Human Performance Interoperability via xAPI: Current Military Outreach Efforts

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ABSTRACT: *In today's era of technology and fast-paced environments, training instruction continues to be presented linearly and uniformly to learners even though research has shown that individuals tend to learn differently and with different styles. For current and future simulators to enable adaptive learner-centric environments, they must be interoperable and track and assess performance of learners over time. Current initiatives at the Advanced Distributed Learning Co-Lab are developing community-driven specifications and tools, such as the Training and Learning Architecture and the Experience Application Programming Interface (xAPI). While xAPI has been designed to support the collection of learning experiences, the U.S. Army Research Laboratory has been making great strides in developing the best practices on assessing human performance through the use of xAPI. Recently defined as Interoperable Performance Assessment (IPA), these efforts support the assessment of individuals across multiple systems through the use of uniformly defined and described data. While these training investments can support distributed simulations, the emphasis is to also share data that will support Live, Virtual, and Constructive events and future training exercises both in the field and training centers. Standardization and interoperability surrounding human performance measurement is looking promising in the coming year. This paper will describe the current IPA efforts as well as the community outreach approaches. Practical examples of air, ground, and gunnery systems will be illuminated to inform the community. The paper will shed light on simulation data encoding methods for harnessing data to support intersystem value through adaptive learning support as well as continue the process of standardizing IPA.*

1. Background

Operational challenges in the future will continue to evolve for military forces and so will the training that supports them. As the Army continues to implement the "Army Learning Concept for 2015" [1], training is shifting towards more adaptive models. These new models will require adjustments in training processes and related technology to meet emerging needs.

As training technology continues to evolve, large amounts of data will be created. This "data exhaust" has the potential to provide significant value for stakeholders in training and education. Single platforms are capable of collecting large amounts of data, yet a number of reasons typically prevent exposing this data beyond the scope of any single platform. Challenges range from security and demand for data to explicitly clear incentives and uniform methodologies for sharing data across platforms.

Typically, only summary information is made available outside the scope of a learning experience. Items such as completion or qualification status are generally the only types of data that persist beyond the scope of single training systems. There are many types of data at lower levels of granularity than completion or qualification that could be used to adapt or personalize simulations. Additionally, data from other systems could be used to continually increase effectiveness of training, mitigate weakness over time, build expertise, or introduce more efficient use of resources. One item often missing from this area is an understanding of intersystem data value, or the value of the residual data from one system to another system. Explicating intersystem data value is a key to providing a case for collection and sharing of such data.

2. IPA Concepts

For our project, IPA is described as “a method of uniformly defining and describing experience and context to assess learning and performance over time; to adapt training across a variety of environments, systems, and modalities, whereby performance is observed, assessed, evaluated, or asserted by systems or observers.” This definition not only combines the methods in which interoperable tracking occurs, but also where the trainee, event, or training content is adapted and how the data are collected. Figure 2.1 shows a notional training cycle of (1) a soldier experiencing classroom, real world or simulation training, (2) being assessed or evaluated by a system or observer, and (3) training being adapted based on the assessments.

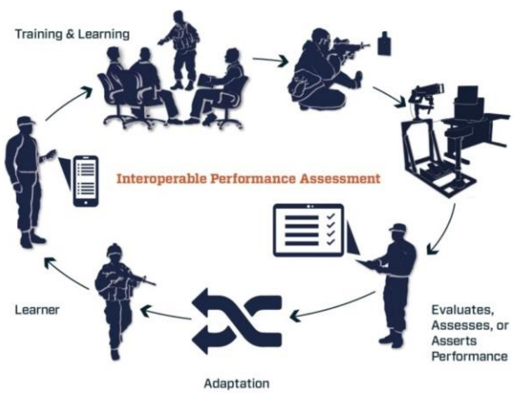

Figure 2.1 - Adaptive Training Cycle with IPA

The goal of IPA is to move toward a common understanding of what is meant by interoperable tracking of performance data and the goals of assessing performance over time.

Implementing IPA could provide the ability for systems to adapt and personalize learning experiences at the micro level, as well as macro levels for future training events. Solutions in this domain provide an opportunity for cost and time savings as performance data is shared between simulation, computer-based training systems, and other learning environments.

3. The Experience API (xAPI)

Interoperability is the ability of different information technology systems and software applications to communicate, to exchange data accurately, effectively, and consistently, and to use the information that has been exchanged [2]. Interoperability has long been a consideration in technology. Attaining interoperability has the capacity to reduce operational cost and complexity, enable best of breed deployments, and leverages existing investment in technology [3].

A number of standards address interoperability across the training domain. Standards which focus on simulations include High Level Architecture (HLA) and Distributed Interactive Simulation (DIS). Additionally, the Sharable Content Object Reference Model (SCORM) aims to also provide learning content interoperability [4]. Though these standards have increased systems interoperability, capturing and sharing performance data is not supported within their scope.

Sharing individual and team performance data across multiple training environments is a capability that can further enhance the interoperability of training environments, supporting future adaptive training capabilities. The Advanced Distributed Learning (ADL) initiative is stewarding efforts of the Office of the Under Secretary of Defense Personnel and Readiness (OUSD P&R) to develop ways to describe and capture learning experiences. Through the Training and Learning Architecture (TLA) [5] effort, ADL is focusing on a method for tracking learning experiences known as the xAPI [6].

The xAPI specification [7] provides an interoperable method to describe experiences across Learning Management Systems (LMS), simulators, virtual worlds, web content, mobile devices, games, and observer-based measures. The 1.0 specification of specification defines a method, using Java Script Object Notation (JSON), to describe the following learning experience: Actor, Verb, Object, Context, Results, and Extensions. Figure 3 is an example of a simple xAPI statement:

```
{
  "id": "9e530c8a-6116-450d-80b9-18200c0771e8",
  "actor" : {
    "objectType" : "Agent",
    "name" : "Smith, Greg",
    "mbox" : "mailto:name@domain.com"
  },
  "verb" : {
    "id" : "http://domain.com/verbs/assessed"
  },
  "object" : {
    "objectType" : "Agent",
    "name" : "John Bates",
    "mbox" : "mailto:name@domain.com"
    }
  }
```

Figure 3.1 - Example xAPI Statement

The statement describes an event where Greg Smith assessed John Bates. Additional elements like

Context and Results could be used to further describe the experience.

The xAPI statements are stored in a data store known as a Learning Record Store (LRS) [8]. In accordance with the xAPI specification, the LRS provides a storage and access mechanism for statements and allows a centralized point for routing, reporting, and data analytics.

4. GIFT and SCALE

Additional efforts are underway at the Department of Defense (DoD) to develop adaptive, learner-centric systems. The Army Research Lab (ARL) and Army Research Institute (ARI) developed the Soldier Centered Army Learning Environment (SCALE) [9] to provide a data-driven architecture to support training and education across multiple hardware platforms (personal computer and mobile devices), using mobile applications, virtual classrooms, and virtual worlds. SCALE is modular and web service-based, which will facilitate the integration of new technologies into the broader SCALE architecture and potentially allow the integration of SCALE into existing and new technologies.

ARL's Learning in Intelligent Tutoring Environments (LITE) Laboratory is also supporting the Army's vision of more efficient and effective learning by developing the Generalized Intelligent Framework for Tutoring (GIFT) [10]. The intent is to research and develop a computer-based tutoring framework to evaluate adaptive tutoring concepts, models, authoring capabilities, and instructional strategies. GIFT's infrastructure provides a generic tutoring capability, including remediation strategies based on learner performance, to integrated learning environments. The goal is for GiFT to support various populations, training tasks, and conditions, enabling summative and formative evaluations.

5. Human Performance Measurement Language (HPML)

HPML is a method to capture individual and collective performance using an eXtensible Markup Language (XML) activity structure [11]. HPML allows the expression of important concepts from the training world so that others, such as training professionals, instructors, operators, and researchers can use, aggregate, and understand the data easily. The schema was designed to capture and assess performance across distributed simulations. HPML identifies critical fields and stores them within an XML activity structure. IPA uses HPML as one basis for describing current performance data. The constructs of HPML are used to guide data collection that is defined in xAPI statements.

6. IPA Effort

The IPA concept is focused on providing capabilities to support adaptation, personalization and tailored learning across a variety of environments along the continuum of learning and training [12]. Robust learner profiles with their experience data will ultimately be needed for IPA to succeed across environments. The effort has included both technology development and the research and development of best practices, as discussed below.

6.1. Encoding Best Practices

Research was conducted to encode individual performance data captured in HPML into xAPI statements. The effort identified constructs that may be utilized for encoding human performance data and context into xAPI statements for both system-based (simulator) and observer-based (instructor) measures. Figure 6.1 outlines key constructs and descriptions that were used to develop the encoding best practices. The key constructs have been mapped to the xAPI statement structure and used for the examples outlined within this paper.

6.2. Tool Development

Requirements and tools to create and view this data for systems such as GIFT and SCALE were also explored and developed. In the case of GIFT, the software is open source and was easily modified in parallel to ongoing efforts. The GIFT Learning Management System (LMS) was modified to allow both the creation and consumption of xAPI data. Additionally, the capability to macro-adapt learning paths was provided, based on proficiency or deficiency data found in the LRS. This capability allows GIFT to both produce and consume data in support of the IPA concept.

6.3. Pipeline

Specific elements for encoding data using the best practices were implemented in a data encoding dynamic link library (DLL) known as Pipeline. Pipeline provides a simplified software component to write individual and team performance data from a simulation to an LRS using the Experience API format. The Pipeline component abstracts the complexity of xAPI implementation details, such as transport and security and enforces best practices by using a shared, common vocabulary. This capability allows more rapid deployment of IPA capabilities to a simulator or system in adopting systems.

Construct	Description
Mission	The task, together with the purpose, that clearly indicates the action to be taken and the reason behind the action.
Mission Phase	A time period or stage in the process of completing a mission.
Task, Subtask, etc.	Hierarchy under a Mission Phase consisting of things to be done during the phase. Tasks > Subtasks > Sub-subtasks.
Competency/METL	The higher-order individual, team, and inter-team competencies that a fully prepared pilot, operator, crew, flight, or team requires for successful mission completion.
Training Objective	A measurable intended end result of a training program.
Standard	Benchmarks used to assess performance at, above, or below competency, as well as supporting data (e.g., anchors, parameters, etc.).
Knowledge and Skills	Knowledge is information or fact that can be accessed quickly under stress. Skills are compiled actions that can be carried out successfully under stress.
Experience	An experience is a developmental event during training and/or career necessary to gain knowledge or skills, or practice a competency under operational conditions.
Position	The duty or related group of duties that a soldier must perform for a given mission.
Platform	Any military structure or vehicle bearing weapons. In this context, the structure by which a MEC is required.
Training Environment	The setting in which the learning or acquisition of skills or competencies is conducted.
Training Character-istic	The specific feature or quality of the training environment relating to the acquisition of skills or competencies.
Measure	The heuristic used to determine success of a demonstrable.
Assessment	The rating of the result of a measured demonstrable.

Figure 6.1 - Experience Description Constructs

6.4. SP2

The IPA research effort also included the development of a prototype called the Soldier Performance Planner (SP^2). The SP^2 is a tool for managing and encoding performance data in the LRS and provides an additional means to interact and visualize the performance data for individuals and groups. Tools are provided for importing and exporting experience records, showing proficiencies and deficiencies of individuals and groups across one or more skills. The SP^2 also captures HPML performance data across distributed simulations, encodes the data into xAPI statements, and stores them in an LRS. Figure 6.2 is an example data flow architecture using these components.

7. Outreach

During IPA research and development, the community was engaged on multiple fronts. Community partners ranging from simulator manufacturers and technology developers to those focused on corporate learning were engaged to gather input, determine scope and functionality for tools, validate IPA concepts and approaches, and provide feedback on best practice development. Example data sets were defined to test and resolve technical issues. The following sections outline example encoding of human performance constructs using xAPI statements that were produced by community stakeholders using the tools in the notional architecture above.

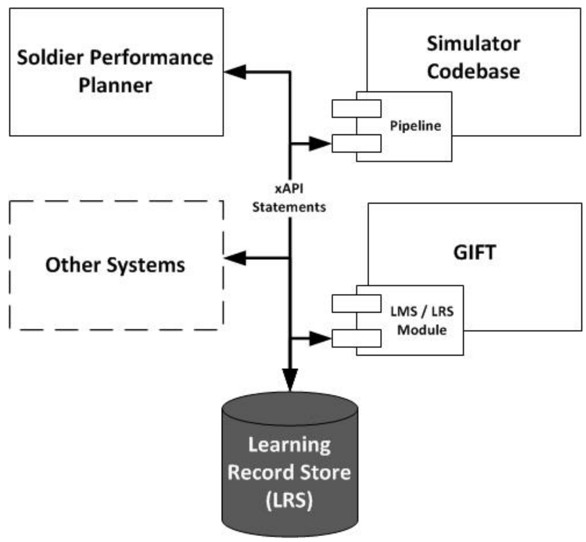

Figure 6.2 - Example IPA Architecture

7.1. Gunnery

The example outlined in Figure 12.1 (see Section 12 – Code Samples) was produced from a simulator and outlines an individual performing a gunnery task. Note that the individual failed the experience (see "results") and the context as well as definitions of the context within which the failure occurred is outlined within the context section of the xAPI statement.

7.2. Air Support

The example in Figure 12.2 is from an AH-64 Apache simulator. In this example, the user failed "Perform Deliberate Attack Operations" during an activity. Note the context and definitions in the context section that outline the conditions that the failure occurred within as well as the score.

7.3. Intelligent Tutoring Systems (ITS)

The example in Figure 12.3 shows an example of the type of information that the GIFT intelligent tutor produces when users are completing a learning activity. This example outlines a case where a user experienced and failed Hemorrhage Control, delivered by GIFT. This example was produced by the LMS module of GIFT and written to the LRS as user activities were completed.

7.4. Assessment Example

The example in Figure 12.4 outlines an example of an assessment. This specific example was created by SP^2 based on data from a simulator. The person logged into SP^2reviewed a number of data points and then created the assessment. Examples like this are being used by GIFT to adapt learning paths. Note the result is marked as “at,” which refers to the “at/above/below” measures that GIFT uses to categorize proficiency. This statement is pushed to an LRS from SP^2. When systems like GIFT connect, they can determine concepts for which someone has deficiencies and either provide recommendations for remediation (macro-adaptation) or provide adaptation within a scenario (micro-adaptation) as a remediation strategy.

7.5. Teams and Groups

The final example (Figure 12.5) outlines an example of a statement made about a team. In this case, a group, 25CABAV1, has participated in an Unstabilized Platoon Gunnery activity. Notice the score of 630 out of a possible 1000 in the Results section. This example also outlines a number of penalties that are defined as Extensions.

While the xAPI statement can be used to define an assessment of a group, the xAPI specification does not support groups of groups. The method used here is an early example of future work for defining groups in a way that enables reporting and visualization to be done in a hierarchical model that approximates group design while the specification does not allow such recursive groupings.

8. Lessons Learned

A number of lessons learned and recommendations have been identified from this effort. The following section outlines key focus areas and lessons learned with recommendations for the future.

8.1. IPA Concept

The Army Learning Concept describes future training as (1) learner-centric and adaptive, (2) assessment driven, and (3) conducive to lifelong learning. To fulfill this vision, data must be easily accessible and usable across systems. The IPA concept was developed to assist with this goal.

8.2. Profile and Learning Models

While some models exist for learner profiles, additional research is needed. Profiles can be built around competencies. Tracking at the learning objectives level is important and relating content to objectives is relevant. Commonality and agreement are needed between learner models and profiles. As a first step, systems should use competencies for tracking learner performance.

8.3. Standards and Interoperability

Standardization and interoperability allow data from one system to be used by others. Though data may be captured in any given system, it may or may not be relevant to other systems. Example data that demonstrates support for intersystem adaptation is needed.

8.4. Standards for Adaptation

While some standards for learner data exist they are not ubiquitous. Currently, no standards exist for performance data used for personalization purposes. As a result, data collected to assess learner state or progress within one system is not easily usable by other systems. Additionally, adaptation and personalization are context specific. Further research is needed in this area.

8.5. Granularity

Granularity, coupling and abstraction are important to adaptation data. Adaptation in or between any systems will depend upon the granularity of the data. Personalized tools that exist are less adaptive and communicate with other systems but do not contain a standard to utilize the data meaningfully. A balance between capturing large amounts of data and capturing meaningful data that is useful to other systems is important. As a result, performance tracking systems should target competencies.

8.6. Timescale

For systems to personalize training based on trainee state or characteristics, data must be tracked over time to assess trainee progress through a specific course or larger training curriculum. Tracking depends on the following factors: granularity of the learner data model, qualitative characteristics or attributes of the model, openness of the model (open learner model versus closed, or characteristics of both), and purpose of the model.

While granularity concerns the grain size of the captured data, tracking may also concern the type of data captured. Typically, tracked data types are attributes of learner models and include all things considered important for tracking and assessing trainee state and the progress needed for adaptation to occur. These attributes may be knowledge states, learner preferences, learning styles, or specific learner behaviors that are meaningful to a system's adaptation or personalization strategy. These attributes may be specific to a particular tracking method and data model (i.e., SCORM, computer managed instruction (CMI), etc.) exclusively or may also contain many other data elements. Sampling frequency across a variety of measurement sources should be considered.

8.7. Interoperability

Information about a learner's knowledge levels or competence assessed within a specific system could potentially inform recommendations for other learning resources within a system, or make recommendations across systems. However, this requires interoperability of data. Most systems that adapt to the learner do so in a black box fashion using proprietary models of the learner, domain, and data. Highly adaptive systems are typically complex and designed as isolated systems that do not communicate or interoperate with other digital learning systems [13]. Providing specifications, standards, or even best practices could increase usage and potential adoption.

9. Future Considerations

Continued focus on the intersection between the variety of efforts underway at the DoD, as they relate to tracking and assessing performance, is critical to evolution of adaptive, learner-centric environments. Future efforts should focus on defining systems and tools that can inform IPA, produce practical examples, and drive encoding best practices.

Additionally, other environments and data sources outside of system-based and observer-based data, e.g. physiological data, computer-based data, etc., will need to be explored. These efforts should focus on expanding encoding best practices toward interoperability of performance data in a physiological context.

The community can increase adoption and move toward performance data interoperability through data sharing and open community development. There is an opportunity to conduct further analyses and technical exchange among groups in order to make the community intersection possible. Future work should focus on the integration of systems via IPA concepts in order to leverage these important applications and support 21st century soldiers.

10. Conclusion

By leveraging analytics and metrics of performance-based activity data about individuals from a variety of sources, organizations can begin to provide the right support to unlock potential efficiencies. While opportunities for adaptive and tailored learning represent a path ahead to larger efficiency, there are currently shortcomings in the data availability across systems for interoperable performance tracking and assessment.

The outcomes of this research provided an accelerator for planning and integrating performance data from multiple systems in support of the IPA concept. The effort also leveraged insight from the community, learning literature, performance measurement system requirements, emerging specifications, and industry/government best practices to provide a perspective to promote unity and collaboration among the various technologies.

Next generation training tools will need to create uniform types of data and communicate in interoperable ways. Systems that aim to provide adaptive or tailored learning will need to leverage both data about learners and data about the content in continually evolving complexity at more and more granular levels. Capturing and sharing individual performance data across systems will be key to enabling adaptive, learner-centric environments.

11. References

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12. Code Examples

```
{
    "id": "95f846ac-a46e-49aa-8a39-7aabba216c85",
    "actor": {
        "objectType": "Agent",
        "name": "Smith, Joe",
        "mbox": "mailto:name@domain.com"
    },
    "verb": {
        "display": {
            "en-US": "assessed"
        },
        "id": "http://www.SP2Test.com/assessed"
    },
    "object": {
        "objectType": "Agent",
        "name": "Jacob Daniels",
        "mbox": "mailto:name@domain.com"
    },
    "result": {
        "success": true,
        "response": "at"
    },
    "context": {
            "grouping": [
                {
                    "id": "URI/forAir_to_Ground_Integration",
                    "definition": {
                        "name": {
                            "en-us": "Air to Ground Integration"
                        },
                        "description": {
                            "en-us": "Target is destroyed"
                        }
                    }
                },
                {
                    "id": "URI/for/101st_CAB_AATX",
                    "definition": {
                        "name": {
                            "en-us": "101st CAB AATX"
                        },
                        "description": {
                            "en-us": "7/18/2013 11:20:15 PM"
                        }
                    }
                }
            ]
        }
    }
}
```

/

Figure 12.1 - Gunnery Statement Example

```
{
    "id": "e6d7b8c4-dd69-4331-af91-54fbd6de4ada",
    "actor": {
        "objectType": "Agent",
        "name": "PVT Joe Smith",
        "mbox": "mailto:name@domain.com"
    },
    "verb": {
        "display": {
            "en-US": "experienced"
        },
        "id": "http://adlnet.gov/verbs/experienced"
    },
    "object": {
        "objectType": "Activity",
        "id": "activityId:uri/101st_CAB_AATX",
        "definition": {
            "name": {
                "en-US": "101st CAB AATX"
            }
        }
    },
    "result": {
        "extensions": {
            "uri/trainingobjective": "course objectives..."
        },
        "success": false,
        "response": "5"
    },
    "context": {
        "extensions": {
            "uri/AVCATT/role": "FAC",
            "uri/AVCATT/visualSceneDisplayRes": "20/10 visuals",
            "uri/AVCATT/cockpitContent": "Layout replicates aircraft",
            "uri/AVCATT/visualFieldOfView": "180 horizontal FOV",
            "uri/AVCATT/gCueing": "No G cues",
            "uri/AVCATT/axisDisturbanceMotionCues": "No none"
        },
        "contextActivities": {
            "grouping": [
                {
                    "id": "contextActivities:uri/01_2_5179_PADAO",
                    "definition": {
                        "name": {
                            "en-US": "01-2-5179 Perform Aerial Deliberate Attack Operations"
                        },
                        "description": {
                            "en-US": "Destroy enemy or force them to withdraw"
                        }
                    }
                }
            ]
        },
        "platform": "AH-64 - Apache"
    }
}
```


Figure 12.2 - Air Support Statement Example


```
{
    "actor" : {
        "objectType" : "Agent",
        "mbox" : "mailto:name@domain.com"
    },
    "verb" : {
        "id" : "http://domain.com/verbs/experienced"
    },
    "object" : {
        "objectType" : "Activity",
        "id" : "activity:uri/GIFT/Hemorrhage_Control",
        "definition" : {
            "name" : {
                "en-US" : "Hemorrhage Control"
            },
            "description" : {
                "en-US" : "Hemorrhage Control"
            }
        }
    },
    "result" : {
        "response" : "Fail"
    },
    "context" : {
        "platform" : "GIFT"
    },
    "timestamp" : "2014-05-16T08:19:15.000Z"
}
```


Figure 12.3 - GIFT Statement Example

```
{
    "id": "95f846ac-a46e-49aa-8a39-7aabba216c85",
    "actor": {
        "objectType": "Agent",
        "name": "Smith, Joe",
        "mbox": "mailto:name@domain.com"
    },
    "verb": {
        "display": {
            "en-US": "assessed"
        },
        "id": "http://www.SP2Test.com/assessed"
    },
    "object": {
        "objectType": "Agent",
        "name": "Jacob Daniels",
        "mbox": "mailto:name@domain.com"
    },
    "result": {
        "success": true,
        "response": "at"
    },
    "context": {
            "grouping": [
                {
                    "id": "URI/forAir_to_Ground_Integration",
                    "definition": {
                        "name": {
                            "en-us": "Air to Ground Integration"
                        },
                        "description": {
                            "en-us": "Target is destroyed"
                        }
                    }
                },
                {
                    "id": "URI/for/101st_CAB_AATX",
                    "definition": {
                        "name": {
                            "en-us": "101st CAB AATX"
                        },
                        "description": {
                            "en-us": "7/18/2013 11:20:15 PM"
                        }
                    }
                }
            ]
        }
    }
}
```


Figure 12.4 - Assessment Statement Example


```
{
        "verb": {
                "display": {"en-US": "unqualified"},
                "id": "URI:///verbs/unqualified"
        },
        "object": {
                "definition": {
                        "type": "URI:///simulations/Collective_Gunnery",
                        "name": { "en-us": "Platoon Table X"},
                },
                "id": "URI:///simulations/Platoon_Unstabilized",
                "objectType": "Activity"
        },
        "actor": {
                "account": {
                        "homePage": "URN:UUID:844dfbd3-97ce-488a-ba7c-757419729b99",
                        "name": "25CAVAB1"
                },
                "objectType": "Group"
        }
        "result": {
                "completion": false,
                "score": { "raw": 600, "max": 1000 },
                "extensions": {
                        "URI://xAPI/resultExtensions/penalties": [
                                {
                                        "penaltyValue": "10%",
                                        "penaltyCategory": "10 Percent",
                                        "penaltyReason": "Engaged friendly or noncombatant targets."
                                },
                        ],
                        "URI://xAPI/resultExtensions/activityEndTime": "2014-03-12T04:49:29",
                        "URI://xAPI/resultExtensions/targetsKilled": "11",
                        "URI://xAPI/resultExtensions/activityStartTime": "2014-03-12T05:00:31",
                        "URI://xAPI/resultExtensions/roundsFired": "438",
                },
                "response": "",
                "success": false
        },
        "context": {
                "extensions": {
                        "URI://xAPI/contextExtensions/unit": "25CAV",
                        "URI://xAPI/contextExtensions/platoon": "1",
                    },
                "contextActivities": {
                        "other": [
                                {
                                        "definition": {
                                                "name": {
                                                        "en-US": "Conduct an Attack/Movement to Contact"
                                                },
                                                "description": {
                                                        "en-US": ""
                                                }
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        }
}
```


Figure 12.5 - Team Statement Example

13. Author Biographies

MICHAEL HRUSKA is a technologist with experiences spanning across standards, emerging technologies, learning, and science. He is a former researcher at the National Institute of Standards and Technology in Gaithersburg, MD. He is currently the President/CEO of Problem Solutions, and provides learning technology solutions to government, commercial, and nonprofit organizations. His team has been supporting efforts at the Advanced Distributed Learning (ADL) Initiative on the future Training and Learning Architecture (TLA) and the Experience API. He holds a B.S. from the University of Pittsburgh and is a member of the e-Learning Guild, American Society of Training and Development (ASTD) and the National Defense Industrial Association (NDIA).

RODNEY LONG is a Science and Technology Manager at the Army Research Laboratory, Human Research and Engineering Directorate, Simulation and Training Technology Center (STTC) in Orlando, Florida. He is currently the STTC project lead for the Soldier-Centered Army Learning Environment, conducting research in support of the new Army Learning Model. Mr. Long is also the STTC project lead for the Joint and Coalition Training Rehearsal and Exercise Research (JCTRER), supporting the use of LVC simulations for joint and coalition warfare. Mr. Long has a wide range of simulation and training experience that spans 25 years in the Department of Defense and has a Bachelor's Degree in Computer Engineering from the University of South Carolina and Master's degree in Industrial Engineering from the University of Central Florida.

CHARLES AMBURN is the Senior Instructional Systems Specialist for the Advanced Simulation Branch of the US Army Research Laboratory, Human Research and Engineering Directorate, Simulation Training and Technology Center in Orlando, FL. After obtaining both a Film degree and a Master's degree in Instructional Systems Design from the University of Central Florida, he began his DoD civilian career in the Advanced Instructional Systems Branch at the Naval Air Warfare Center Training Systems Division (NAWCTSD). There, he worked on special projects for the Navy and Marine Corps for 10 years before becoming the Lead Instructional Designer for the Army's Engagement Skills Trainer (EST) program at the Program Executive Office of Simulation, Training and Instrumentation (PEOSTRI), Orlando, Fl.