2016

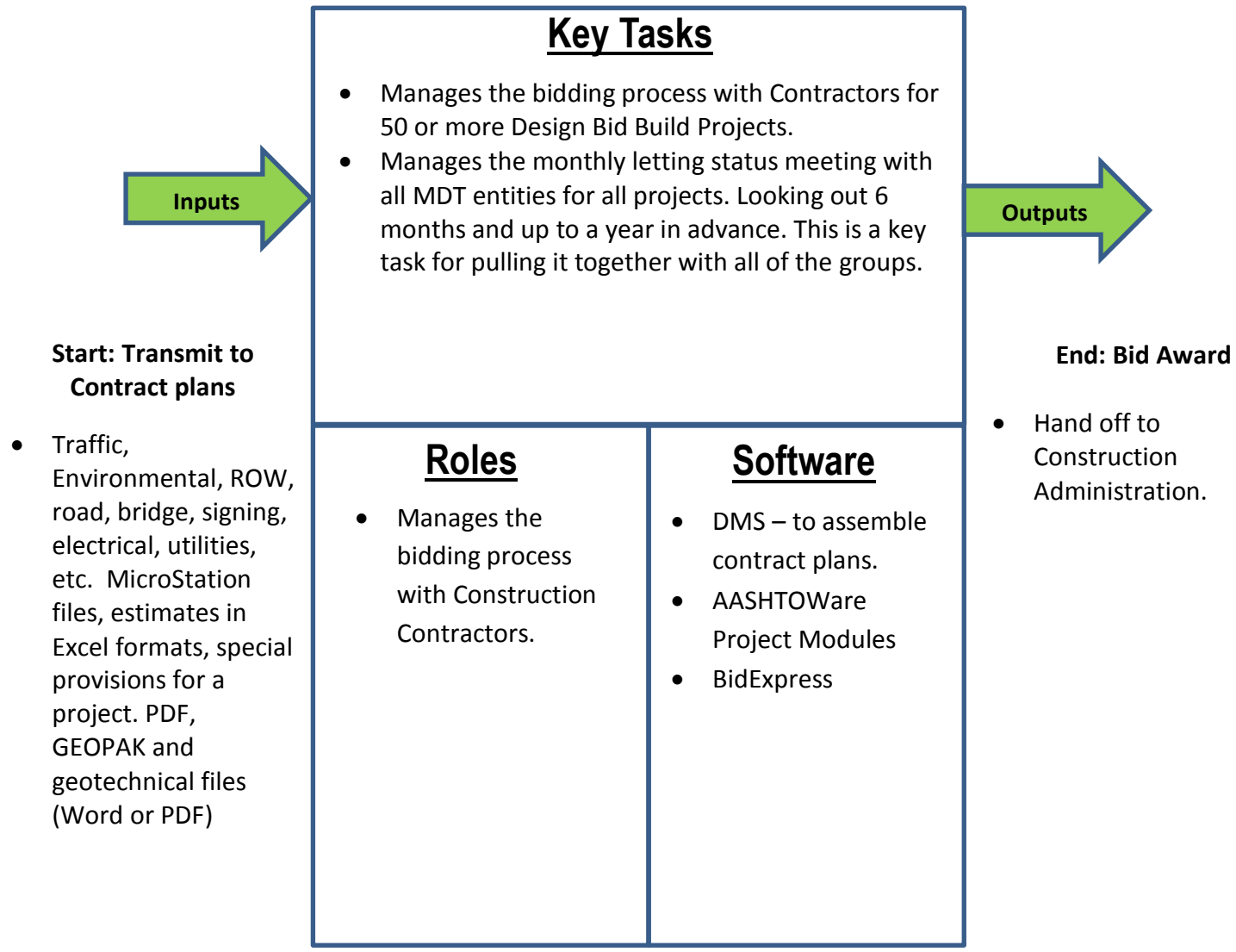
3D Study

And Implementation Plan

Appendix B – Discovery Session #2 – As-Is Summaries

January 29, 2016

Group Name: Procurement - Contract Plans
Process Name: Project Delivery – Bidding



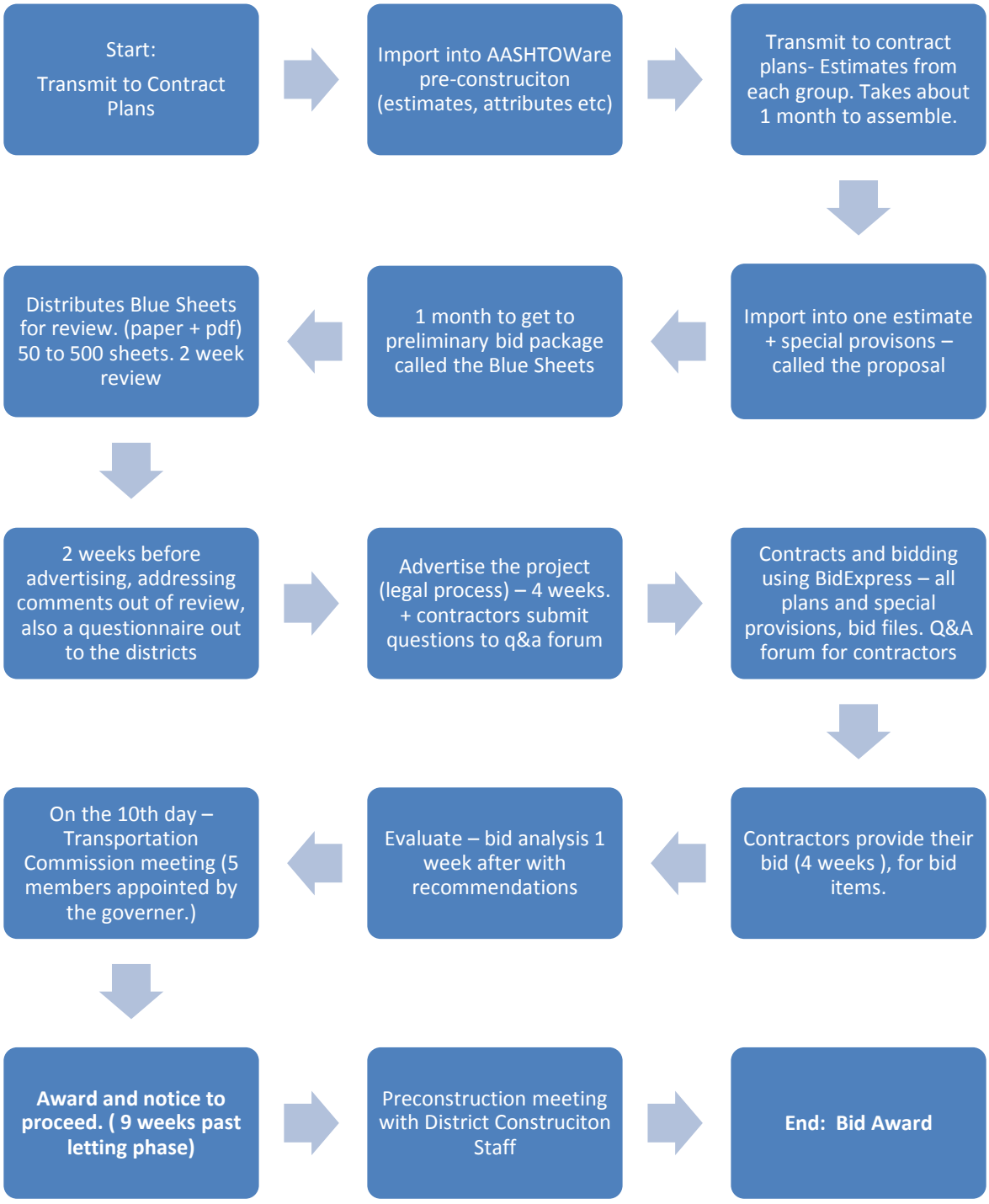
Start: Transmit to Contract plans

- Traffic, Environmental, ROW, road, bridge, signing, electrical, utilities, etc. MicroStation files, estimates in Excel formats, special provisions for a project. PDF, GEOPAK and geotechnical files (Word or PDF)

End: Bid Award

- Hand off to Construction Administration.

Current State Process Summary



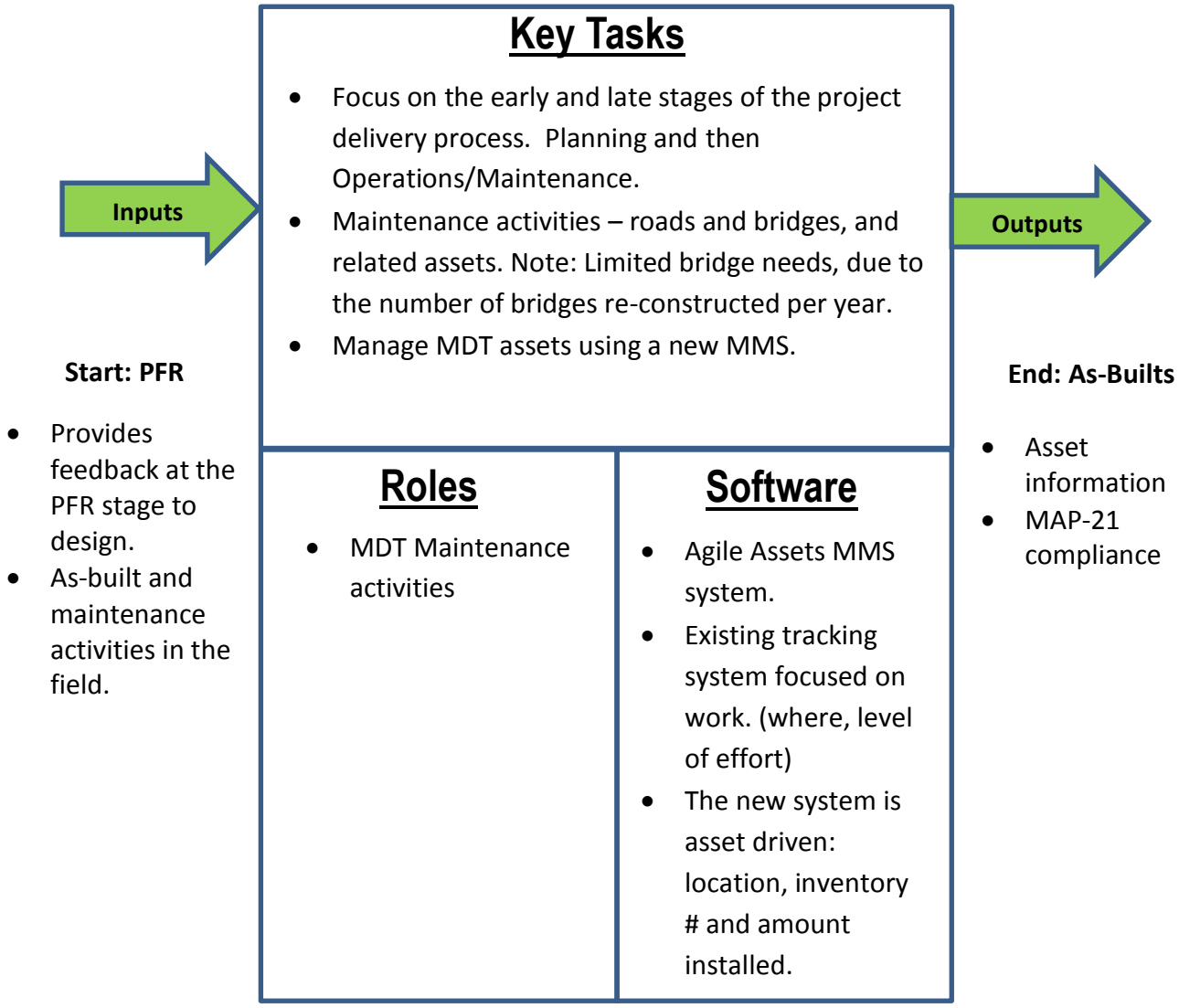
- **Technology**
  - Utilize AASHTOWare - Import into AASHTOWare pre-construction (estimates, attributes etc.)

- Utilize DMS to assemble estimates and plans for bidding.

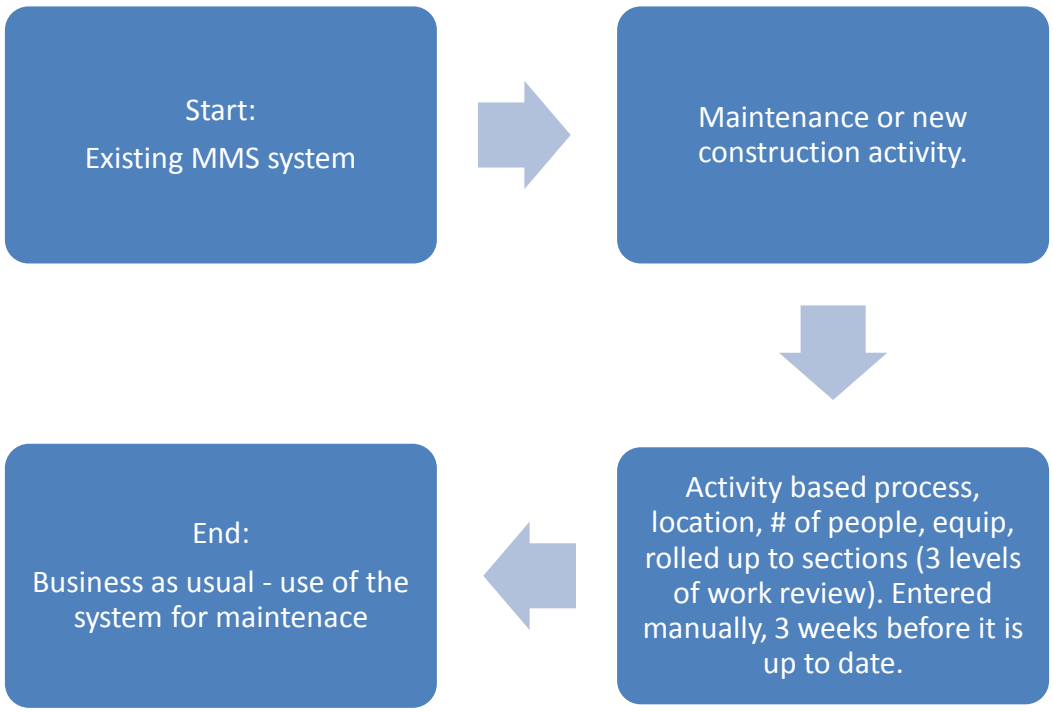
- **People**
  - Very limited exposure to 3D.
  - Need to be able to read/understand 3D models to get the information for AASHTOWare. Key interaction with that business process.

- **Identified areas of 3D Impact and Improvement**
  - Key impact area is the interface of the 3D model with the existing AASHTO business process – Would like to extract quantities in an automated way out of the 3D model.
  - The current workflow uses the DMS to assemble bid plans. The future would further require the use of 3D models as the contract document instead of 2D drawings.
  - The use of a 3D Electronic model would impact the required scanned plans for the wet signature. Currently 3 versions of the same file are created. (MicroStation, pdf and scanned files.)
  - Impacts blue sheet process since it is currently paper based.
  - Use of BidExpress.

Group Name: Maintenance
Process Name: Implementation of a new MMS system



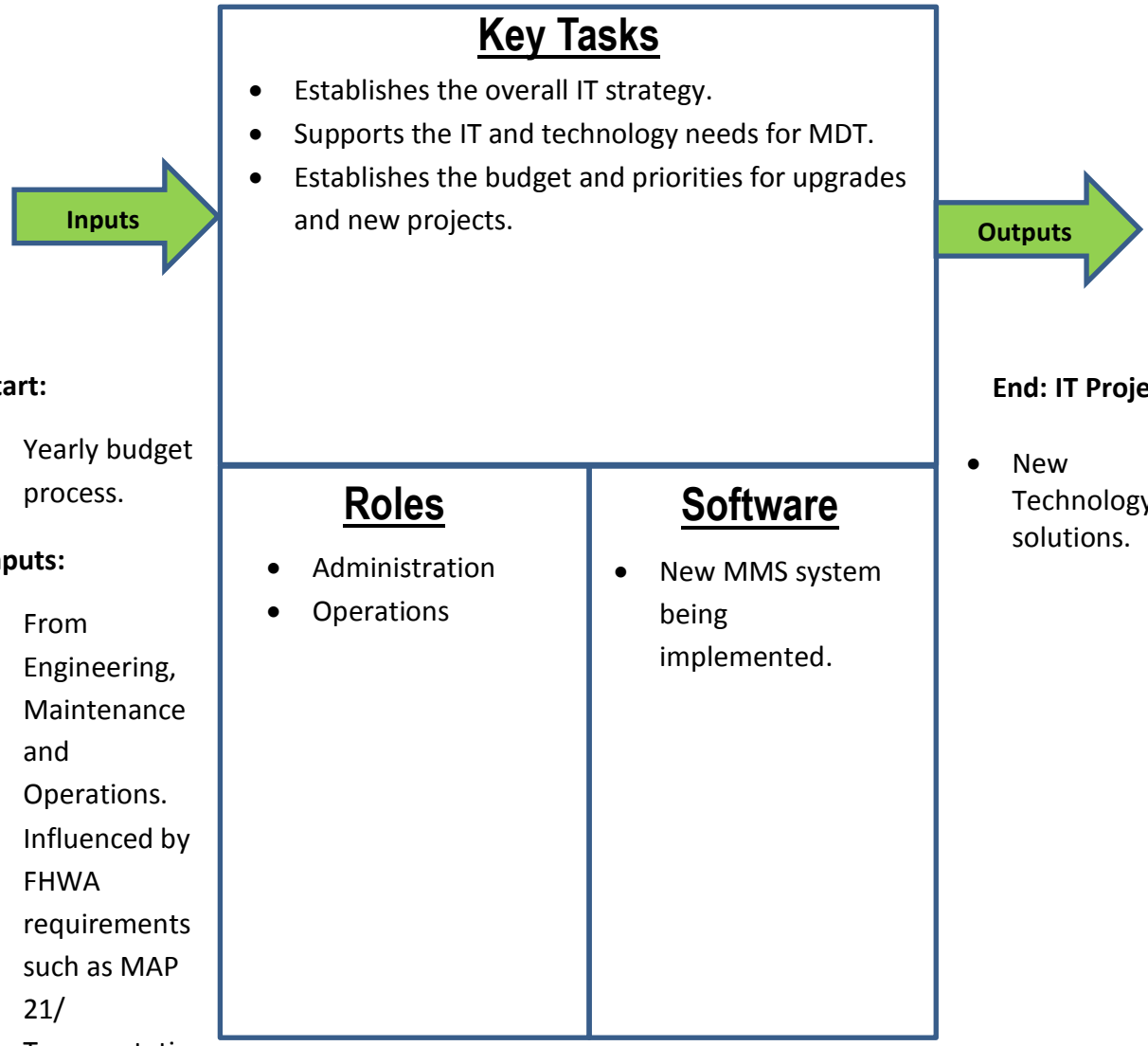
Current State Process Summary



- **Technology**
  - Implementing an Agile Assets MMS. Target launch is August 2016. Currently doing a process review and defining the future configuration.
- **People**
  - Very limited 3D exposure.
- **Identified areas of 3D Impact and Improvement**
  - 3d model attributes - Need asset type, location and amount installed from the 3d model for the MMS system.
  - Would like to capture maintenance activities using mobile devices.
- **Expected/Stated Benefits using 3D models:**

- Savings with utility locations – significant $s spent on locating utilities.
- Utilize the attributes of an intelligent model that information can be extracted from.
- Able to leverage federal aid (A federal aid state).

Group Name: ISD - IT
Process Name: Functional Group



Start:

- Yearly budget process.

Inputs:

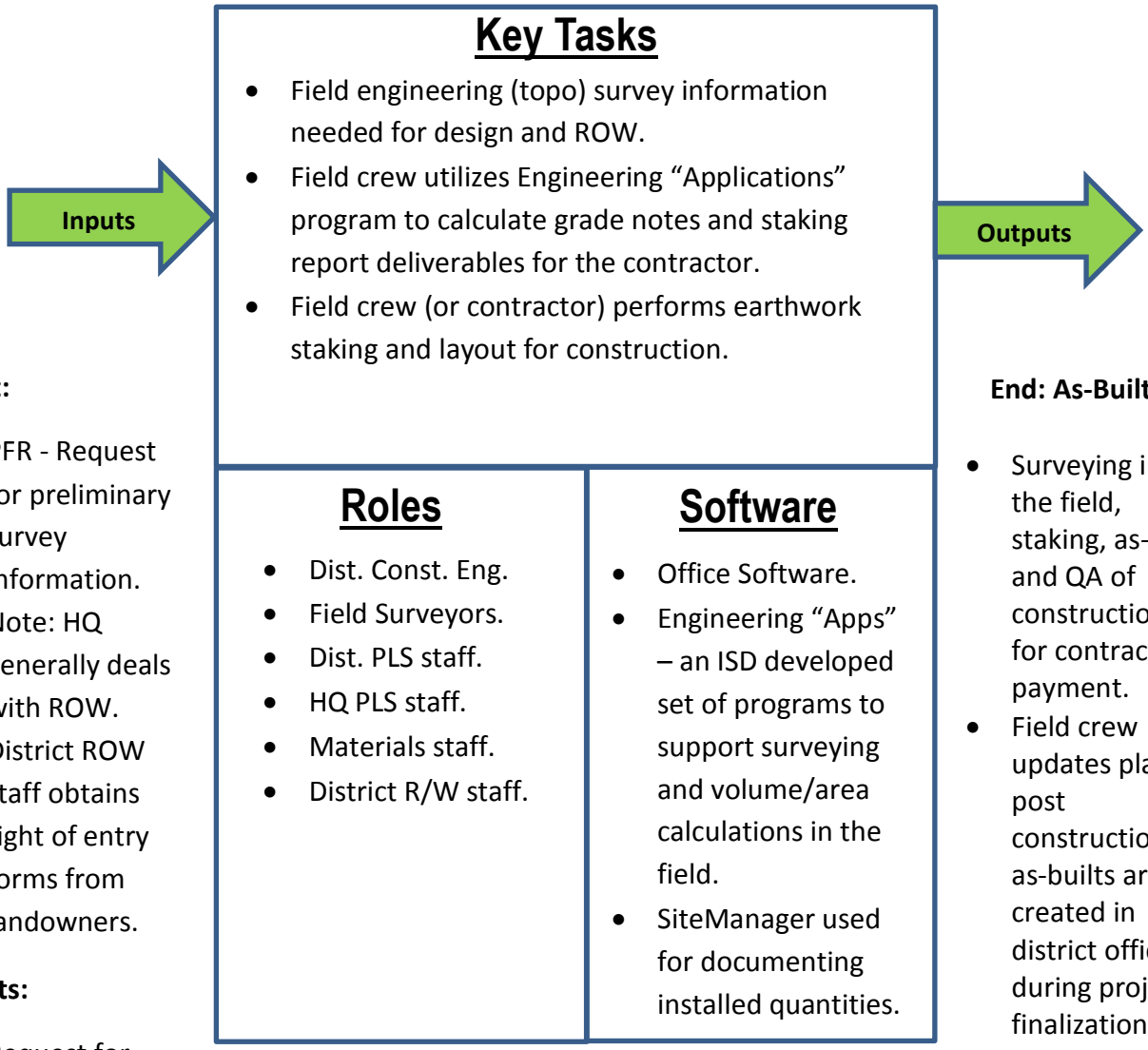
- From Engineering, Maintenance and Operations.
- Influenced by FHWA requirements such as MAP 21/ Transportation Asset Management (TAM) plan.

End: IT Projects

- New Technology and solutions.

- **Technology**
  - Requirements driven by the use of 3D models and related technology needs to be communicated to ISD for the 2017 budget.
  - Wireless communication is often a challenge in Montana.
- **Identified areas of 3D Impact and Improvement**
  - Technology needed for both the pilot and future needs to be planned well ahead of time. (12-24 months)
  - What is the impact of large files such as Lidar on network/storage needs?
  - What is the impact of 3D models from both a storage and network capacity when moving files from HQ to various district offices and the field construction sites?
  - The 3D business process interaction with the new MMS system. What attributes can be used?

Group Name: Field Construction
Process Name: Project Delivery



Start:

- PFR - Request for preliminary survey information. Note: HQ generally deals with ROW. District ROW staff obtains right of entry forms from landowners.

Inputs:

- Request for survey information.

End: As-Builts

- Surveying in the field, staking, as-is and QA of construction for contractor payment.
- Field crew updates plans post construction; as-builts are created in district office during project finalization process.

Current State Process Summary

- **Technology**
  - Engineering “Apps”

- Engineering apps used to input alignment and grade information, staking notes, and to generate staking reports for contractors. Design to engineering apps interface, alignment, horizontal, vertical, and typical sections in engineering apps. Generates grade and earthwork staking notes.
- Engineering apps does not have the ability to communicate with anything, design or survey software. Standalone software. (sits between design and survey equipment)

▪ As-Builts

- For As-built information, the Project Manager will update the plans, sheet by sheet and submit them to the District Engineering Officer or design staff who make the changes to the DGN files. Have a living set of 2D plans that are marked up. The updates are typically done post construction.
- Note: See summary sheet for as-builts for more detail.

○ **People**

▪ Very limited exposure to 3D design models. Field staff has been exposed to contractor developed MGC models over the past 10-15 years. Field staff coordinate with the contractor when performing alignment and grade checks during construction.

○ **Identified areas of 3D Impact and Improvement**

▪ Need to change people's perception to make a shift to a 3d model. Touching paper vs. an intellectual model.
▪ For Survey need equipment/accuracy to support 3D models and AMG.
▪ Output of the staking from the Engineering Apps program is not necessarily the same as the output from the GEOPAK model today or the 3D Model in the future. The staking information (horizontal and vertical alignments, typical section transitions, etc.) should be electronically transferred from the model.

○ **Expected/Stated Benefits using 3D models**

- Really help with utility location and identifying conflicts. Get existing utilities into the model.
- Electronic transfer of information will reduce man hours currently required to manually input staking information.
- Electronic file sharing will reduce errors resulting from manual entry.
- Design and model changes will be incorporated into as-built plans. Less reliance on Project Manager's memory.

Group Name: Environmental
Process Name: Project Delivery Support and Aquatic Mitigation Projects

Start: Planning for Roads/Bridges

Project Nomination for aquatic mitigation

- A project that needs environmental support for its lifecycle.
- Natural Resource Information System – (Underground tanks)

Inputs

Key Tasks

- Corridor Studies, includes environmental impacts.
- Support NEPA Requirements.
- Aquatic mitigation has a lot of involvement through construction. They are managed as an asset forever. Monitor for 5 years on a yearly basis. 15 wetlands and streams in the 5 year review. After 5 years continue to manage and monitor. Total of about 50 locations.

Roles

- 2 major workflows
- Aquatic projects which are managed forever.
- Road/Bridges projects that need environmental support

Software

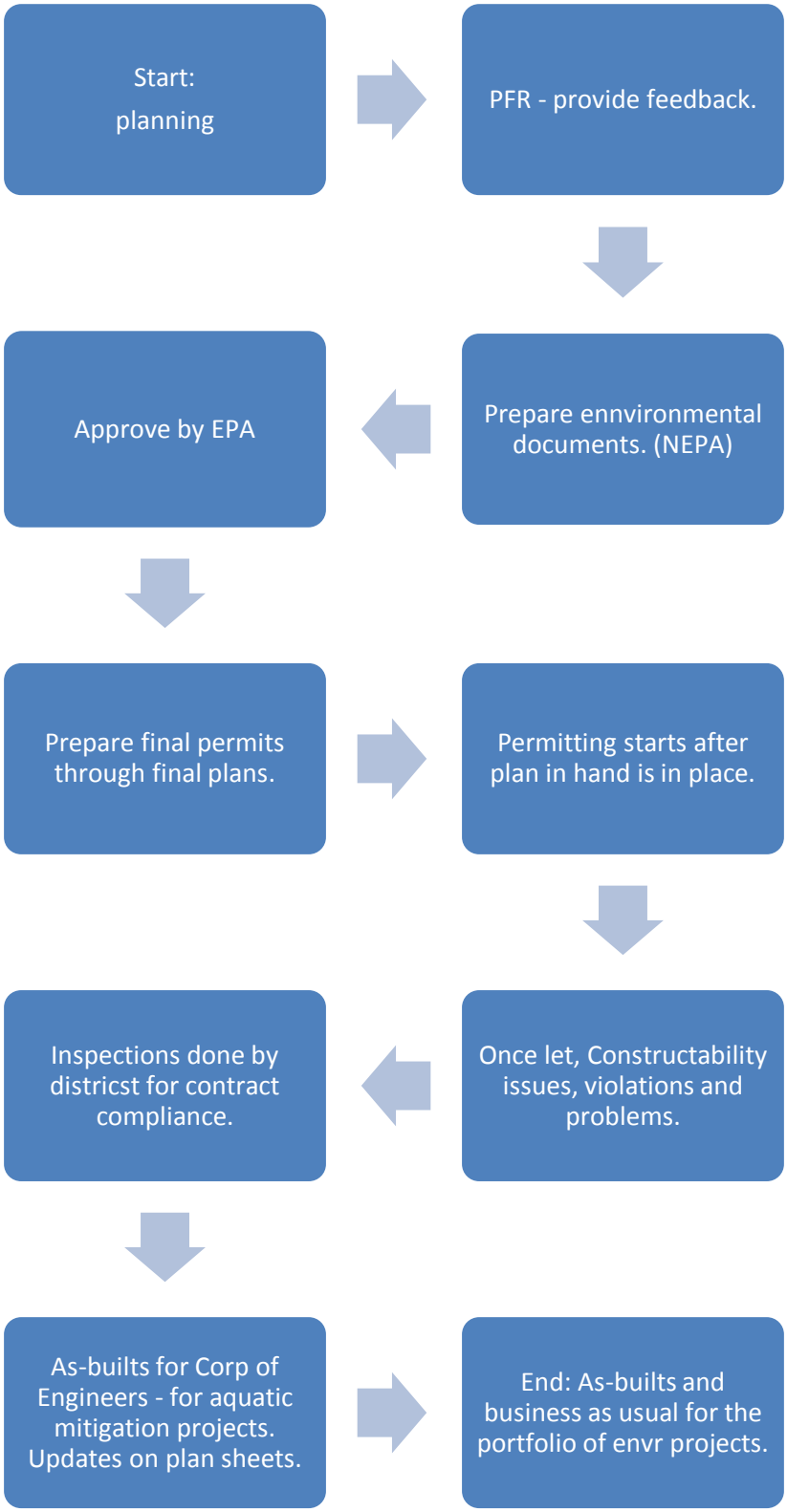
- Traffic Noise model 2.5. Plan to use 3.0 in the future.
- ArcMap, ArcGIS – Online
- MicroStation

Outputs

End: Monitor aquatic mitigations for 5 years on a yearly basis.

- Permits, design work, - plans, specs, estimates.
- NEPA documents.

Current State Process Summary – Roads and Bridges.



- **Technology**

- GPS units are Trimble.
- See software above.

- **People**
  - Very limited exposure to 3D.

- **Identified areas of 3D Impact and Improvement**
  - No significant 3D impacts to the current process. The use of 3D models would “enhance” the business outcomes to the current workflows.
  - Potential use of mobile devices in the field to reduce manual efforts.
  - The portfolio of Aquatic Mitigation projects are managed forever. There is an opportunity to determine if further improvements from an Asset Management perspective could be achieved.

- **Expected/Stated Benefits using 3D models:**
  - Support the NEPA process with the public what they intend to construct. To allow better questions for a very public process.
  - Augment permitting to show agencies for review of permits. Resource (Federal, State and Tribal) agencies external to MDT.
  - To assist with tribal governments showing areas of impact. Also US Fish and Wildlife service impacts.
  - Show noise walls to the public.
  - Could use 3D PDF files in EIS documents and in permitting.
  - Could use AVI fly-through of a project for permitting reviews.

Group Name: Contractor(s)
Process Name: Contractor Construction using AMG

Contractor Discovery Session Summary:

- **Common Themes:** (Note: MDT does the slope staking based on Engineering Applications data)
  - Creates 3D models from the plans and then use the MDT created staking reports to connect to the actual terrain.
  - Each company has a "model expert" to create the needed 3D models for AMG.
  - AMG is used primarily for grading.
  - 3 of the contractors use Carlson software to create 3D models
  - Delivery of information to contractors is not consistent from district to district

- **3D Models:**
  - Contractor A
    - Creates 3D models from MDT provided plans.
    - AMG, on the job surveying, quantities. Not use for pre-bid.
  - Contractor B
    - Primarily does BIM/3D Models in the vertical market. Their Civil group is looking to follow MDT's lead on the use of 3D models for civil projects.
  - Contractor C
    - Carlson is used to create a 3D model from the 2D plans
  - Contractor D
    - Carlson software is used to create 3D models.
    - Creates the final 3D model after the staking notes are provided. Model #1 shows full subgrade with any ditch grades. Then a 2nd model with the final top course of gravel.
    - Would like to have data in a XML format.
    - In addition to getting 3D models, getting the text and alignment files would be helpful.

- **Software/Hardware Used**
  - Contractor A
    - Topcon – 3D office – import LandXML
    - Carlson Software
  - Contractor B
    - Agtek software
  - Contractor C
    - Uses Agtek for estimates
    - Carlson is used to create 3D models. Need break lines, shoulders, catches and ditches.
    - Trimble business Center is used to take the Carlson files and convert them for the machine controllers.
  - Contractor D
    - Using machine control since 2005.
    - Grading and Paving AMG. The paving is being done for airports for the needed tolerances.
    - Using Carlson, can look at individual cross sections to spot check them.
    - Topcon – 3D office has a virtual simulator using the 3D model and the equipment prior to release to the field.
    - XML files don't seem to work well. This may be related to the boundaries. This may be caused by different versions of the software and what to include in the settings.

- **Stated Benefits: (For the use of 3D models being provided by MDT for AMG)**
  - Contractor A
    - saves time (Man-hours), safety, improved quality (reduces rework). If MDT provided a 3D model, it would reduce hours of creation time, but would still verify and load the model.
  - Contractor B
    - Quality, safety, reduced cost (Lower bids)
    - Improved understanding of how the elements fit together.
    - Staged work that is required for construction.
  - Contractor C
    - Time savings, more efficient (the biggest thing), 75% of staking has been reduced. Some staking is done for the operators as an added check.
    - Decrease programming time

- A related automation issue are the geometric tables currently being provided on drawings. They have to be entered by hand. Having the geometry provided by MDT in a consumable format would be a big benefit. (Excel)

- Contractor D
  - Efficiency, time saver. Not competitive with using AMG.
  - Getting a 3D model from MDT, would cut office time by 50% or more. They would only need to check and verify the 3D model.

- **Stated Challenges:**
  - Contractor A
    - Can't load a DGN file with their software.
    - File format compatibility between hardware. (AMG controllers and survey equipment).
  - Contractor B
    - Need a certain level of infrastructure to support 3D models.
  - Contractor C
    - Support for the software and hardware in the field from the vendor community is critical to what software is used.
    - Utilities are not moved before construction starts or the Utility company locates them where they want. There would be a big benefit in having the Utility Company located the new utility in a 3D model for use with AMG.
  - Contractor C
    - Existing topo surveys don't appear to be up to date to capture everything.
    - Topcon requires a localized network. MDT designs in state plan.

Group Name: Construction Reviewer
Process Name: Project Delivery

Inputs

Start:

- PFR (for Bridges)
- For roadway – start with Blue sheet review.

Inputs:

- Road and Bridge designs and estimates.

Key Tasks

- Review project designs for constructability by 9 construction reviewers, including payment items.
- Claims and disputes
- 90% of effort after award – visit projects, verify contract is being administered correctly. Produce a report after the site visit.
- Federal oversight role.
- Change order process.
- Improving Specs for new processes

Roles

- Oversight and technical assistance role.
- Engineering, construction and administration support roles.

Software

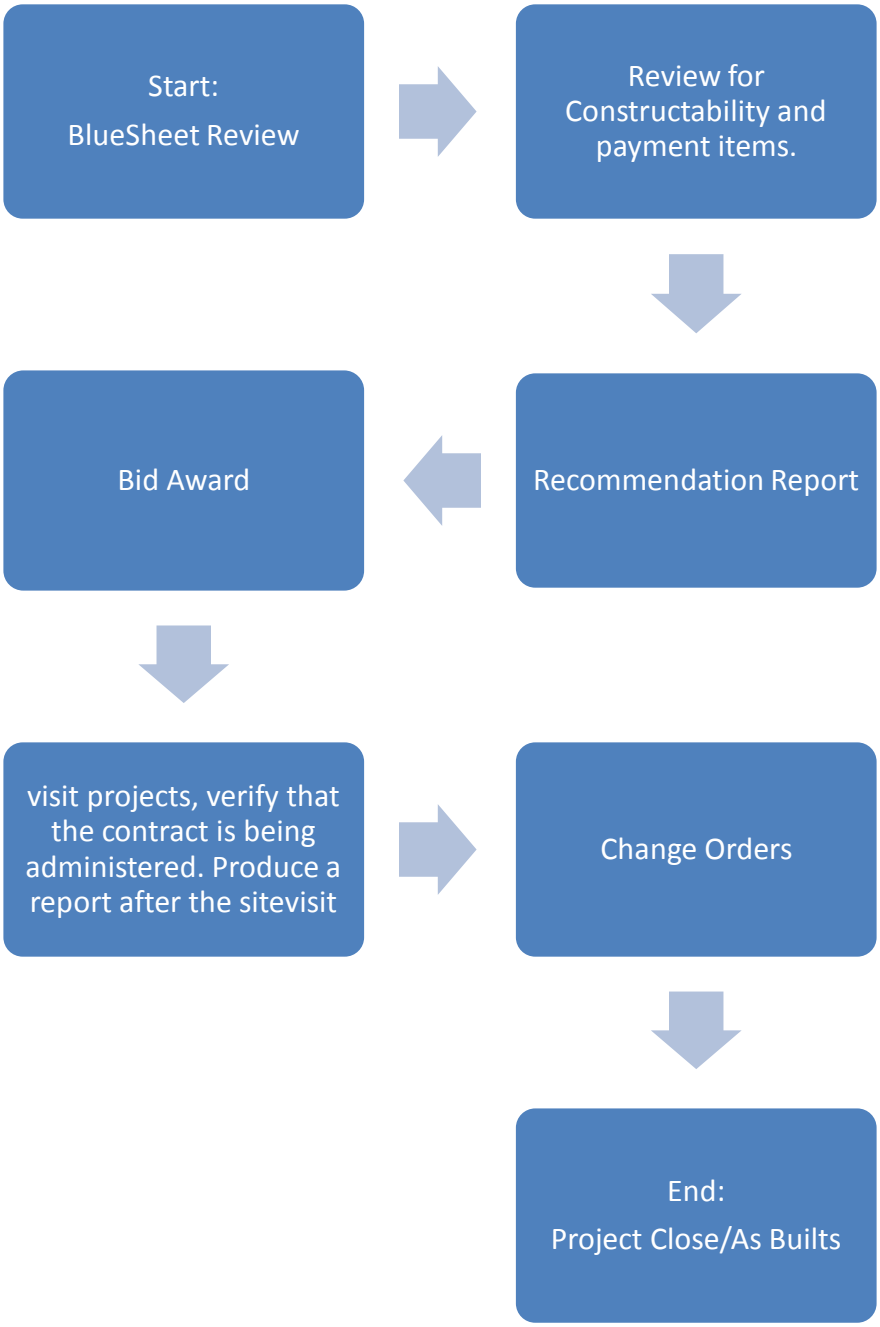
- Office Software

Outputs

End: As-Builts

- Report(s)

<u>Current</u> State Process Summary

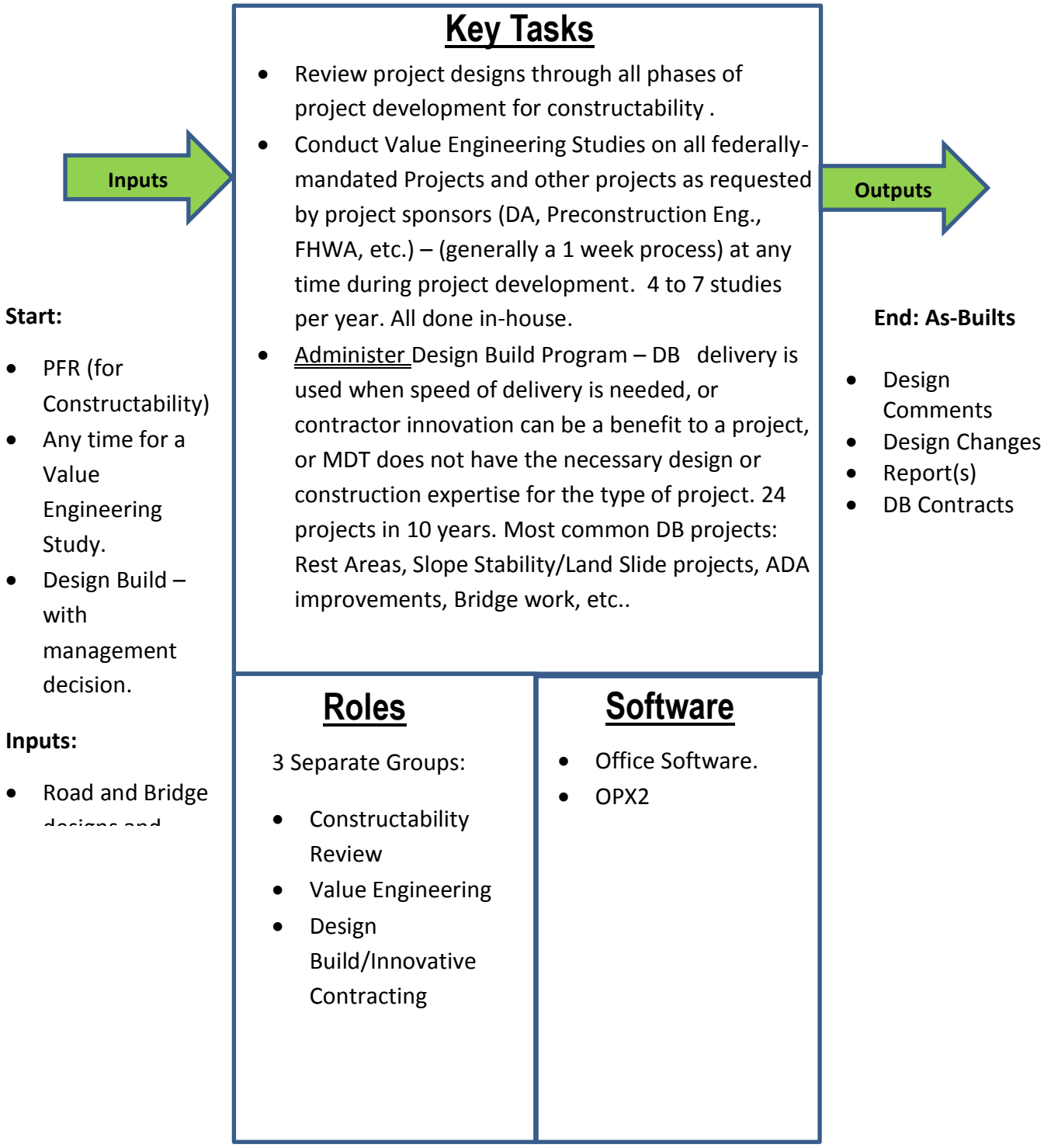


- **Technology**
  - Uses office software.
- **People**
  - Very limited 3D exposure.
- **Identified areas of 3D Impact and Improvement**

- No 2D plans to review, would need to do the constructability review with 3D models.
- How would change orders be conveyed? Would 3D Model be involved? Would the model be updated and by whom?

- **Expected/Stated Benefits using 3D models:**
  - Construction Simulation
  - Design Reviews using a 3D model would enhance a constructability review.
  - Conflict resolution – utilities

Group Name: Constructability Review
Process Name: Project Delivery and Functional Roles



<u>Current</u> State Process Summary:

(Note: See Construction Reviewer Summary for the Constructability Review process.)

- **Technology**
  - Uses office software.
- **People**
  - Very limited 3D and AMG exposure.
  - No training in place for constructability reviews. Attends national conferences for training.
- **Identified areas of 3D Impact and Improvement**
  - Value Engineering –Breaks a project into functions, to come up with better ways for that function and better value to the project. Intended to save $ or provide a better value. Using 3d models you could make a change and see the impact of a larger number of possibilities. A potential big impact area. Note: This function is NOT in the project delivery process.
  - Design Build – Management decision for speed for project completion and transfer to bid award. **<u>The use of 3d would have a big impact on DB</u>**. Currently MDT provides a preliminary design package for the proposal. MDT would need to provide a preliminary **<u>3D model package</u>**. Phase 1 design by a consultant would need MDT 3D guidelines. At the end of construction, standard as-builts would need to be applied to the 3D models.
- **Expected/Stated Benefits using 3D models:**
  - Use of a 3D review process to accelerate review time and potential number of redundant comments. Could save time.
  - The possible use with plan reviews.
  - Benefit to VA Studies to quickly review recommendation impacts.
  - May allow a person with less experience to see things. Also making changes – allows someone the ability to see impacts

Group Name: Construction Administration Section
Process Name: Project Delivery

Inputs

Start: Bid Award

- Plans and proposal from Design
- Commission Review approval.
- Final Engineering Estimates

Key Tasks

- Supports over 200 projects per year, 20 projects let annually over a 2-4 year timeframe.
- Specifications Section - supports specifications for the entire business process.
- Construction Systems - supports and trains AASHTOWare products from procurement through construction.

Roles

- Construction Systems
- Financial
- Specifications

Software

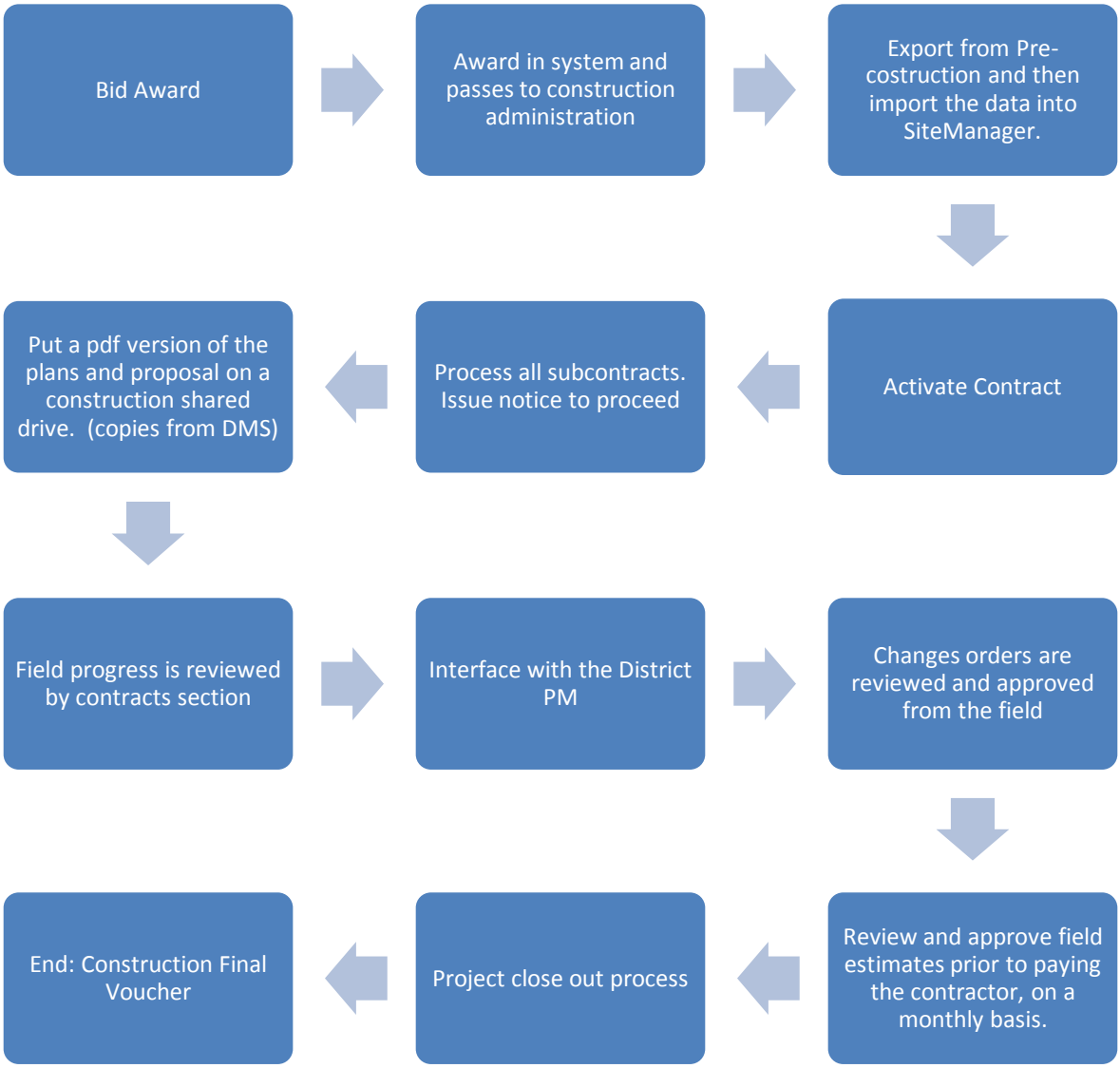
- DMS
- AASHTOWare Project, SiteManager (500 users)
- QA program ISD developed, but supported by Randy.
- CARES system – cost accounting

Outputs

End: Construction Final Voucher

- Pay contractors
- Train and Support AASHTOWare
- Specification Support

Current State Process Summary



- **Technology**
  - 500 people are using AASHTOWare Site Manager in the field.
  - Utilize DMS to copy plans and estimates to the Construction shared drives.
- **People**
  - Very limited exposure to 3D.

- They are aware that the Contractors are using AMG for grading and earth work.

- **Identified areas of 3D Impact and Improvement**
  - Copying of the plans and proposals from DMS to the construction shared drive is a duplication of data.
  - AASHTOWare business process interaction. This is a very important impact. AASHTOWare is oriented around a 2D process.
  - How to measure and pay for items, how is it documented and stored? How are quantities extracted from the model to feed the pay items in AASHTOWare?
  - Organizational specification impacts using 3D.
  - Documentation side using 3d models. Needed to support payments. The documentation is currently captured with Site Manager (using shared drives) and ultimately archived to DMS. How are "as built" quantities tracked to support payments? Would the model be involved in any way and who would be responsible for it?
  - Construction Administration Manual – (internal) how does MDT do business? Impacted by any changes internally.

Group Name: Construction – District Engineering Officer
Process Name: Project Delivery – As-builts

Start: After bid award

- Alerted via SiteManager – project status.

Inputs

Key Tasks

- Monitors and validates construction progress with SiteManager. (Auditor like role)
- Create red-line as built drawings by the Field
- Gets as-let drawings from DMS
- Changes are made in MicroStation.
- Create PDF and upload to As-Built and DMS systems.

Roles

- Provides construction status, as-builts, and ongoing as-built information to external and internal requestors.

Software

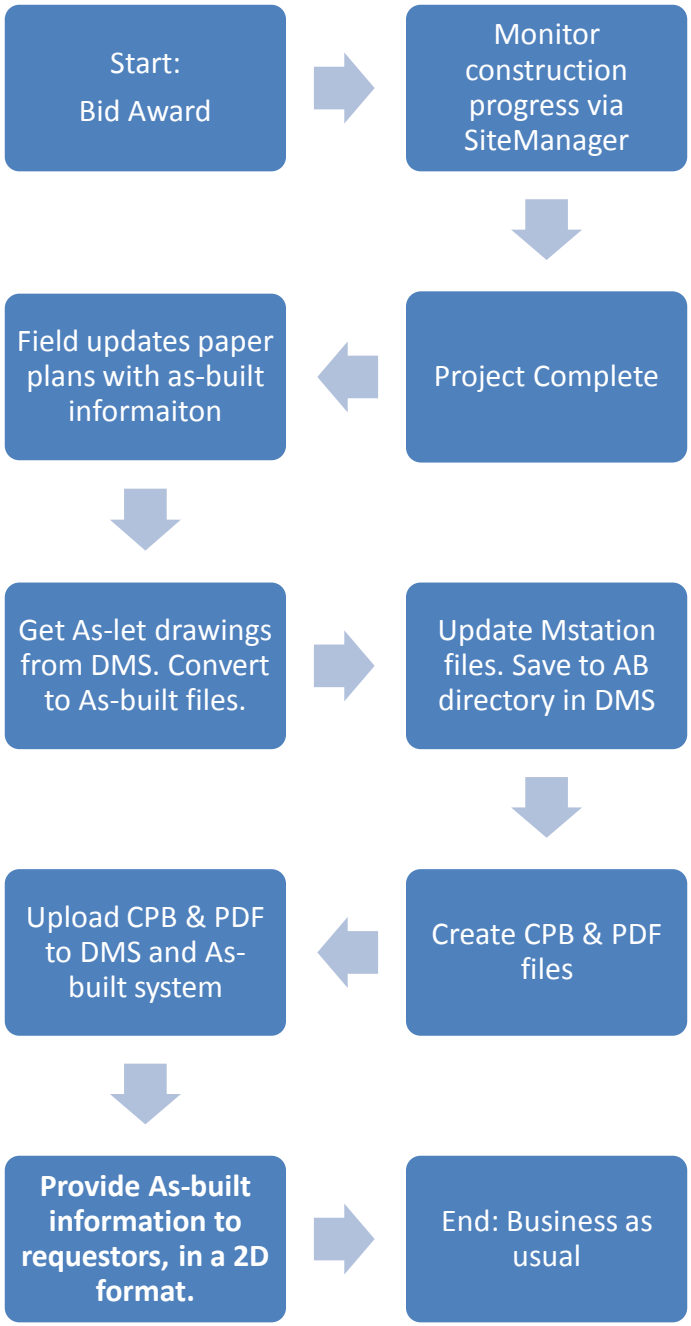
- DMS – used to get as-let design files and to save as-built design files.
- AASHTOWare Project Modules – SiteManager to track construction progress.
- As-built system
- MicroStation
- Adobe Pro or similar pdf program

Outputs

End: As-builts

- Entered into As-built system.
- On-going as-built requests for information from external and internal requestors.

Current State Process Summary



- **Technology**
  - Utilize AASHTOWare – SiteManager to track construction progress.
  - Utilize MicroStation to update as-let drawings with red-lines.
  - PDF software used to create the final as-built drawings.
  - DMS is used to download the as-let drawings.
  - Existing As-built system. This system also has scans of old drawings.

- DocuPlot is used to print 2d drawings of the as-builts, with the disclaimer stamp “use at your own risk.”

- **People**
  - Very limited exposure to 3D and AMG.
  - Need to be able to read/understand 3D models to get the information for AASHTOWare. Key interaction with that business process.

- **Identified areas of 3D Impact and Improvement**
  - Redlines are done by construction crews by hand on paper.
  - There are 2 sources of as-built information, DMS and the existing As-built system. The existing As-built system has limitations (unable to search by location).
  - Key impact area is the interface of the 3D model with the existing AASHTO business process:
    - How to create the as-let drawings from the 3D model?
    - How to do red-lines with a 3d model?
  - What is the role of the existing as-built system with 3D models?
  - What do external users of the as-built models need? (Utilities such as cable, power, water lines, and maintenance people) 90% of interactions are currently done via email. Assume they want 2D paper or pdf documents? Who owns the 3D Model through the design to as-built process and how are changes made? Is there one model throughout?
  - May need a dedicated person that does red lines with 3D models? Consider an easier user interface and tool that would reduce the impact of capturing the changes.
  - How will changes in the field be made? (updated quantities) How should the updates be done and by whom? Then, the changes need to be updated in SiteManager to be confirmed and validated by field personnel.
  - How does updated staking information, associated with the engineering app model, get updated as an as-built?