White Paper

Return on Investment

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Executive Summary

This study projects a realistic return on investment (ROI) that a company might achieve when upgrading from Autodesk® Land Desktop to Autodesk® Civil 3D™ software. It is based on observations, estimates, and attestations obtained from seven industry professionals who work for a variety of engineering companies across the United States. Research was conducted through October 2004.

The information obtained includes opinions on implementation costs, real and anticipated productivity improvements, and other tangible and intangible benefits related to upgrading to the Autodesk Civil 3D product. The metrics obtained from their experiences were reduced to a single data set that could be analyzed in a spreadsheet. A hypothetical "composite project" was developed from the respondents' experiences. Then a realistic budget scenario was applied to an extensive analysis of this project, resulting in an estimated ROI for the project. The process of how the premises were arrived at and how the data was compiled and reduced is detailed in the following report. Jump to the composite project.

Summary of Estimated Implementation Costs for the Composite Project

- Estimated cost to upgrade three network software licenses for six staff members x $800 = $2,400
- Estimated training expenses for six staff members x $4,437.5 = $26,625
- Estimated standards development costs of $24,000
- Total estimated investment of $53,025 is assumed to achieve the productivity gains discussed for this project.

Summary of Anticipated Productivity Improvement

- An average consensus of productivity improvement was estimated to be about 100 percent. In other words, if a task took one hour in Autodesk Land Desktop, it is projected to take about 30 minutes in Autodesk Civil 3D.
- A composite project analysis yielded an estimated first-year profit percentage of 11.98 percent over Autodesk Land Desktop.
- The projected increase in potential profit was valued at $37,551 for the first year.
- This yields a potential seven-month ROI for those investing in the Autodesk Civil 3D product.
- Succeeding-year potential profit results were estimated at $75,174 a year and were higher because much of the implementation costs were essentially one-time costs. (Jump to analysis and results.)

Part of the research identifies the different civil engineering fields and the tasks within each field. It then distinguishes which tasks are well suited to using Autodesk Civil 3D, which are partially appropriate, and which are not within the scope of the software current capabilities. (Jump to the engineering projects and tasks identification.)

Then, based on the respondents' opinions, the perceived improved productivity that Autodesk Civil 3D offers to project tasks was established and reduced to a working value for the composite project analysis. (Jump to the respondent's opinions.) There are also many new intangible benefits in that the software may open up new revenue markets due to the inclusion of Autodesk® VIZ Render and powerful corridor design tools.

In addition to the metrics supported by the hypothetical composite project analysis, the tangible and intangible benefits add to the conclusion that Autodesk Civil 3D is an important addition to the tools available for the civil engineering industry. This study makes a compelling case for upgrading to Autodesk Civil 3D.

Introduction

This white paper calculates a realistic return on investment (ROI) that a company might achieve when upgrading from Autodesk Land Desktop to Autodesk Civil 3D software. The powerful Civil 3D product allows all project data to quickly react to the designer's intent. Any change to one object is automatically reflected in all related data throughout the project. The application will help move the industry toward more interactive design and a 3D mode of thinking.

The research is based on observations, estimates, and attestations from seven industry professionals who work for engineering companies across the United States. These professionals were selected based on their backgrounds in the use, management, and implementation of both Autodesk Land Desktop and Autodesk Civil 3D. Their positions within their respective companies range from expert-level users to CAD managers to senior corporate managers. Production work performed by the firms represents the full range of civil engineering, thus ensuring a strong representation of the industry. Research was conducted through October 2004 and included Autodesk Land Desktop 2005 and Autodesk Civil 3D 2005.

A hypothetical composite project was developed from the experiences of the respondents. Then, a realistic budget scenario was applied to an extensive analysis of this project, resulting in an estimated ROI for the project. The spreadsheet was constructed by first identifying those project types that are appropriate for Autodesk Civil 3D software. Based on the experts' recommendations, tasks required to complete this project were categorized as follows: completely within the range of Civil 3D, partially within the range, or outside the software's current capabilities. Productivity gains were applied to the respective categories so as to reflect realistic expectations. Budgetary figures were correlated to each task, staff and management were assigned to the composite project, and, again, realistic expectations were applied to denote their billable time *actually on the CAD system*. Then estimated productivity gains or losses were applied on a task-by-task basis, yielding a projected ROI for the representative project.

The goal of this paper is to identify the effectiveness of Autodesk Civil 3D in performing various design, drafting, and reporting functions compared to Autodesk Land Desktop and to develop a method that would support any conclusions using realistic methodologies and computations.

Methodology

The methodology of this paper consists of the following steps:

1. Identify the engineering industries and types of projects that each industry might undertake. Identify project areas that are beyond the scope of this paper; identify project types that are strong candidates for use of Autodesk Civil 3D, and identify those areas that can use Civil 3D software as a supporting tool.
2. Identify the breakdown and flow of engineering tasks on these projects and identify the components and tasks required for each project type.
3. Analyze a composite hypothetical project, identify project tasks, provide a budget and timeline, and identify staff members that might be assigned to that project. Recognizing that not all staff members use CAD all day, we then estimate the time that the project staff actually spends using the Civil 3D product during their work day.

4. Based on industry interviews, identify productivity improvements that Autodesk Civil 3D would make possible for staff members involved on identified tasks. Estimate productivity increases for Autodesk Civil 3D users.
5. Determine estimated costs to upgrade from Autodesk Land Desktop to Autodesk Civil 3D software.
6. Compare the profit potentials to the costs required to attain them, and produce a realistic ROI that Autodesk Civil 3D would provide to a new user or one who upgrades from Autodesk Land Desktop.
7. Evaluate some of the intangible benefits that Autodesk Civil 3D offers to Autodesk Land Desktop users, based on the experience of industry professionals.

Approach

The approach taken in developing this paper is as follows:

- I began with research into the capabilities of the software current as of this writing. The software identified in this research paper is the Beta 3 release of Autodesk Civil 3D 2005. This version has added a powerful corridor design feature that builds on the software's object-based technology. This feature is useful for anyone designing roads, channels, aqueducts, tunnels, and so forth. Another addition to this version of the software is the inclusion of VIZ Render, which incorporates the industry's highest quality computer rendering abilities into the Civil 3D product. In today's business environment, communication is paramount, and the ability to develop accurate renderings of the engineering projects is crucial.
- I interviewed seven key industry professionals, all of whom are familiar with the product and are in a position to implement or recommend the software for use in their organization. The interview content consisted of the following:
  - General comments on Autodesk Civil 3D software
  - Estimated costs for upgrading and implementing the software
  - Estimated costs for standards and style development
  - Estimated costs for training
  - Estimated opportunity costs for billable time lost during training
  - Estimated productivity improvements over Autodesk Land Desktop
  - Estimations of the tasks where productivity improvements would occur
  - Evaluation of tangible and intangible benefits of upgrading to Autodesk Civil 3D
  - The process for the upgrade, maintaining Autodesk Land Desktop and Autodesk Civil 3D, or making a complete switch
  - Management and user support for making the switch

Their comments were reduced to composite responses that were then used to develop an analysis of the potential productivity that Autodesk Civil 3D offers Autodesk Land Desktop users who upgrade.

- The participating experts included representatives from firms in San Diego, California; Parsippany, New Jersey; Richmond, Virginia; Jacksonville, Florida; Dallas, Texas; New Brunswick, New Jersey, and Manassas, Virginia.
- A hypothetical composite project was developed from the results of these interviews to show a realistic scenario in which Autodesk Civil 3D could be used and analyzed. Metrics were developed using the estimates of these CAD management professionals and were applied toward this project to show projected improvements in profits.
- These projected improvements were then contrasted to the investment costs that would be made by the organization and extrapolated to produce a ROI.

- The concept is summarized in a spreadsheet analysis that shows the tasks for a composite project, the staffing for both CAD users and staff who don't use CAD, and the projected productivity improvement.

Step One: Identify Industry Components

Civil engineering design work typically includes services such as planning, preliminary engineering, surveying, final design, plans preparation, and construction plan preparation. This section defines which industries can use the Autodesk Civil 3D product.

Traditional civil engineering projects are typically performed for public and private clients. Public clients include municipal, county, state, and federal agencies. Private clients include private landowners, developers, and industrial and commercial organizations.

Public sector projects include corridor design, which comprises roads, tunnels, channels, aqueducts, and so forth; construction management; environmental engineering; water supply (treatment, distribution, and pump stations); sewage networks (collection and effluent treatment); transportation (traffic flows, signalization, and evacuation planning); waste management; wetlands delineation and mitigation; water resources; bridge design; and airport engineering.

Private sector projects typically consist of subdivision design, roadway design, commercial design, industrial site design, water supply and distribution, sewage collection, waste management, wetlands delineation and mitigation, water resources, and construction management.

Autodesk Civil 3D does not provide functionality for bridge design and surveying tasks such as data collection and global positioning system (GPS) computations, nor does it currently provide hydraulic and hydrological features. Thus, this paper does not consider it for projects in these areas.

From the preceding projects, Autodesk Civil 3D software is a *primary solution* for corridor design, airport engineering, waste management, subdivision design, roadway design, commercial design, and industrial site design.

From the preceding projects, Autodesk Civil 3D is a *strong supporting solution* for construction management, environmental engineering, water supply, sewage networks, transportation, wetlands delineation and mitigation, and water resources.

Step Two: Identify the Breakdown and Flow of Typical Industry Engineering Tasks

This section discusses the workflow and project requirements for each project type identified in step one. By recognizing these items, we can identify which parts of a civil engineering project benefit most from Autodesk Civil 3D functionality.

The following listing provides a step-by-step description of each project's requirements. **The tasks that benefit most from the use of Autodesk Civil 3D are denoted in green / bold text.** *Those tasks that can use Civil 3D as a supporting tool are in blue/italic.* Tasks in black/regular text are beyond the current Civil 3D feature set.

Public Sector

(Return to Executive Summary)

The following public sector projects are shown with corresponding workflow milestones.

Corridor design

- **Preliminary planning and alternative layout creation**, communication with decision makers, **preliminary planning and engineering,** project funding and approval, and notice to proceed
- *Surveying activities, including property research, zoning issues, ownership, determination of existing site conditions,* **terrain modeling**
- *Determination of subsurface and geological conditions*
- *Wetlands determinations*
- **Rights of Way determinations**
- **Curvilinear 2D geometry development, easements, alignments, parcels**
- **Drafting and labeling**
- **Corridor profile, section and corridor creation and analysis, roadway design, intersection, ramp, and gore development**
- *Paving requirements*
- **Intersection and cul-de-sac design**
- *Utilities crossings, relocations, and conflict resolutions*
- *Drainage improvements, storm-water retention*
- *Landscape design plans*
- *Irrigation design plans*
- **Signage, electrical, and striping plans**
- **Erosion and siltation design plans**
- Submit review plans and **make modifications based on review comments**
- **Construction plan development**
- *Quantity takeoffs and cost estimations*
- **QA / QC and survey stakeout**
- **Public communication and public hearings with potential for visual renderings**

Construction management

- *Obtain RFP, verify plans, analyze design documents*
- *Quantities, earthworks takeoffs, and cost estimates*
- *Proposal preparation, project awarded, and notice to proceed*
- *Surveying activities, including establishing project control, verify existing site conditions*
- **Making design changes based on change orders and for constructability**
- **Curvilinear 2D geometry development**
- *Quantity takeoffs and cost estimations*
- **Terrain modeling for existing and proposed conditions**
- **Earthworks computations**
- **Build / rebuild project data for road grading**
- **Build / rebuild site grading data**
- *Build/rebuild utilities*
- **QA / QC of design plans and construction approaches**
- **Generate stakeout information, GPS machine control, or both**
- **Format for machine control usage**
- **Construction plan development**
- *Pavement design and analysis*
- *As-built surveying and plan generation*
- *Project operations and maintenance*

Environmental engineering

- **Curvilinear 2D geometry development for property lines, planimetrics, and so forth**
- Terrain modeling and analysis
- Proposed impact studies
- Data collection of above- and below-ground conditions, chemicals, species, and so forth
- Subsurface water analysis, conditions, modeling
- Air quality conditions, analysis, modeling
- GIS development and mapping

Water supply (includes treatment, distribution, and pump stations)

- **Curvilinear 2D geometry development for waterline trunks, distribution systems,** *elevated storage*, **planimetrics, and so forth**
- **Terrain development and analysis for waterline depth and conflict resolution**
- Water pressure analysis, demand loading, and so forth
- *Location of elevated storage, lift stations, capacities, and so forth*
- *Water treatment plants and processes (see Industrial Projects)*

Sewage networks (includes collection and effluent treatment)

- **Curvilinear 2D geometry development for trunkline, vacuum sewers and collection system, planimetrics, and so forth**
- *Location and design of collection system, lift stations, capacities, and so forth*
- **Mapping and GIS tasks**
- **Drafting and labeling**
- **Terrain development and analysis of gravity flow systems**
- System capacity analysis
- *Location and design of collection systems from main trunks to treatment facilities*
- *Wastewater treatment plants and processes (see Industrial Projects)*

Transportation (includes traffic flows, signalization, and evacuation planning)

- **Geometry development, planimetrics**
- Data collection, traffic counts
- Signalization
- *High Occupancy Vehicle development plans and GIS studies*
- Data collection, traffic counts
- **Mapping and GIS tasks**
- *Pavement design and analysis*
- **Drafting and labeling**

Wetlands

- *Delineation, classification and mitigation*, **curvilinear 2D geometry development for wetlands and other boundaries, property lines, tree lines, planimetrics, and so forth**
- **Mapping and GIS tasks**
- **Drafting and labeling**
- Data collection and reduction
- RTK/GPS and traditional surveying

Water resources

- **Preliminary planning, project funding and approval, and notice to proceed**
- *Surveying activities, including property research, ownership, determination of existing site conditions*
- *Determination of subsurface and geological conditions, flows, and magnitudes*
- Surface water and groundwater analysis
- Design and analysis of wells, water transfer systems, irrigation
- Hydrology and water supply
- River conditions and forecasts
- Water quality
- Weather forecasts
- Flood emergency information
- Water use, conservation, and planning
- Design and analysis of dams
- **Geometry development for planimetrics**
- Rainfall determinations
- Flood studies
- *Wetlands determinations*
- *Storm-water analysis*
- **Erosion and siltation design**
- *Landscape analysis*
- Chemical analysis
- **Development of maps**
- *Report generation*
- **QA / QC**
- **Public hearings with potential for visual renderings**

Airport engineering

- Obtain Federal Aviation Administration (FAA) and local grants. **Preliminary planning and alternative layout creation**, communication with decision makers, **preliminary planning and engineering,** project funding and approval, and notice to proceed
- *Surveying activities, including property research, zoning issues, ownership, determination of existing site conditions,* **terrain modeling**
- *Determination of subsurface and geological conditions*
- **Curvilinear 2D geometry development, runway / taxiways, FAA obstruction and clearance plans, parking lots, service industry access roads,** *security considerations*, **planimetrics, and so forth**
- FAA and state regulations compliance, **FAA height contours, clearance analysis, and so forth**
- *Pavement design and analysis*
- *Runway and taxiway profiles and sections or corridors*
- **Drafting and labeling**
- *Drainage improvements, storm-water retention, underground retention facilities*
- **Rough grading, finished grade development**
- **Erosion and siltation design**
- **Final design engineering, pad siting for hangars and services**
- *Landscape design*
- *Irrigation design*
- **Easement determinations**
- **Value engineering and review**

- **Engineering modifications**
- **Construction plan generation**
- **Quantities and cost estimates**
- **QA/QC and survey stakeout**
- Obtain FAA and local construction grants
- **Public hearings with potential for visual renderings**

Private Sector

The following private sector projects are shown with corresponding workflow milestones.

Subdivision design

- **Preliminary planning and alternative layout creation,** communication with decision makers, **preliminary planning and engineering,** project funding and approval, and notice to proceed
- *Surveying activities, including property research, zoning issues, ownership, determination of existing site conditions*, **terrain modeling**
- *Determination of subsurface and geological conditions*
- *Wetlands determinations*
- **Refined site layout, park, and green-space requirements**
- **Curvilinear 2D geometry development, easements, alignments, parcels**
- **Roadway design and** *paving requirements*
- **Intersection and cul-de-sac design**
- **Corridor profile, section, and corridor creation and analysis**
- **Drafting and labeling**
- **Rough grading, overlot, and finished grade development**
- *Drainage improvements, storm-water retention*
- *Sanitary sewer design plans and profiles*
- *Waterline design plans and profiles*
- *Landscape design plans*
- *Irrigation design plans*
- **Erosion and siltation design plans**
- Submit review plans and make **modifications based on review comments**
- **Construction plan development**
- *Quantity takeoffs and cost estimations*
- **QA/QC and survey stakeout**
- **Public communication and public hearings with potential for visual renderings**

Environmental engineering

- **Curvilinear 2D geometry development for property lines, planimetrics, and so forth**
- Terrain modeling and analysis
- Proposed impact studies
- Data collection of above- and below-ground conditions, chemicals, species, and so forth
- Subsurface water analysis, conditions, modeling
- Air quality conditions, analysis, modeling
- GIS development and mapping

Water supply (includes reticulation distribution and pump stations)

- **Curvilinear 2D geometry development for waterline trunks, distribution systems**, *elevated storage*, **planimetrics, and so forth**

- **Terrain development and analysis for waterline depth and conflict resolution**
- Water pressure analysis, demand loading, and so forth
- *Location of elevated storage, lift stations, capacities, and so forth*
- *Water treatment plants and processes* (see industrial and waste management site layout)

Sewage networks (includes collection, not treatment)

- **Curvilinear 2D geometry development for trunk line, vacuum sewers and collection system, planimetrics, and so forth**
- **Mapping and GIS tasks**
- **Drafting and labeling**
- **Terrain development and analysis of gravity flow systems**
- System capacity analysis
- *Location and design of collection systems up to main trunks or lift stations*

Transportation (includes traffic flows for commercial and large subdivision impact)

- **Geometry development, planimetrics**
- Data collection, traffic counts
- **Mapping and GIS tasks**
- *Pavement design and analysis*
- **Drafting and labeling**

Wetlands delineation and mitigation

- *Delineation, classification and mitigation*, **curvilinear 2D geometry development for wetlands and other boundaries, property lines, tree lines, planimetrics, and so forth**
- **Mapping and GIS tasks**
- **Drafting and labeling**
- Data collection and reduction
- RTK/GPS and traditional surveying

Commercial design

- **Preliminary planning and alternative layout creation**, communication with decision makers, **preliminary planning and engineering,** project funding and approval, and notice to proceed
- *Surveying activities, including property research, zoning issues, ownership, determination of existing site conditions,* **terrain modeling**
- *Determination of subsurface and geological conditions*
- **Access requirements**
- **Site layout, parking space requirements, curvilinear 2D geometry development, easements, Building Restriction Lines, parking lots, parcels, planimetrics**
- *Paving requirements*
- **Drafting and labeling**
- *Drainage improvements, storm-water retention, underground retention facilities*
- **Rough grading, finished grade development**
- **Erosion and siltation design**
- **Final design engineering, pad siting**
- *Environmental considerations, oil/water separators, and so forth*
- *Pavement design and analysis*

- *Water and sanitary plans and profiles*
- **Erosion and siltation plans**
- *Landscape design*
- *Irrigation design*
- **Easement determinations**
- **Value engineering and review**
- **Engineering modifications**
- **Construction plan generation**
- **Quantities and cost estimates**
- **QA / QC and survey stakeout**
- **Public hearings with potential for visual renderings**

Industrial and waste management site layout

- **Preliminary planning and alternative layout creation,** communication with decision makers, **preliminary planning and engineering,** project funding and approval, and notice to proceed
- *Surveying activities, including property research, zoning issues, ownership, determination of existing site conditions,* **terrain modeling**
- *Determination of subsurface and geological conditions*
- **Public and staff access requirements**
- **Site layout, parking space requirements, curvilinear 2D geometry development, easements, Building Restriction Lines, parking lots, parcels, planimetrics,**
- **Drafting and labeling**
- Environmental engineering analyses and considerations
- *Drainage improvements, storm-water retention, underground retention facilities*
- **Rough grading, finished grade development**
- **Erosion and siltation design**
- **Final design engineering, pad siting**
- *Environmental considerations, oil/water separators, and so forth*
- *Pavement design and analysis*
- *Water and sanitary plans and profiles*
- **Erosion and siltation plans**
- *Landscape design*
- *Irrigation design, yard piping design for plant activities*
- *Environmental Protection Agency (EPA) requirements for spill and containment*
- *Disaster and evacuation plans*
- **Easement determinations**
- **Value engineering and review**
- **Engineering modifications**
- **Construction plan generation**
- **Quantities and cost estimates**
- **QA / QC and survey stakeout**
- **Public hearings with potential for visual renderings**

Hydrology and water resources: surface water analysis, groundwater analysis, wells, water transfer, irrigation, hydrology

- **Preliminary planning, project funding and approval, and notice to proceed**
- *Surveying activities, including property research, ownership, determination of existing site conditions*

- *Determination of subsurface and geological conditions, flows, and magnitudes*
- **Geometry development for planimetrics**
- Rainfall determinations
- Flood studies
- *Wetlands determinations*
- *Storm-water analysis*
- **Erosion and siltation design**
- *Landscape analysis*
- Chemical analysis
- **Development of maps**
- *Report generation*
- QA/QC
- **Public hearings with potential for visual renderings**

Step Three: Analyze Hypothetical Composite Project

The hypothetical composite project assembled for this discussion is a 70-lot, high-end subdivision located in the mid-Atlantic region. Typical staffing might include a project manager, a project engineer, a project surveyor, an engineer, and two technicians. In this part of the country the engineering costs are estimated to be about $2,700 per lot, yielding a project engineering budget of $189,000. The estimated task breakout and probable worker-hours are shown in the following table. (**Green/bold denotes Autodesk Civil 3D usage**; *blue/italic partial usage*; red/underlined indicates that Civil 3D won't be used.)

Task Description: 70-Lot, High-End Subdivision	Survey	Design	Drafting	Task Ratio*
Feasibility Study and Planning		**60**	**60**	60/20/60
Property Research, GPS and Control	*50*		**20**	60//20
Surveying Existing Site	80		**40**	10/10/
Existing Terrain Preparation and Analysis	**20**		**40**	10/70/
Field Annotation, Labeling, Callouts			**40**	30/10/
Boundary Computations, Geometry, Base Sheet Preparation	*40*		**40**	140/40/
Initial Design Functions and Site Layout		**80**	**80**	10/10/60
Roadway Computations		**40**	**40**	20/10/50
Parcel Computations	**40**	**40**	**40**	60//60
Scanning, Digitizing, Drafting, Details			*80*	Composer**
Refine Roads and Site Layout		**80**	**80**	40/20/100
Rough Grading		**40**	**40**	/20/60
Finish Grading		**80**	**40**	10/10/100
Compute Volumes, Check, and Analyze		**30**		//30

Task Description: 70-Lot, High-End Subdivision	Survey	Design	Drafting	Task Ratio*
Balance Site, Grading Revisions		40	40	10/10/60
Storm Drainage and Sanitary Design/Drafting		*100*	*80*	20/20/40
Utilities and Easements Design and Drafting	*20*	*80*	*80*	40/20/120
Rainfall, Detention, and Storage Analysis		*20*	*20*	5/5/30
Detention and Storage Design and Drafting		*40*	*20*	5/10/45
Landscape Layout, Irrigation Layout		*60*	*60*	//120
Construction Plan Preparation		*20*	*80*	/20/80
Cutsheet, 3D MC QA, and Stakeout Preparation	40	20	20	30/30/20
3D Modeling and Computer Rendering			40	/20/20

* Projected ratio of geometry tasks versus terrain tasks versus design tasks.

** AutoCAD® 2005 Detail Composer is anticipated for use in this area.

From the project schedule and analysis shown in the table, 2,200 estimated worker-hours are allocated to the project. The project duration is estimated at about five months from notice to proceed. Assuming that about two months are consumed with startup activities, planning, and assorted administrative and review activities, that leaves about three months for design and drafting work.

Descriptions of the probable staff members for the hypothetical design project are as follows.

- The project manager is the organization's responsible fiscal and supervisory leader.
- The project engineer is the lead technical expert.
- The project surveyor assumes responsibility for all survey activities: project control, data collection, reduction, base sheet creation, some proposed geometry and stakeout computations.
- Engineer(s) support the design effort with their design abilities, which may include high-level CAD design.
- Technicians perform the engineer's instructions often in a CAD system. The technicians range from "redliners," who trace and perform low-level CAD drafting functions, to high-end design technicians who design a large majority of the site while seeking assistance from engineers when necessary. This project uses high-end CAD technicians savvy in both design and CAD usage.
- An administrative person. Administrative staff often supports multiple teams and often entire departments but are not usually CAD users.

Estimated CAD Usage by Position

Although staff members have non-billable time built into their positions for vacations, sick time, and so forth, we try here to identify a realistic expectation of how much of their billable time is actually spent on the CAD system.

CAD usage by project managers is typically quite low, even though their backgrounds may include CAD experience; they spend so much time performing managerial functions that their CAD skills diminish. As a result, project managers do not use CAD and are projected to receive no direct efficiencies from it. Their time is removed from the benefits that Autodesk Civil 3D would potentially provide. Therefore, we discount 100 percent of the time that a project manager would directly benefit from use of CAD and Civil 3D software.

The project engineers' CAD usage is higher but is limited by several factors. First, much of their computational input involves regulatory and code compliance—activities that typically don't involve CAD. Second, they spend much time guiding and troubleshooting issues brought to them by the engineers or technicians. Third, many administrative tasks fall on the project engineer such as meeting attendance, correspondence, project telephone calls, email tracking, and so forth. Although the project engineer may use CAD to a limited degree, such use tends to be high-level input such as identifying points of vertical intersection (PVIs) and vertical curve lengths on a roadway design or performing review on the CAD system. Therefore, we discount 90 percent of the time that a project engineer would directly benefit from use of CAD and Civil 3D.

There is also a project surveyor on the job however; field crews and fieldwork are eliminated from the Civil 3D usage and benefits since it doesn't include surveying functions. On the other hand, the drafting associated with the survey work does benefit from Civil 3D software since it includes significant computational, parcel and easement development, and labeling tools. The time allocated for survey technicians is bundled into the total technician's time for the project.

CAD usage by the engineer is significantly higher but is also somewhat limited by several factors. First, much of the routine research and administrative functions fall into this position, such as meetings, phone calls, research, client negotiations, and government agency coordination. Engineers typically oversee the CAD input of the technicians and provide design guidance. Second, they often generate many of the reports required for the project or at least the content for the reports and much of this is not related to CAD. Third, they perform ancillary design functions for the project, such as inlet design, allowable pipe flows, pond routing, paving requirements, and so forth. They often use spreadsheets, software provided by government agencies, customized software, or calculators for these computations. Construction plans are not the only deliverable since a myriad of reports, studies, charts, diagrams, spreadsheets, quantities, cost estimates, operations and maintenance manuals, and so forth are a part of any project. A poll of several companies indicated a wide variety of CAD usage among the project's engineers, ranging from zero to 80 percent. Therefore, and although arguable, we discount 60 percent of the engineer's time from being able to benefit from the use of Civil 3D and CAD.

Finally, the technician is usually the fundamental piece to this design puzzle. Technicians perform the majority of the project's routine design tasks using the CAD system. They flush out the detailed information required for the completion of the project's construction plans. Technicians also typically prepare supporting data used by other team members and, as a result, do not spend all their time on the CAD system. Therefore, we discount 35 percent of their time from receiving benefit from the Civil 3D product.

In summary, it is estimated that staff members spend the following percentage of their time using Autodesk Civil 3D on a daily basis:

- Project Manager: 0 percent
- Project Engineer: 10 percent
- Engineer: 40 percent
- Technicians: 65 percent

These values are used to develop the expected potential ROI for an Autodesk Civil 3D user.

Employee Billable Rates

The project manager (estimated billable at $110 an hour) often oversees more than one job at a time and is estimated to spend about 200 hours overseeing this project. The project engineer (estimated billable at $100 an hour) also oversees several projects at a time and is allocated 200 hours for high-end input on this project. We extract 110 hours (estimated billable at $100/hour) from the budget as mentioned earlier for fieldwork and some other survey computations that might occur independently of Autodesk Civil 3D functionality. This leaves an estimated $135,200, or 1,690 hours, to be used for three full-time staff members consisting of an engineer (estimated billable at $90 an hour) and two technicians (estimated billable at $75 an hour) for about three months. This averages to an estimated $80 an hour for the three staff members. One worker-month consists of an estimate of 160 hours.

Step Four: Analyze Potential Productivity Increases Based on Interviews

This step involves reviewing the information gathered from interviews with seven civil engineering professionals and Autodesk Civil 3D users and reducing it to values that we can enter into the hypothetical project analysis in step five. These professionals provided estimates based on their opinions and experiences with the software on engineering projects and their respective tasks. The assumption here is that the costs estimated for software acquisition, standards development, and training have been invested before the project’s startup.

In general, two predominant themes arose in our discussions. The first involved the importance of styles to the design process since the software is based on a data-driven, style-assisted methodology. Embedding design parameters into the styles or standards provides great assistance in the initial design and drafting process.

The second theme involved the productivity improvements that data relationships add to design and drafting, and specifically to the modification phase of engineering projects. These relationships produce a ripple effect wherein all related design objects update automatically when design information changes. For instance, if a roadway alignment is shifted or modified as the design progresses, the software automatically updates all related alignments, profiles, and labeling.

Two rules of thumb arose for productivity increases: 1) Autodesk Civil 3D software helped the company achieve an estimated 60 percent level of design at 30 percent of the budget typically allocated if the firm has been using Autodesk Land Desktop and 2) many functions that took 20 minutes in Autodesk Land Desktop took respondents only five minutes with Autodesk Civil 3D.

The following list describes the engineering design and drafting tasks identified in step two along with the range of productivity increases proposed by the industry professionals interviewed. These estimates compare the improved potential productivity and expected efficiency that an Autodesk Civil 3D user can achieve over performing the same task using Autodesk Land Desktop, with all other parameters being equal. In other words, if a respondent said that parcel development took 60 minutes in Land Desktop and 60 minutes in Civil 3D, that was logged as a **0 percent improvement**. If the respondent said that in Civil 3D parcel development could be done in 30 minutes whereas in Land Desktop it took 60 minutes, that was logged as a **100 percent improvement**. The values used in our hypothetical project analysis were arrived at by averaging the efficiency improvement percentages that these experts proposed and rounding them downward.

The efficiency **improvement** expectations of Autodesk Civil 3D over Autodesk Land Desktop are shown on a task-by-task basis. (**Note:** All values show improvement of Civil 3D over Land Desktop 2005. Also not all respondents could discuss all task types due to the work their firm might perform.) (Return to Executive Summary)

- Planning and Preliminary Engineering
  - First respondent's estimate: **100 percent**
  - Second respondent's estimate: **300 percent**
  - Third respondent's estimate: **400 percent**
  - Estimate used for our study: **200 percent**
- Horizontal Curvilinear Geometry Design and Analysis
  - First respondent's estimate: **15 percent**
  - Second respondent's estimate: **300 percent**
  - Third respondent's estimate: **400 percent**
  - Estimate used for our study: **200 percent**
- Parcel Development
  - First respondent's estimate: **10 percent**
  - Second respondent's estimate: **15 percent**
  - Third respondent's estimate: **300 percent**
  - Estimate used for our study: **100 percent**
- Alignment Development
  - First respondent's estimate: **100 percent**
  - Second respondent's estimate: **300 percent**
  - Third respondent's estimate: **400 percent**
  - Estimate used for our study: **200 percent**
- Alignment Modifications
  - First respondent's estimate: **100 percent**
  - Second respondent's estimate: **300 percent**
  - Third respondent's estimate: **400 percent**
  - Estimate used for our study: **200 percent**
- Horizontal Geometry Labeling
  - First respondent's estimate: **15 percent**
  - Second respondent's estimate: **100 percent**
  - Third respondent's estimate: **400 percent**
  - Estimate used for our study: **150 percent**
- Terrain Modeling
  - First respondent's estimate: **0 percent**, but the results are higher quality due to computational improvement and enhancements
  - Second respondent's estimate: **300 percent**
  - Estimate used for our study: **150 percent**
- Terrain Labeling
  - First respondent's estimate: **0 percent**, but the results are higher quality due to computational improvement and enhancements
  - Estimate used for our study: **0 percent**
- Terrain Analysis
  - First respondent's estimate: **0 percent**, but the results are higher quality due to computational improvement and enhancements
  - Estimate used for our study: **0 percent**
- Existing Profile Generation and Labeling
  - First respondent's estimate: **100 percent**
  - Second respondent's estimate: **300 percent**
  - Third respondent's estimate: **400 percent**
  - Fourth respondent's estimate: **700 percent**
  - Fifth respondent's estimate: **1100 percent**

    - Estimate used for our study: **500 percent**
- Proposed Vertical Geometry Design and Analysis
    - First respondent's estimate: **100 percent**
    - Second respondent's estimate: **400 percent**
    - Third respondent's estimate: **700 percent**
    - Fourth respondent's estimate: **1100 percent**
    - Estimate used for our study: **500 percent**
- Proposed Vertical Alignment Development and Labeling
    - First respondent's estimate: **400 percent**
    - Second respondent's estimate: **500 percent**
    - Third respondent's estimate: **1100 percent**
    - Estimate used for our study: **600 percent**
- Existing Cross-Section Generation
    - First respondent's estimate: **100 percent**
    - Second respondent's estimate: **400 percent**
    - Third respondent's estimate: **500 percent**
    - Fourth respondent's estimate: **1100 percent**
    - Estimate used for our study: **500 percent**
- Proposed Section Assemblies or Subassemblies
    - First respondent's estimate: **0 percent**
    - Estimate used for our study: **0 percent**
- Corridor Development
    - First respondent's estimate: **15 percent**
    - Second respondent's estimate: **300 percent**
    - Third respondent's estimate: **400 percent**
    - First respondent's estimate: **500 percent**
    - Second respondent's estimate: **1100 percent**
    - Estimate used for our study: **400 percent**
- Site Grading
    - First respondent's estimate: **10 percent**
    - Second respondent's estimate: **15 percent**
    - Third respondent's estimate: **100 percent**
    - First respondent's estimate: **400 percent**
    - Estimate used for our study: **100 percent**
- Site Grading Modifications
    - First respondent's estimate: **10 percent**
    - Second respondent's estimate: **300 percent**
    - Third respondent's estimate: **400 percent**
    - Estimate used for our study: **200 percent**
- Quantities and Earthwork Computations and Takeoffs
    - First respondent's estimate: **15 percent**
    - Second respondent's estimate: **400 percent**
    - Estimate used for our study: **200 percent**

The following areas were identified as breakeven considering that Autodesk Land Desktop might remain the dominant solution since Autodesk Civil 3D does not currently offer these analysis and design tools. Efficiencies in laying out alignments, profiles, and so forth might be offset by the costs of migrating data into Land Desktop or at least are difficult to project at this time.

- Utilities (Water, Sanitary) Analysis, Design, Drafting, and Labeling
    - **0 percent** since analysis and design are not implemented in Civil 3D
- Hydrologic Analysis
    - **0 percent** since analysis and design are not implemented in Civil 3D

- Storm-Water Drainage, Retention, Pond Routing
  - **0 percent**
- Landscape and Irrigation Layout
  - **0 percent**
- Construction Plan Development and Stakeout Abilities
  - **0 percent** since software may not be fully fleshed out for complete and customized plans development at this time

Step Five: Estimated Productivity Gain for Autodesk Civil 3D Users

The fifth step involves using the information gathered from the interviews with seven civil engineering and Autodesk Civil 3D experts and reduced as described in step four. These efficiency values are next entered into the project's analysis as described earlier to determine a realistic expectation of potential increased profits resulting solely from the use of Civil 3D software. Again, the assumption is that the costs estimated for software acquisition, standards development, and training have been invested and accomplished before the project's startup. These costs are discussed in step six. In step seven we compare the costs from step six with the profits in this step, thereby producing the projected ROI that an organization might anticipate from using Autodesk Civil 3D software. The spreadsheet data on the following pages highlights the hours saved by using Civil 3D on this composite project. (**Green/bold denotes Autodesk Civil 3D usage**; *blue/italic partial usage*; red indicates that Civil 3D won't be used.)

Task Description—70 Lot, High-End Subdivision [Return to Exec Summary]	**Survey**	**Design**	**Drafting**	**Hours Saved in Survey**	**Hours Saved in Engineering**	**Hours Saved by Technicians**
Feasibility Study and Planning Proj. Mgr. = 20 hrs Proj. Engr. = 20 hrs Engineer = 40 hrs for design Technicians = 40 hrs for drafting		60–20 = 40	60 –20 = 40		11.39	18.09
Property Research, GPS and Control—40 hrs removed from analysis due to only partial use of Civil 3D. Note: We are billing Proj. Surv. at engineer rate.	50 – 40=10		20	1.00		3.25
Surveying Existing Site—80 hours removed from efficiency analysis as discussed since Civil 3D does not offer features in field work collection. Proj. Surv. = 10 hrs	80 – 80 = 0		40 – 10 = 30			5.125
Existing Terrain Preparation and Analysis Proj. Surv. = 5 hrs Proj .Engr. = 5 hrs	20 – 5 = 15		40 – 5 = 35	3.075		6.975
Field Annotation, Labeling, Callouts Proj. Mgr. = 5 hrs Proj. Engr. 5 hrs			40 – 10 = 30			12.0

Boundary Computations, Geometry, Base Sheet Preparation—Civil 3D is used for 50 percent of the work. Proj. Mgr. = 10 hrs Proj. Surv. = 15 hrs	40 – 15 = 25		40 – 10 = 30	140/40/	5.175		5.85
Initial Design Functions and Site Layout Proj. Mgr. = 40 hrs Proj. Engr. = 30 hrs		80 – 40 = 40	80 – 30 = 50	10/10/1960		8.0	17.75
Roadway Computations Proj. Mgr. = 10 hrs Proj. Engr. = 20 hrs		40 – 20 =20	40 – 10 = 30	20/10/50		7.56	17.22
Parcel Computations Proj. Mgr. = 5 hrs Proj. Surv. = 15 hrs	40 – 10= 30	40 –5 = 35	40 –5 = 35	60//60	11.75	7.0	11.625
Scanning, Digitizing, Drafting, Details—Estimate that 20 percent of this effort will be improved using Civil 3D. 10 percent efficiencies will be gained using the Detail Composer.			80	** Detail Composer			1.6
Refine Roads and Site Layout Proj. Mgr. = 20 hrs Proj. Engr. = 20 hrs		80 – 20 = 60	80 – 20 = 60	40/20/100		16.75	26.8
Rough Grading Proj. Mgr. = 10 hrs Proj. Engr. 10 hrs		40 – 10 = 30	40 – 10 = 30	/20/60		6	10.25
Finish Grading Proj. Mgr. = 10 hrs Proj. Engr. = 10 hrs		80 – 10 = 70	40 – 10 = 30	10/10/100		18.76	13.735
Compute Volumes, Check and Analyze		40		/40/		8.04	

Balance Site, Grading Revisions Proj. Mgr. = 10 hrs Proj. Engr. = 10 hrs		**40** – 10 **= 30**	**40** – 10 **= 30**	10/10/1960		8.375	13.4
Storm Drainage and Sanitary Design/Drafting Proj. Mgr. = 20 hrs Proj. Engr. = 20 hrs		*100*	*80*	20/20/40	breakeven	breakeven	breakeven
Utilities and Easements Design and Drafting Proj. Surv. = 20 hrs Proj. Engr. = 10 hrs	*20*	*80*	*80*	40/20/120	breakeven	breakeven	breakeven
Rainfall, Detention, and Storage Analysis Proj. Mgr. = 10 hrs Proj. Engr. = 10 hrs		*20*	*20*	5/5/1930	breakeven	breakeven	breakeven
Detention and Storage Design and Drafting Proj. Mgr. = 10 hrs Proj. Engr. = 10 hrs		*40*	*20*	5/10/1945	breakeven	breakeven	breakeven
Landscape Layout, Irrigation Layout Proj. Mgr. = 5 hrs		*60*	*60*	//120	breakeven	breakeven	breakeven
Construction Plan Preparation Proj. Mgr. = 20 hrs Proj. Engr. = 10 hrs		*20*	*80*	20//80	breakeven	breakeven	breakeven
Cutsheet, 3D MC QA and Stakeout Preparation Proj. Surv. = 20 hrs	**40**	**20**	**20**	30/30/20	breakeven	breakeven	breakeven
3D Modeling and Computer Rendering—The VIZ Render feature is new and offers new technology.			**40**	30/30/20	breakeven	breakeven	breakeven

Analysis and Results

(Return to Executive Summary)

Based on the results of the hypothetical project analysis in the preceding spreadsheet, the following hours were saved using Autodesk Civil 3D software:

	Survey	Design	Technicians
Hours Saved	21.0	91.875	163.67
Hourly Rate	$100 hr.	$90 hr.	$75 hr.
Project Profits Increased Per Discipline	$2,100	$8,268.75	$12,275.25

- Total projects estimated profits using Autodesk Civil 3D: $22,644.00
- Total estimated project budget: $189,000.00
- Potential Percent profit increase: 11.98 percent

Step Six: Estimated Upgrade Costs for Autodesk Civil 3D Users

In this step we look at the costs to upgrade from Autodesk Land Desktop to Autodesk Civil 3D software.

Interview Results on Costs to Implement Autodesk Civil 3D

In addition to cost savings and projected profits, upgrade costs were discussed in depth. Costs vary by firm, but they are outlined as follows and a consensus on the cost is estimated.

Cost of Software

Subscriptions are assumed to be the main upgrade method to move from Autodesk Land Desktop to Autodesk Civil 3D software. If Autodesk Land Desktop and Autodesk Civil Design subscriptions are current, Civil 3D software is included as part of subscription fulfillment. If a user has a Land Desktop subscription but no Civil Design subscription, there is a $100 fee (limited time offer) to upgrade to Civil 3D.

For our hypothetical composite project at least three network licenses are needed. For this study, subscriptions for network licensing are estimated at $800 per license for a total of $2,400.

Estimated Cost for Standards and Style Development

The projected costs for standards and style development varied by organization. One estimate was from $25,000–$40,000 for a firm of 60 people. Worker-hour estimates ranged from 4 weeks to 6 months. For our hypothetical composite project, we use a middle ground estimate to complete a working draft of the styles of six weeks of advanced-level effort by a CAD manager. The estimated costs for this individual also varied because some felt it would be an expert taken out of production and others felt it would be an overhead CAD expert. Some firms have experts on overhead and others do not. In the interest of obtaining a realistic cost, we again take the worst-case scenario and assume a cost to the firm for this work. We estimate an opportunity cost for an expert of this caliber to be $100 an hour.

Estimated Training Costs

The projected number of training days also varied greatly, depending perhaps on the workflow in the organizations involved. In some firms, engineers and technicians are specialized in the work they do and, therefore, need to become expert in only relevant aspects of the software. In other firms, designers work on all facets of the project and often take a project from start to finish. The range of estimated times allocated for training were as follows:

- 24–30 hours per person customized to level of staff member
- 80 hours per person
- 40 hours per person
- 40–60 hours per person

Firms suggested between six and no more than 10 people in a class. The average rate for a trainer runs between $1,000 and $2,000 a day, depending on the level of complexity, consulting, and style development. Once again, taking the middle ground, we estimate that 40 hours of training should be provided to staff. Therefore, the trainer's fees might average $1,500 a day. With, say, eight people in training for five days, the fee would be $7,500 divided among eight staff members, for a training cost of $937.50 a person, or $187.50 a day per person.

The opportunity costs while in training depend on the lost billable salary of the individual. With technicians at $75 an hour, engineers and project surveyors at $90 an hour, project engineers at $100 an hour, and project managers at $110 an hour, and a ratio of three technicians for every engineer and manager, we can assume an average lost hourly rate of about $87. Assuming that each person receives 40 hours of training, there is a lost potential income of about $3,500 per person.

Most professionals interviewed felt that with proper training and a support system to troubleshoot and answer questions after training, no significant production loss should occur. However, this is hard to quantify at this stage.

Summary of Implementation Costs

The estimated costs for a firm to upgrade to Autodesk Civil 3D, develop the standards and styles to automate design, and train the staff for our hypothetical composite project are as follows:

- Estimated six weeks of effort by an advanced Autodesk Civil 3D user or CAD manager at $100 an hour = $24,000
- Estimated training costs of $937.50 a person
- Assumed lost billable time in training of $3,500 a person
- Our project team on this composite project consists of a project manager, project surveyor, project engineer, engineer, and two technicians. Therefore, the largely one-time costs to be absorbed by the firm are as follows:
    - Three network software licenses for six staff members x an estimated fee of $800 = $2,400
    - Estimated training expenses for six staff members x $4,437.5 = $26,625
    - Estimated standards development costs of $24,000
    - Therefore an estimated total investment of $53,025 is assumed to achieve the potential productivity gains discussed in step five, for this project. *An*

additional benefit is that the standards work can possibly be used elsewhere in the company.

Step Seven: Compute Potential Return on Investment

The potential ROI for Autodesk Civil 3D software can now be computed since we have anticipated profits for a hypothetical project of three months' duration, estimated one-time costs for implementing the software, and projected recurring annual costs to maintain that investment in style development, licenses, and training.

In our study, the three-month hypothetical composite project returns an estimated profit of $22,644 against the first year and one-time projected cost estimate of $53,025. The potential profits would be expected to repeat every three months as work continues to come in, producing an estimated increased profit of $90,576 a year. The costs would hold steady for the reminder of the year.

Therefore,

- $22,644/3 months = $7,548 estimated monthly increased profit
- $7,548.0 x 12 months = $90,576 estimated yearly increased profit
- $53,025/12 months a year = $4,418.75/estimated monthly cost spread over one year
- $53,025/$7,543.0 = 7.02 months

This data yields a projected ROI of 7.02 months.

Assuming certain expenses recur annually to maintain our investment in Autodesk Civil 3D licenses, styles, standards, and continuing education for the staff, then the projected ROI can be adjusted as follows:

- Maintain licenses through subscription at an estimated cost of $800 per license x three licenses = $2,400 a year.
- Second-year continuing education costs of two days per employee where trainer cost is an estimated $375 + lost billable time is $1,392 = $1,767 a year per person. For six project staff members the projected cost is $10,602.
- Second-year costs for maintaining, updating, and refreshing the styles and standards are estimated at $2,400 a year.
- Therefore, second year recurring costs of $10,602 + $2,400 + $2,400 are an estimated $15,402.

Comparing these recurring costs and the corresponding potential profits yields:

- Estimated Costs of $15,402 and potential profits of $90,576 or an estimated net profit of **$75,174**

Based on the hypothetical analysis, extrapolating these figures for years one through five provides the following potential results for a company that upgrades from Autodesk Land Desktop to Autodesk Civil 3D:

- Year 1: Estimated costs of $53,025 and profits of $90,576 or a potential net profit of **$37,551**
- Year 2: Estimated costs of $15,402 and profits of $90,576 or a potential net profit of **$75,174**
- Year 3: Estimated costs of $15,402 and profits of $90,576 or a potential net profit of **$75,174**

- Year 4: Estimated costs of $15,402 and profits of $90,576 or a potential net profit of **$75,174**
- Year 5: Estimated costs of $15,402 and profits of $90,576 or a potential net profit of **$75,174**

*Based on the hypothetical project figures, The five-year estimated profit for upgrading to Autodesk Civil 3D software from Autodesk Land Desktop is **$338,247.***

Step Eight: Evaluate Profit Potential from Intangible Benefits

The interviews highlighted several additional items having to do with the potential profit from intangible benefits. Although these benefits are difficult to quantify, they should be noted.

First is the potential for Autodesk Civil 3D to open new markets for users. Because the software now has powerful corridor design capabilities, Civil 3D users can perform corridor work for clients at the DOT level. Although Autodesk Land Desktop can be used for corridor projects, the data is typically piecemeal. Autodesk Civil 3D software eliminates having to compute multiple roadways and manually tie them together. This intangible benefit could improve productivity and profits over time.

The second intangible asset is the Microsoft® Visual Basic® for Applications (VBA) Developer's Kit that is available with Autodesk Civil 3D 2005. Because this kit is based on the new Civil 3D model, development is more efficient than when using the Land Desktop VBA Developer's Kit. This opens the door for the addition of adjunct software capabilities to the Civil 3D offering, further boosting potential productivity.

A third intangible benefit in the fact that VIZ Render has been added to the software. With public communication an ever-increasing challenge, the software now provides a built-in, high-end rendering solution. This capability has the potential to expand the service offerings of organizations that implement Autodesk Civil 3D.

Finally, there are other potential miscellaneous intangible benefits such as increased competitiveness, client retention, employee retention, and proprietary advantage.

Conclusion

This study calculates the ROI that a company might achieve when upgrading from Autodesk Land Desktop to Autodesk Civil 3D software. Results were based on interviews with seven industry professionals experienced in the use of the software. These professionals provided opinions on implementation costs, productivity improvements, and other tangible and intangible benefits of upgrading to the Autodesk Civil 3D product. Metrics were reduced to a single set of figures for analysis in a spreadsheet. A hypothetical composite project was developed and analyzed by identifying those project types that are conducive to using Civil 3D. Tasks for those projects were then analyzed, and budget and staffing were allocated. The estimated productivity improvements were weighed against the implementation costs. Finally, an ROI was computed for the hypothetical composite project.

Generalizing on the results of this project and allocating the profits and costs over multiple years produced the following results:

- Estimated first-year profits of **$37,551**
- An estimated **7.02 month ROI** for Autodesk Civil 3D
- Estimated succeeding-year profits of **$75,174**

The tangible and intangible benefits indicate a compelling case for upgrading to Autodesk Civil 3D software.

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