

Setting a precedent where the U.S. government establishes alternative venues for developing standards is very dangerous in that it both increases the amount of taxpayer dollars required while creating a disincentive for industry to lead an activity that it must lead. The U.S. government can provide a very high value by participating in standards development activities with other participants, large and small. The U.S. government can provide a critical success factor by participating in the work of standards consortia, as this leads to greater industry participation.

The primary alternative "business model" for standards organizations has been a combination of membership and for-fee standards. Some very successful organizations such as the IEEE and ISO/IEC use this model. In this model, there are still member fees, but there are also charges for the published specifications. All IMS specifications are free of charge and publically available. While the for-fee publication model has been successful, IMS believes that this approach is too restrictive for our community.

A third model for developing standards is a lightweight process where a few organizations get together, solve a problem, and then put the solution out in the public domain. Google and a few partners used this approach in developing OAuth, which IMS utilizes at part of Basic LTI. The resulting work can potentially be sustained by submitting it to a larger standards organization or could be sustained by the vendors involved. Succeeding with this approach generally requires backing from major market influencers who can commit to adoption that helps drive the marketplace. As discussed previously in this RFI response, many standards consortia would not consider this an "open process" because there is not an established set of rules on how any interested organization could become part of the governing body and the processes are generally not transparent.

As discussed in the answer to the previous question, it is difficult to conceive of an approach that has been more beneficial to the global public educational community than IMS. The overwhelming majority of IMS users have not paid any IMS membership dues, but yet have been able to benefit from the work because it is free and free to license. This has all been made possible because IMS has established a membership

model that provides high value to those organizations that wish to be the core supporters of the work. IMS has also been a very efficient venue for national governments to benefit from the investment of industry. APIP is a great example of this. Because APIP was done in conjunction with IMS and leveraged a very large body of IMS work, APIP is now implementable at a fraction of the cost for the U.S. government to conduct such an activity on its own. How much would it cost for the U.S. government to develop and maintain APIP? If SCORM is to be used as a comparable case, a rough estimate of $100 million or more taxpayer investment would be required to turn APIP into a government run standards activity.

3.2.32 Availability. What are the costs associated with final publication of technology standards, and with all supporting materials for those standards, and can these assessment products be made available at nominal or no cost to users? Do technology standards require restrictions for use or application, including limitations on derivation, resale, or other restrictions? Is it appropriate to obtain patent, copyright, or trademark protections for assessment technology standards? Are the publications for technology standards and materials provided in a machine-readable, well-defined form? Are there restrictions or limitations on any future application of the publications and materials after initial release? Are developer-assistance materials (e.g., Document Type Definitions, test harnesses, code libraries, reference implementations) also made available free under an open-license? In what circumstances should technology standards-setting organizations retain rights or control, or impose restrictions on the use of publications, derivations, and resale or developer-assistance technologies, as opposed to open-licensing everything? When should materials be made freely available (that is, at no cost to the consumer) while still retaining most or all copyright license rights?

As discussed in the answer to the previous question, some standards organizations like IEEE and ISO/IEC publish standards for a fee. IMS publishes all specifications work without requiring any fees to access or implement and also provides a license to allow third parties to distribute IMS work, as discussed in the answer to question 3.2.4. So, yes, under the IMS model all specifications are made free to users. This is a very proven model used by hundreds if not thousands of standards consortia around the world.

IMS also provides many implementation resources, such as machine-readable bindings and best practice documents which are free and free to use.

Also, implementation of IMS standards does not require the purchase of third-party hardware and software to implement the standards as is required for SIF. IMS standards are "built-in" to supplier applications and therefore included with them. One IMS application "talks" directly to another without the need for any special IMS software or hardware.

The answer to question 3.2.4 details IMS's perspective on the important of protecting users of IMS specifications from infringement of 3rd party IP. IMS processes incorporate a world-class IPR policy explicitly for this purpose. Any standards development activity that does not incorporate such a policy and include wide industry backing is open to potential IP threats as it becomes used in the marketplace.

The answer to question 3.2.4 details IMS's perspective on use of copyrights to lead to strong interoperability and avoid confusion in the marketplace. IMS generally follows the practices of larger standards development consortia on such matters. However, IMS is open to adopting mechanisms that are proven to provide the greatest return on the investment in interoperability standards. Generally speaking, the challenge in the education segment has been on achieving ubiquitous voluntary adoption of standards that deliver on strong interoperability in practice. IMS believes our current approach is making huge strides in this regard, But, IMS is a member organization and the members have the right to evolve the policies and procedures as they see fit to achieve a better result.

3.2.33 Derivation. For technology standards, do copyright licenses for publications and all supporting materials and software licenses for software artifacts permit the unrestricted creation and dissemination of derivative works (a.k.a. “open licensed”)? Do such open licenses contain restrictions that require publication and dissemination of such works in a manner consistent with the openness criteria described by, for example, a GNU Public License (a.k.a. “viral licensed”) or an MIT Public License (a.k.a. “academic licensed”)? Are there policies or license restrictions on derivative works intended to prevent re-packaging, re-sale, or modifications without re-publication for assessment technology standards?

The goal of interoperability specifications and standards is to proliferate interoperability, not to proliferate the number of divergent specifications and standards and related activities. The education and learning technology sector has had no shortage of specifications and standards related activities over the last 15 years. That is because information is readily shared and copyright is far from a full proof way to avoid duplication or derivation of work. However, the industry needs strong interoperability - that works for all parties concerned, both large and small – in order to gain confidence and in order to lower barriers to entry. IMS believes that the substantial changes we have made in our process and membership in the last 5 years are evidence that such changes are now taking hold.

The definition provided in the question for “open licensed” is incorrect as it relates to standards and specifications. The generally accepted definition of “open licensed” for standards and specifications is that there are no fees to implement them. For instance, even IEEE and ISO/IEC can legitimately make the claim that many of their specifications are “open licensed” even though one must buy them to access them. An exception might be a specification such as MPEG-21which contains patent claims from multinational organizations. In such a case, use of the specification must be negotiated with the patent holder. All IMS interoperability specifications are free of charge to both obtain and use. IMS specifications exceed the generally accepted definition of open licensed as it relates to specifications and standards.

A great deal of viral deviation and derivation from IMS standards occurs all the time. Standard copyright does a reasonable job at preventing deviation in derivative works, but it is far from airtight. Copyright only protects the specific expression of an idea and not the idea itself. And, most standards organizations are too small to actively defend a copyright infringement unless it is extremely blatant. In addition, IMS specifications have defined extension points and many optional parameters. Therefore, deviation occurs all the time very naturally. Setting up a publishing paradigm that encourages even more deviation is probably not a wise approach for those that would like to see more interoperability and less standards activities.

If the goal of the interoperability specifications is to enable strong interoperability in

practice and to garner a large community of support, then deviation and derivation should not be the goal. IMS specifications are loaded with extensibility options and optional fields. This makes them very suitable for derivative works by nature. And, as discussed in the answer to question 3.2.5, IMS has invested heavily in creating public tools to encourage such derivative works to benefit the derivers and the IMS membership. However, despite setting this up, nearly all parties to date simply use the existing specifications and tailor them on their own using the built-in provisions to do so.

It should also be noted that for a vendor there are very different processes for contributing IP to open source versus to an open standard. The current model used by IMS involves vendors in a negotiated process to arrive at the best of innovation and interoperability, while protecting their investments and business models, thus ensuring their participation. Various open source licenses and models may seem attractive. But are they proven to provide suppliers and end users alike with the same assurances that open standards processes do? Standards development processes must remain neutral with respect to how products are developed and the business models employed to support the products. Open source is only one such approach. And open source does not mean implemented to an open standard. Open standards are implementation and business model agnostic.

It is also critically important to note, as discussed in the answer to question 3.2.5, that a copyrighted specification does not inhibit innovation in terms of implementing a software solution. A copyrighted specification simply means that the specific expression of the specification is protected. It does not speak at all to implementations. So, any supplier can create additional APIs and so forth beyond a current specification or combine those with pieces of a specification. There are no practical limitations on innovation or usage of a specification because it has a copyright. This is one reason why open source and other communities around the world have made viral use of IMS specifications.

As discussed in the answer to question 3.2.4 there are potentially large downsides in publishing interoperability specification documents that encourage derivative works. For instance, do the RttTA consortia wish to deal with a situation in which assessment vendor A claims they have the authoritative version of APIP while vendor B claims the same thing? So, while conceptually it seems like a great idea to allow derivative works, it is counter-productive to establishing a non-partial final authority on what the interoperability benchmark is and how it is to be met. Should a state trust a single vendor to be the ultimate arbiter of a dispute with respect to interoperability achieved? Of course not.

Effective standards organizations are in fact great examples of "viral" licensing. What has made the Worldwide Web so successful? A large number of committed organizations are working together and legally agreeing that none of them can own the copyright on a set of specifications that they all follow. This is what successful standards' organizations do every day. The World Wide Web did not succeed because there is a plethora of derivative specifications, but rather a plethora of implementations that have been enabled to work together. And, as discussed previously in this RFI response, IMS

standards are used overwhelmingly by organizations that have never invested in them or participated in IMS. The use of standard copyright, while perhaps not sufficient, is the current best practice for standards bodies. However, IMS is open to better policies that are shown to produce better interoperability in practice. As a relatively medium-sized standards organization, we will tend to follow the lead of the larger organizations as they establish new policies. We are very pleased with the success we are having with our current policies. The trend is very encouraging.

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3.2.34 Licensing Descriptions (for materials contained
within the standard, not for the standard's licensing
itself). How do technology standards address licensing
terms for assessment resources described within the
technology standard? Are there successful technology
standards or approaches for describing a wide variety of
license types, including traditional per-use licensing,
web-fulfillment, free (but licensed), open (but licensed,
including commercial or non-commercial use permitted), and
public domain status. Are there other resource licensing
issues that should be addressed within a technology
standard as a best practice?
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We are not 100% sure of our interpretation of this question. It seems to be referencing educational materials developed using the technology standards, such as items or tests in the case of RttTA.

It certainly seems reasonable to consider having metadata on a learning resource that describes its license for use. But, technology standards should be neutral with respect to the business model or license used to make learning materials available. One role of interoperability standards is to make it easier for smaller organizations or even individuals to create resources that can be delivered across many platforms. Without the interoperability standards it would require an individual to develop an assessment in the proprietary schema employed by each platform. With interoperability standards, the assessment can be developed in one schema and run anywhere. This is why the IMS Common Cartridge is so popular. Content, including assessments in QTI, can be developed one way and run on most of the educational course management systems. Thus, this opens up the market. It requires significantly less expense for a new entrant to have their materials work with multiple platforms. It also serves the incumbent market participants in terms of their content now being capable of running on new emergent platforms.

IMS sees a diversity of business models with respect to educational content and platforms as indicative of a healthy market. However, IMS has no position on whether any business model is better than any other. Open resources have many benefits. However, they still need a business model in order to evolve and maintain. Removing the incentive to be compensated for high quality educational materials is probably not a wise move for any government that wishes to see their educational system improve. The significance of the IMS standards is that they enable a blending of open source and open content business models with proprietary business models. IMS enables "write once, run anywhere" without being locked into either an open approach or a proprietary approach. It is the foundation for both.

As an example, the IMS product directory (see http://www.imsglobal.org/productdirectory/directory.cfm) includes over 500 open content courses from the Open University's UK's OpenLearn project and 100 courses from educational publisher Elsevier (to support their top 100 selling textbooks). Both

types of content can be supported by the IMS standards and run together in the same learning platform. Thus the power of the IMS standards to support both open and proprietary content.