A Systems Approach to Accelerating Testing, a Case Study

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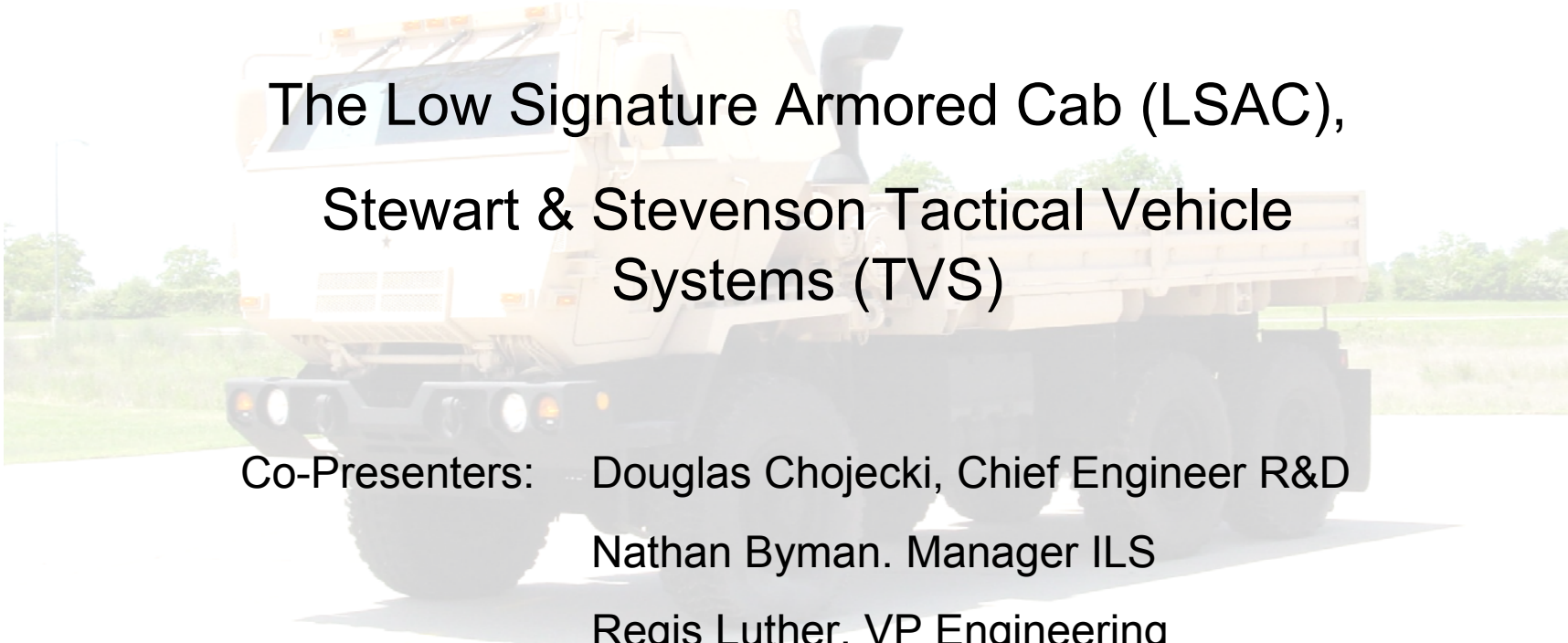

The Low Signature Armored Cab (LSAC),

Stewart & Stevenson Tactical Vehicle Systems (TVS)

Co-Presenters: Douglas Chojecki, Chief Engineer R&D

Nathan Byman. Manager ILS

Regis Luther, VP Engineering

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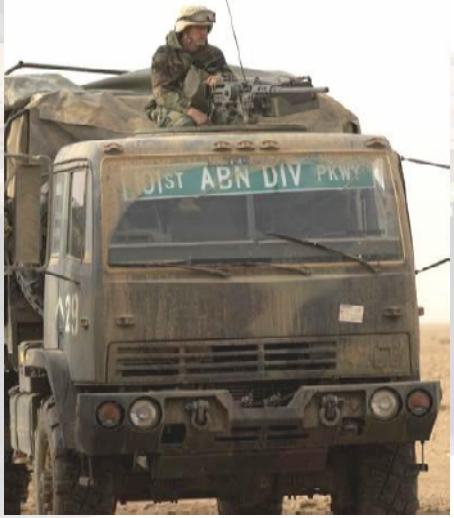
Introduction

- U.S. Army pre-OIF strategy for Tactical Wheeled Vehicles (TWV) did not require armoring



- Battlefield experience in OIF quickly showed TWV required protection; ambush – small arms, IED, RPG

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Introduction, continued

- Demand for Armor on TWV resulted in need for accelerated development, including system-level testing
- Normal U.S. Army development test for cab would require 6 -12 months of effort, production to follow
- LSAC tested within 3 months
- Qualification testing run in parallel with first production

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The "Real" world

- The customer knows what they want
- Requirements are derived considering all affected by the system; users, logistics, manufacturing, finances...
- Requirements are stable, or with the rare exception: revised in a controlled change environment
- Schedules are well planned, fixed and met
- Designs successfully anticipate all failure modes and complete documentation is available for procurement, manufacturing and field support
- The end product is verified to meet all requirements

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The Original Requirements

- TVS IRAD effort used existing vehicle requirements
- C130 transportability was maintained
- Coupon testing of ballistic solutions validated LSAC could be built to withstand objective threat levels
- Meeting other standard FMTV requirements with LSAC allowed maximum commonality

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The original project milestones

Oct. 2002	Project approval/requirements analysis
Jan. 2003	Design start
Apr. 2003	Ballistic solution chosen
Jul. 2003	1st prototype cab complete
Aug. 2003	TVS test of prototype

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August 2003, Project is on schedule! – Success!

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Realizing an opportunity

- Shortly after successful completion of the 2-man LSAC concept cab, U.S. Army is shown concept
- Interest quickly accelerates
- Results in requirements redefinition for the armored cab

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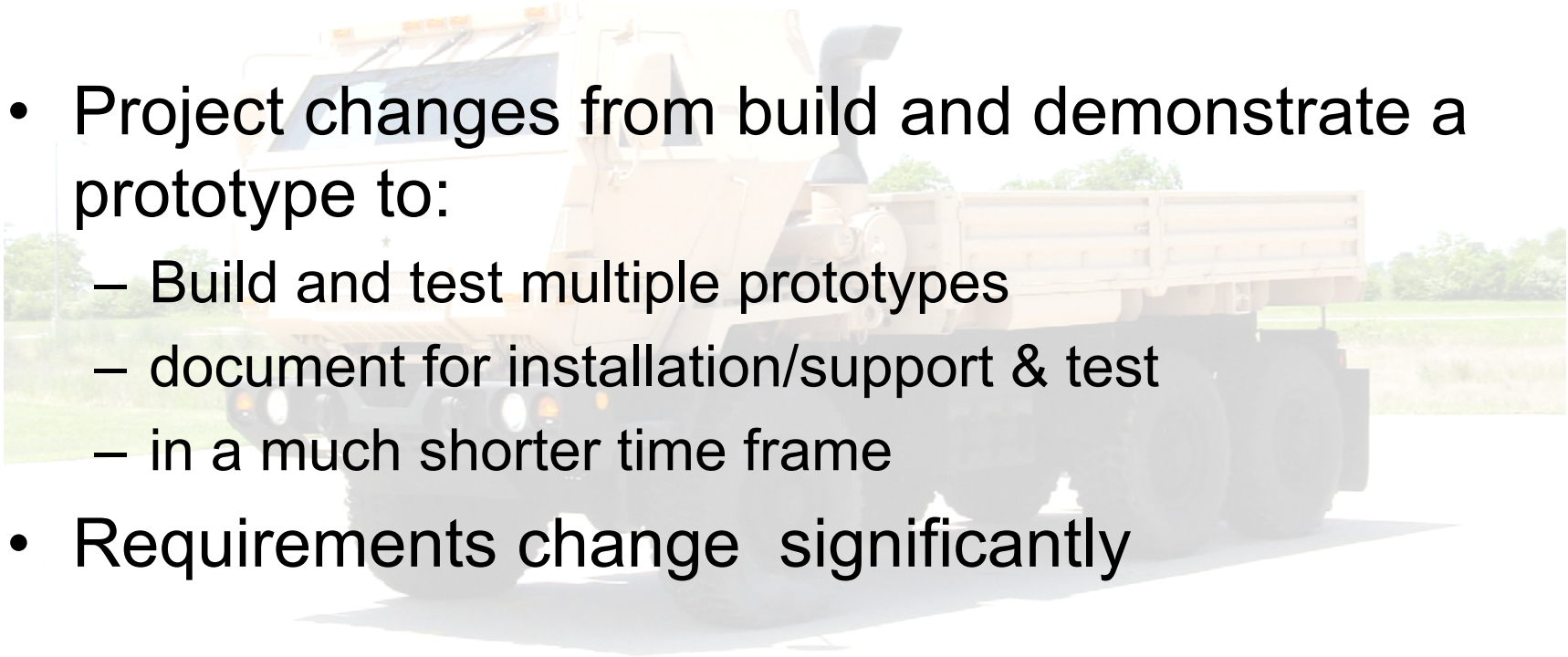
Scope and schedule change dramatically



- Project changes from build and demonstrate a prototype to:
  - Build and test multiple prototypes
  - document for installation/support & test
  - in a much shorter time frame
- Requirements change significantly

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The new project milestones

Sep. 2003	U.S. Army begins discussions
Apr. 2004	1st Prototype of 3-man cab
May 2004	Government testing begins
Jun. 2004	Safety Release
Nov. 2004	Contract for initial production cabs
Dec. 2004	Delivery of initial cabs

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Re-engineering the product

- U.S. Army ballistic requirements are specified – classified
- 3-man cab defined in place of TVS IRAD developed 2-man cab
- Man-lift changes glass configuration
- Supplemental armor requirements added

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Accelerated testing: durability, safety, performance

- LSAC required safety release
- 3k mile durability test scheduled at Government Test site
- Performance testing scheduled at Government Test site
- Testing scheduled to be accomplished May-June 2004

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Documentation; Configuration Management

- 3-D modeling developed for design
- Model revisions controlled via database
- Initial new parts built from models
- Technical data package (drawings) finalized during initial build
- Change approval streamlined
- Change approval became more limited during production to concentrate on must have, not like to's

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Logistics & Supportability

- Logistics/maintainability involved during design phase to ensure supportable design
- Commonality of parts, LSAC versus standard cab used to maximum advantage
- Work instructions for field retrofit developed on 1st LSAC cab(s)

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Production

- Ramp-up to 300 cabs/month achieved in 4 months
- Close coordination with design engineering and manufacturing during tooling and process definition
- Manufacturing changes to TDP processed with highest priority

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Fielding

- Established installation teams and sites through existing support network,
- And additional site(s)
- Design concept of replaceable cab versus “add-on-armor” made installations quicker
- Data from initial fielding, gathered through established networks, enhanced testing and required/suggested were implemented expeditiously

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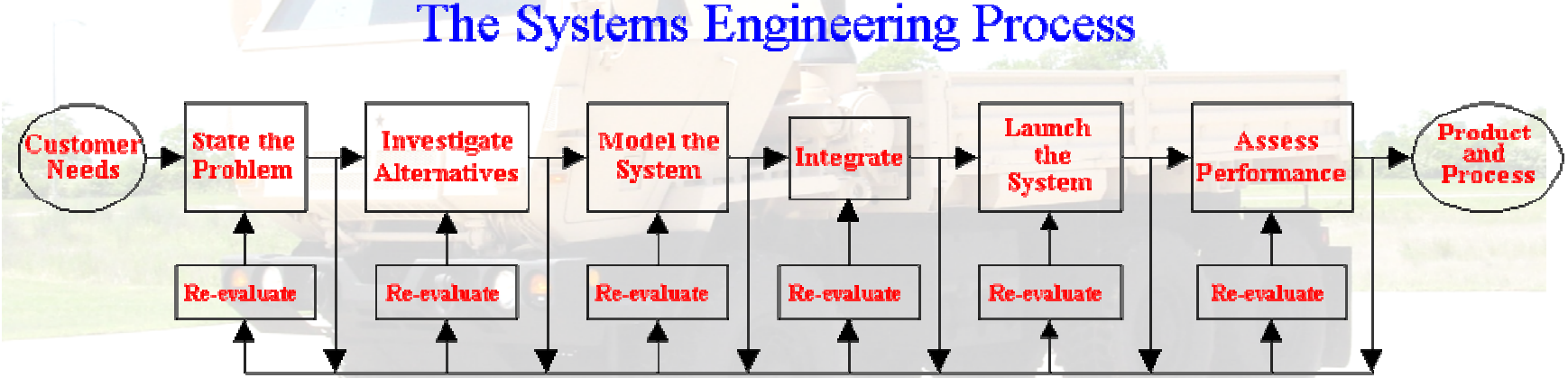
Evaluation of the Project - The Systems Engineering Process



This figure is from Bahill and Gissing (1998)

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How the LSAC requirements were established and changed

- Discussions with and evaluation by U.S. Army resulted in current cab 3-man capability being retained
- Internal volume of cab was also required to be minimally changed,
- Resulting increase in axle loading during transport approved as acceptable

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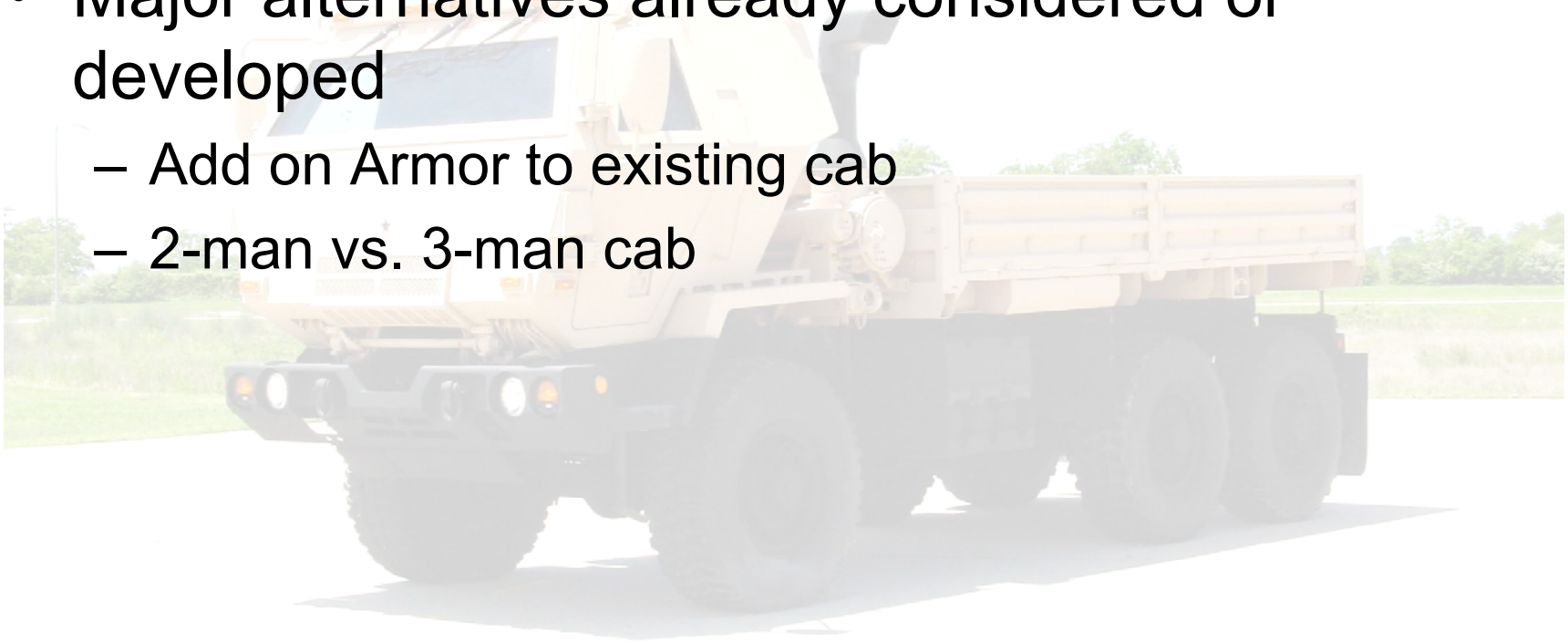
LSAC Alternatives investigations

- Major alternatives already considered or developed
  - Add on Armor to existing cab
  - 2-man vs. 3-man cab



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Integration of LSAC

- Maintained standard production cab interfaces to maximum extent
- Development by OEM with full access to TDP, manufacturing and vehicles assets expedited design
- Most ILS development of technical documentation achieved during design & prototype build

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System Fielding

- Design concept of replaceable cab simplified installation
- Teams led by trained personnel
- Cabs shipped to theatre and installed on deployed vehicles
- Direct communication between installation teams and factory

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Assessing the performance

- The key to achieving success was to get the product designed and qualified ASAP
- Testing for safety release was accomplished in less than 2 months
  - Normally this would require at least 6 months
- Controlling change through production and test phases is critical. Changes must be minimized!

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Conclusions

- Buy-in from all levels required to get the project accomplished in the expedited time-frame
- Priority must be established to achieve success
- Excellent communications and working relations required