Indirect Fires Precision and Lethality Enhancements through Digitization of Artillery and Mortar Weapon Systems

Presented by
Victor Galgano & Ralph Tillinghast
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Overview and Outline

Outline

- **Fire Control Digitization** *(Presented by: Vic Galgano)*
  - Fire Control Functions
  - Indirect Fires Before Digitization
  - Digitized Systems and Their Advantages

- **Current and Future Trends** *(Presented by: Ralph Tillinghast)*
  - Smart Projectile Interface
  - The Move Toward Commonality
  - New Fire Control Technologies and Innovations
The Fire Control Functions

- Navigate
- Projectile Interface (e.g., Excalibur)
- Determine Platform Position
- Determine/Affect Weapon Pointing
- Communicate on Fire Support & Sit Aware Nets
- Sensor Interfaces Data Processing & Display
- Tactical & Technical Fire Control/Data Processing
Manual Precision Survey (Aiming Circles / Aiming Stakes / Collimators manually placed)

Sight Units on weapons referenced to aiming circles

Map navigation

Voice communication of gun orders

Instrument and weapon leveling / cross-leveling

Plotting boards / Protractors / Slide rules at FDC

Manual control of weapon aiming

CREW-INTENSIVE OPERATIONS
Digital technology provides significant improvements to Indirect Fire Systems

- Digital link to Fire Support Network
  - Call for fire
  - Met data
  - Logistics data

- On Board Ballistic Computation and Sensors using Ballistic Kernel

- Automated navigation and location systems

- Automated 3-axis gun orientation

- Precise weapon aiming and automatic weapon drives (Paladin)
Indirect Fire Digitization Efforts for PM Customers
M95 Mortar Fire Control System

Digitizing the M1064 through integration of Hardware and Software Components
ARDEC Digitizes Mortar Warfare for PM Mortars

**ARDEC Approach**

- In-house software development & system integration
- IPT employed
- EVM employed
- Level 5 CMMI Processes

**Mortar Fire Control System (MFCS)**

- Gunner's Display
- PDA
- SINGGARS Radio
- Commanders Interface (computer)
- Inertial Nav & Pointing Devices
- Driver's Display
- Software

**Significant Performance Improvements**

- Improved Responsiveness (1.5 vs. 8 min)
- Increased Survivability (No need to dismount)
- Increased Accuracy (75 M CEP)

**Full Digital Connectivity**

ARDEC applies digital technology providing significant improvements to mortars
**Performance vs M23**

- **Computational Accuracy**: 10M (vs 25)
- **Uses Ballistic Kernel**: <2 lbs (vs 8)
- **Response time**: 4 min (vs 8)
- **6 simultaneous missions**: (vs 3)
- **Accommodates all fielded ammo**
- **Digital connectivity**
- **MET Data**
- **Integrated GPS**

**Improvements In:**

- **Responsiveness**
- **Survivability**
- **Accuracy**
- **Portability**
- **Ease of Use**

**Enables “Shoot & Scoot” Tactics**

**Winner of “DoD Top 5 Program” and “Army’s 10 Greatest Invention Award”**
Digitized M119 Sled Configuration - Transport

On Carriage:
- Inertial Navigation Unit
- Muzzle Velocity Sensor
- Gunner Display

Sled:
- iPIK
- Battery
- Data Power Hub
- Common Power Module
- Radio / Amplifier * / Antenna
- FCC
Digitized M119 Sled Configuration - Firing

**Sled:**
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**On Carriage:**
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Fire Control Interface with EPIAFS / PIK

Munitions / Weapon Systems

- Excalibur
  - Paladin (Portable Excalibur Fire Control System (PEFCS) was Interim Solution)
  - LW 155
  - M198 (Australian PEFCS)

- PGK (Precision Guidance Kit)
  - Paladin
  - LW 155

- Advanced Precision Mortar Munition Initiative (APMI)
  - MFCS-M M113
  - MFCS-M STRYKER
  - MFCS-D
Numerous potential applications across US and NATO FC systems

Technical Feasibility

- Fire control functions largely independent of weapon requirements - their implementation varies
- “Weapon-Specific” technical requirements are essentially the same and mainly affect HW integration
- “Weapon-Independent” requirements such as network interfaces/protocols and situational awareness affect all platforms and influence software upgrades

Opportunity for

- Enhanced development and interoperability among Nations
- Potential Future Joint System Development
- Significant Schedule and Life Cycle Cost Savings
Example of the Effectiveness of Commonality

**D120 MFCS**
- Gunner's Display
- PDA
- SINCGARS Radio
- Pointing Devices
- Software

**MFCS (H) Heavy**
- PDA
- SINCGARS Radio
- Commanders Interface
- Driver's Display
- Software

**MFCS for STRYKER BCT**
- Gunner's Display
- PDA
- SINCGARS Radio
- Commanders Interface
- Driver's Display
- Software

**DragonFire II/REAMM**
- Gunner's Display
- PDA
- Pointing Devices
- Software
- Computer

**Portable Excalibur Fire Control System**
- Gunner's Display
- PDA
- Pointing Devices
- Software

**Lightweight Handheld Mortar Ballistic Computer**
- Gunner's Display
- Pointing Devices
- Software

**M119 Howitzer**
- Gunner's Display
- Pointing Devices
- Software

**LW 155 Blk 1a**
- Towed Artillery Digitization
- Software

**ONR/USMC Effort EFSS Demo**
- Gunner's Display
- PDA
- SINCGARS Radio
- Computer

**Total Avoided: $55.35M**

*NOTE: SOFTWARE DEVELOPMENT COSTS ONLY*
Long Term Vision

Common Requirements
- System Management
- Communication: FBCB2 & FS Nets
- Technical Fire Control
- Data Management/Processing
- Projectile Interface (e.g. XM982, MRM)
- Soldier Machine Interface/Displays
- Hardware/Peripheral Interfaces
- Sensor Interfaces
- Weapon Positioning
- Autoregistration
- Navigation
- Embedded Training
- Maintenance

Common Solution
- Maximum Use of Existing, proven HW & SW
- Facilitates Pre-planned HW & SW Upgrades
- Promotes HW & SW Commonality
- Reduces Development, Testing, Production, Training, Maintenance, O&S Costs

Numerous Developments and Systems
- NATO Platforms
- SBCT
- Paladin
- LTW M777/TAD
- Bradley
- LAV
- Current Systems
- D120
- GCV
- Abrams
- Trainers/Simulators
- Other Services
- FMS

Enhanced Products & Capabilities
- Prototypes for Beta Fielding
- Responsiveness to User
- System Growth & Enhancements
- Consistent Products
- Concurrent Deployments
- Technology Capabilities
- Increased Reliability
- Common Maintenance
- Lower Life Cycle Costs
- Operating Systems & Hardware Platform Porting

Structured Approach and Integration of Complementary Hardware & Software Fire Control Elements
MEMs Based Technologies
Commercial Market Drivers
  - Automotive
  - Gaming (WII)
  - Smart Phone / Tablets
SBIR Work, AVAM-JWG
Secure Wireless

What does that drive?
  - Smaller
  - Lighter
  - Cheaper
  - More Accurate
  - Less Power
  - Increase in Operation

MEMs Vibratory Gyroscopes Prof. Andrei Shkel, University of California at Irvine
WULF provides weapon pointing data from the LHMBC wirelessly to gunner. The Gunners display unit indicates the required gun shift information.

- **Embedded Computer**
- 3-4 mil Accuracy
- Target Battery Life: 24+ hours
- Report Delta Deflection and Elevation
- Adaptable to different wireless standards
- 60, 81 and 120mm compatible
Questions

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