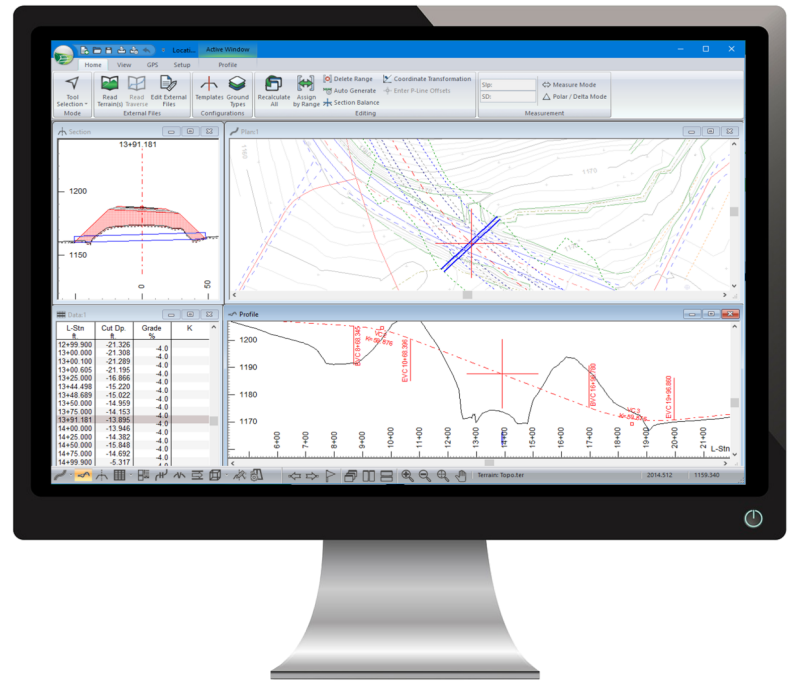# RoadEng®

WHITE PAPER:

Dedicated Geometric Design Software Makes Engineering Design Workflows More Efficient.

This paper explores the question of how to most efficiently streamline engineering-CAD workflows, and tackles the question of who should be using CAD.

EXECUTIVE SUMMARY

This paper explores the question of how to most efficiently streamline engineering-CAD workflows within firms by assigning dedicated geometric design software to those doing engineering & to leave CAD exclusively to those doing drafting. This paper evaluates different industry standard software tools, associated software workflows, and the associated cost/benefit relationships. It proposes a workflow which incorporates the use of RoadEng civil design software alongside a CAD-based system, which ultimately leads to a more efficient and cost-effective design workflow.

The proposed workflow in this paper clearly delineates what is done by CAD and what is done by engineering. Engineering work is done only by those in an engineering role, and then it is passed on to CAD in a form ready for drafting without needing further edits.

The power of CAD-based software is a double-edged sword: it offers a lot of functionality, but with many functions comes a steep learning curve. A one-size-fits-all compatible CAD package allows many users of varying roles in a firm to access the same software, yet each individual user rarely uses the entire set of functions at once. Thus, the firm often ends up paying for a total number of licenses that often far surpasses their actual design needs.

RoadEng is an easy-to-use, easy-to-learn, and relatively inexpensive standalone civil design software package that has a focus on engineering (geometric design) functions over drafting functions. RoadEng is an ideal tool for those in a firm who are making engineering design decisions, but who are not CAD experts and do not have the time to learn. The use of RoadEng by those in engineering and management roles instead of CAD software also frees up CAD licenses for CAD technicians whose role it is to navigate and use CAD for detailed drafting.

The end result of this proposed workflow is: first, those in engineering roles can focus on engineering decisions without being bogged down by the complexities of CAD software; second, a firm needs a smaller number of CAD licenses and thus spends less money on software; and third, better drawings are produced in less time, with less back-and-forth between engineering and CAD.

Producing high-quality and professional drawings is an integral part of the work of every civil design firm. These drawings have both drafting and engineering components.

Drafting is the practice of creating accurate representations of objects for technical and engineering needs. *Engineering* is the design, analysis, and/or construction of works for practical purposes.

In the early days, CAD (Computer Aided Drafting) was really a replacement for the traditional drafting board. Now, CAD usually means *Computer Aided Design,* reflecting the fact that modern CAD tools have been extended to include design capabilities.

Some argue that since the emergence of CAD, the line between drafting and engineering has become blurred. Engineers proficient in CAD can produce detailed drawings, eliminating the need for a draftsperson. Similarly, a draftsperson can perform engineering design with the use of CAD design software. In theory this is a good concept, but from the engineer's perspective it runs into practical problems:

1. Engineers must undergo significant training in order to use the software. In many cases this is simply not feasible and the lost opportunity costs are prohibitive.

2. In order to remain proficient, the engineer must regularly use the software. This is a problem for busy engineers who have a variety of responsibilities such as meetings, client negotiations, construction supervision, administration and reporting etc.

3. CAD software is general in purpose. For land development-specific applications this flexibility is overhead in the software. It limits the optimization that can be done for specific geometric design processes like contouring, cross section calculations, volumes etc. The result is that CAD-based software is generally not as quick and reactive as specialized standalone software.

The net result of these problems is that the engineer often does not effectively use the design software his/her firm has available, or in some cases does not use it at all, and great inefficiencies result. Engineers may revert to pen and paper, rely heavily on others with CAD expertise to assist them, or may complete designs which are sloppy and take a lot of time for others to "fix."

STANDALONE SOFTWARE FOR ENGINEERING DESIGN

There are a variety of Civil Engineering software packages on the market today. Some well-known products include AutoCad's Civil 3D®, Bentley's InRoads®, Softree's RoadEng®, and a variety of others. Most of these packages require a CAD platform to run. In addition to being large sophisticated products, they require a thorough understanding of the CAD engine.

For many companies, this complexity of design software restricts its use to CAD specialists, and engineers are forced to rely on these technicians to carry out their design work.

CAD software is feature-rich. It can be used to design anything from widgets to jet airliners. This flexibility brings with it a significant processing overhead. Additional information (entities, object types, proxies, layers, blocks etc.) must be saved and processed. This slows everything down.

Free from this CAD overhead, standalone software (such as RoadEng) is easy-to-use and can optimize application-specific tasks such as surface modeling or volume calculations. The result is a highly interactive design tool capable of processing larger data sets.

IS CAD-BASED SOFTWARE BECOMING BLOATED?

Software bloat, or bloatware, is a term used in both a neutral and disparaging sense, to describe the tendency of software to become larger, or to use larger amounts of system resources (memory, disk, processing power etc.), while adding little or no value to the end user.

One of the main catalysts for software bloat is money. In the software world a key source of revenue is to add more features to a product, up the version number, and charge the end user more money. In early versions of a new product, more functions with each new version usually means the newest version is better. However, there comes a point beyond which more actually makes the product less effective.

Questions to consider:

- *Is the software I am using appropriate for the work I do?*

- *Is it focused on that type of work I do, or does it contain a large number of features which are not of interest to me?*

- *What is the cost in terms of training, licensing and lost productivity as a result of the ongoing adding of features?*
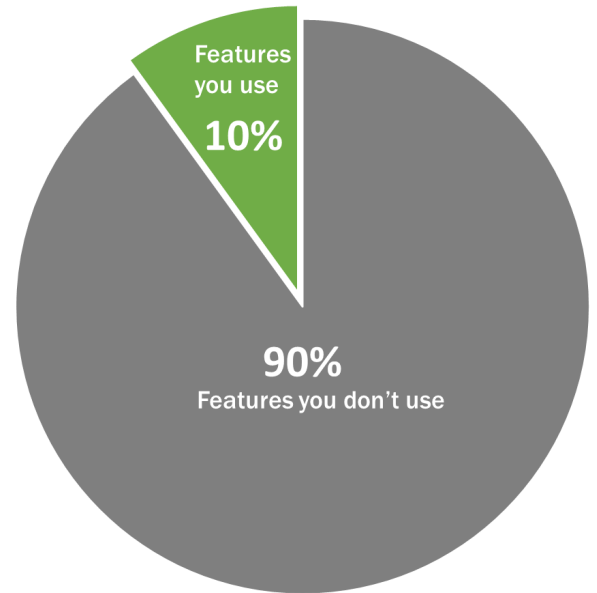
Figure 1—Bloatware: A survey of CAD-based design users revealed that only a fraction of the software's functionality is used. More than 90% of those surveyed indicated that they use less than 10% of the features in the software.

COMPATIBILITY AND INTEROPERABILITY

Obviously, compatibility and interchangeability of data between software packages is very important.

In the software industry, compatibility has a lot to do with market share. In markets where there is a dominant leader (such as Microsoft in the word processing market) the industry standard format generally becomes that of the leader (e.g. *.docx format).

For drafting, AutoCad's DWG format is generally the CAD standard. However, DWG files are not suitable for storing Civil/Survey data such as surfaces, alignments, profiles, cross sections etc.

There is no commercial standard format for civil/survey data. To address this issue, the civil/survey software industry has adopted the LandXML standard to provide true compatibility and interoperability.

INDUSTRY STANDARD: LANDXML

In January 2000, an industry consortium LandXML.org was formed to create the LandXML standard. Founding members include Autodesk, Bentley and many other software and survey equipment suppliers.

LandXML is a generic interchange format used to save civil/survey project data. It allows project data including Points, Surfaces, Parcels, Alignments, and Profiles to be moved from one software vendor to another. For example, you can export a surface created in Civil 3D® and import it into InRoads®.

LandXML offers true vendor compatibility of civil/survey data.

THE SOLUTION: ROADENG® , ENGINEERING TOOL

RoadEng® is an easy-to-use site and road design software package. It works either as a companion to other civil design software or as an independent standalone system. It includes functions for data collection, terrain modeling, contouring, volumes, profiles, sections and road design.

RoadEng focuses on engineering, not CAD. It was designed from the ground up to work with objects such as surfaces, cross sections, alignments, drainage structures, and templates. Its interactive capabilities allow the engineer to quickly evaluate different design situations.

RoadEng requires minimal training; often new users will be up and running in an afternoon. More than 90% of RoadEng users don't require formal training. Occasional users such as Project Engineers and Managers are able to use the software to try alternatives, review and check alignments, profiles, cross sections etc.
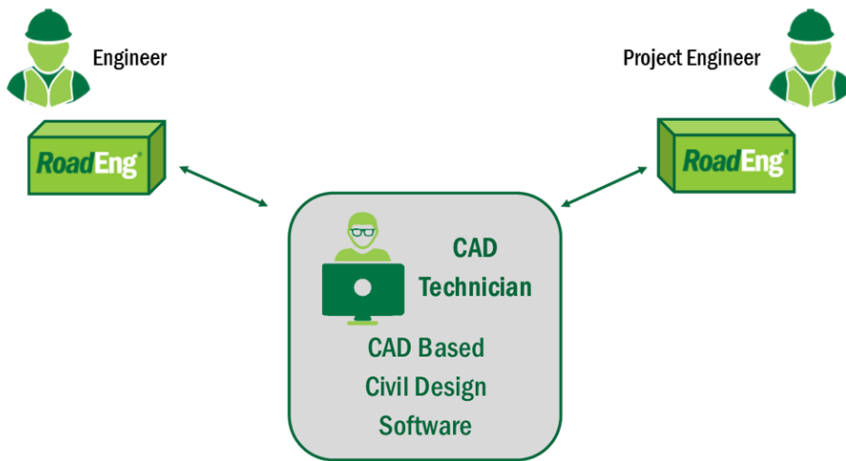

Figure 2— Engineering Office Configuration using both RoadEng and CAD software

RoadEng can be deployed as a standalone tool or as a compliment to CAD-based design software. Drawings can be output directly or saved in DWG format. Alignments and surfaces can be moved easily between CAD design software using LandXML for final drafting and completion.
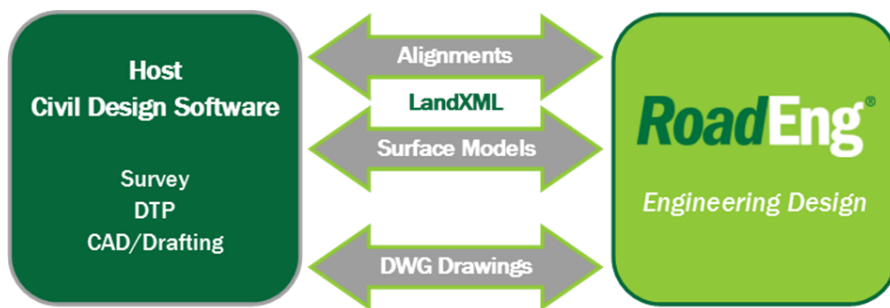

Figure 3— LandXML Data Interoperability

CONCLUSION

Civil Engineers are becoming increasingly separated from design software tools due to the complexity and steep learning curve associated with CAD-based software.

Software tools have the potential to empower the design engineer. They allow him/her to be creative, to try different alternatives and to determine the best design through an iterative process. This potential is not being realized using CAD-based software.

RoadEng® has been introduced as a supplement to CAD-based civil design software. It is an easy-to-use site and road design software package.

Significantly different from other civil design software, RoadEng focuses on geometric design engineering functions, not CAD. Its interactive capabilities allow the engineer to quickly evaluate different design situations.

RoadEng supports industry standard formats such as DWG and LandXML, allowing data to be moved back and forth between CAD-based software and RoadEng.

The proposed solution improves the efficiency of engineering design workflow and requires minimal training.