ENNOVA
Engineering Innovation.

White Paper:

Envision Product Overview and Value Proposition

http://envisionapp.com

July 2012

ENNOVA
Engineering Innovation.

Envision Product Overview and Value Proposition

Contents

Introduction

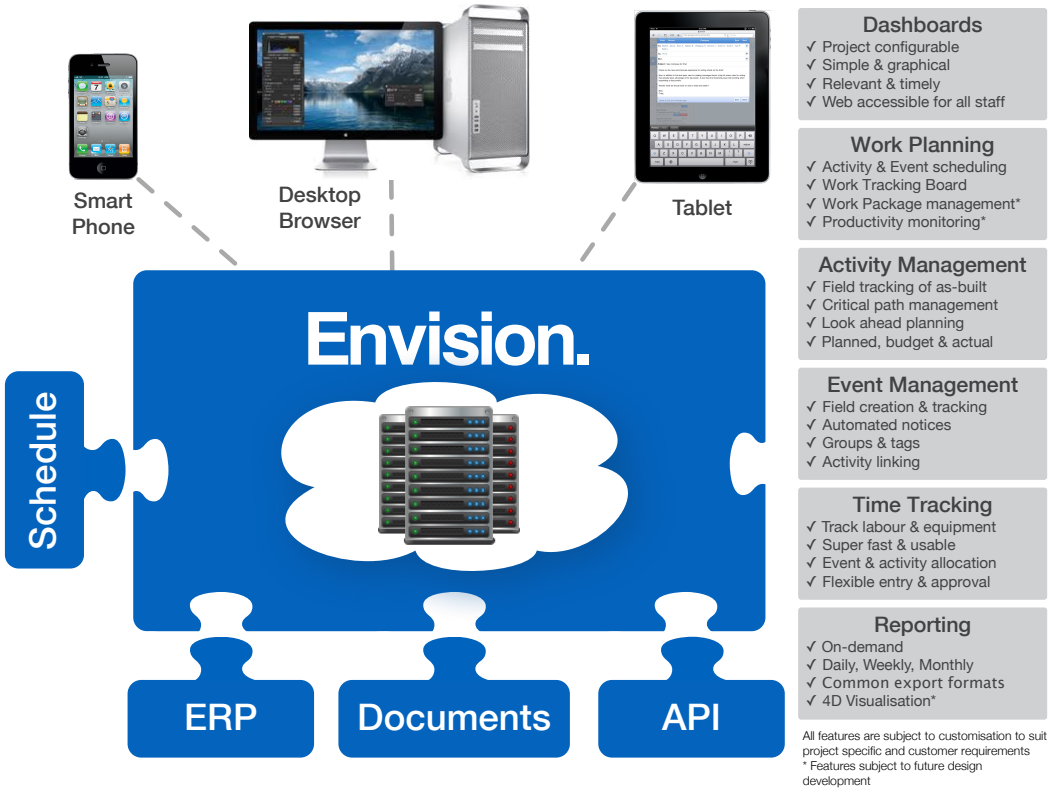
Envision is an integrated, web-based construction management software platform that has been purpose built to help constructors optimise project outcomes by improving field productivity and reducing disputes. Underpinning Envision are the principles of Lean Construction that focus on maximising value and eliminating waste. These principles have guided the development of Envision in terms of technology selection, feature implementation, workflow and interface design.

Envision is built around a hosted web application/ service that provides the platform for a range of product features. The features are based on the real-time management of planned and unplanned work together with the integration of field data.

Integration with Envision is enabled through file import/export for industry standard systems like Primavera, MS.Project and SAP. Custom integrations can easily be created utilising the Envision API.

Increased productivity and reduced disputes are the key benefits of Envision, however many additional benefits are created through proper implementation. These benefits are based upon improving the organisation and accessibility of information which reduces non-productive time and focuses effort on critical path activities. Additionally, Envision enables real-time capture and reporting of field progress and events allowing thereby improving project control.

When implemented properly Envision reduces the cost of construction and improves project outcomes for both clients and constructors. This paper describes the Envision product, value proposition and the supporting technology.



Lean Construction

Lean Construction [1] is an adaption of Lean Manufacturing principles and practices to the design and execution of construction projects. The adaption is based around treating a construction project as a temporary production system, thereby enabling many of the Lean Manufacturing principles and practices to be applied. The principles of Lean Construction are focused on maximising value while also eliminating waste and are described below.

Lean Construction Principles	
Principle	Description
Reliable Flow of Work	Work is only assigned work once all dependencies are fulfilled
Reduce Waste	• Construction build errors • Oversupply of materials • Unnecessary processing of materials • Unnecessary movement of materials • Unnecessary movement of people • Waiting between activities
Process Transparency	Clear and accurate documentation and reporting of all work flows involved in construction process
Pull	Create a pull of work, materials and information through the construction process
Reduce Cycle Time	Minimise the time between construction steps
Synchronise Processes	Align timing of all steps in the construction process

Although Lean Construction shares many principles with Lean Production, it is different in how it is practiced.

Key Differences from Lean Manufacturing

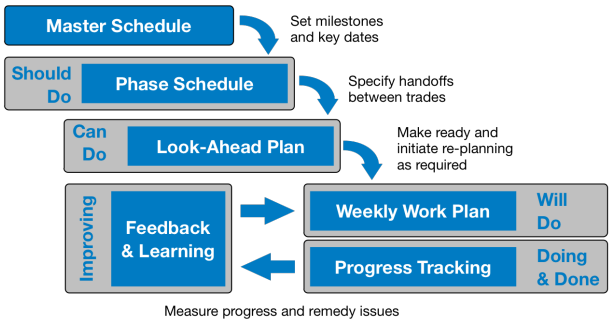
- Construction projects are unique (one-of-a-kind) prototypes
- Multiple contractors/suppliers act under different commercial arrangements
- Construction environments are typically outdoors and difficult to control
- Communication challenges caused by teams being geographically separated adding complexity to sharing of information

Despite the differences, many of the key Lean practices are applicable to construction. Additionally, specialised methods such as the *Last Planner System* and *WorkFace Planning* have been developed to address the unique challenges of construction.

Last Planner System

The Last Planner System [2] (also known as Collaborative Planning, Lean Planning, Pull Planning, Right to left planning or Short-term planning) is a method of controlling and providing certainty around materials, resources and dependencies at the work face by using a collaborative approach for *pull* scheduling.

Last Planner System



The key practices of the Last Planner System include:

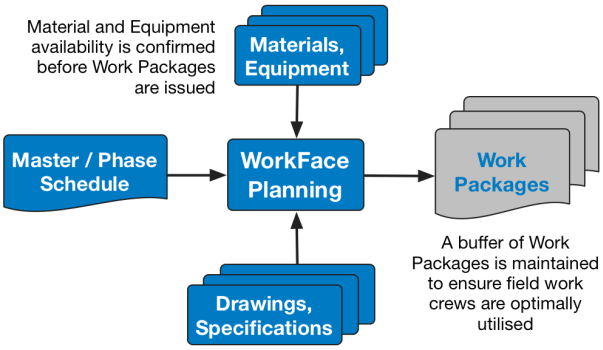
- Minimising work variability between tasks as a way of improving the labour utilisation
- Creating look-ahead plans that are based upon work tasks that can be completed without interruption, rework, or remobilisation
- Planning work on weekly basis through coordination meetings involving planners and supervisors
- Measuring progress by monitoring the actual completion of work and using weekly learning to improve work practices

WorkFace Planning

WorkFace Planning [3] is an activity that involves the creation of small, well defined, field installation Work Packages that support the construction workforce. A typical Work Package supports one rotation (5 to 10 days) of a work crew and is based on activities that are extracted directly from the construction schedule/plan. Each Work Package has a standard list of requirements that must be satisfied before the work is released for execution. These requirements identify all the things that a Field Supervisor and crew will need to complete the work uninterrupted.

Work Packages are typically developed and managed by WorkFace Planners who have prior experience as either a field supervisor and are skilled in planning. This role is relatively new to the construction industry, but offers a potential career path for field staff seeking skill development and ongoing involvement in the industry rather than retirement.

WorkFace Planning



Typical Work Package Contents	
1	Detailed scope of work and deliverables
2	Drawings and 3D model views
3	Safety plan - how will work be completed safely?
4	Quality plan - how will the work be approved?
5	List of trades or skills required and timing
6	List of materials - availability confirmed
7	List of plant equipment - availability confirmed
8	Personnel and equipment time/cost booking codes
9	Budget effort/costs
10	Work method statements

Kanban Systems

Kanban systems are an important tool of Lean Manufacturing and are based on using physical cards (Kanban) to control the flow of work and materials. In these systems the Kanban act as a visual signal to initiate work or material movement once downstream capacity becomes available within the system. This has the effect of limiting the work-in-progress and creates a pull of work and materials through the system.

Kanban systems offer benefits that include improved efficiency and accuracy in forecasting progress. Improved efficiency is achieved through continuous process improvements (optimisations) that are initiated when problems are identified. Limiting work-in-progress creates a pull of materials and work from upstream to downstream. This equalises each process and smooths the flow of work and materials through the system. Improved progress forecasting is a result of creating a predictable work flow through the system based on actual evidence.

Challenges and Opportunities

While the above approaches address many of the problems affecting construction projects, the work practices have yet to be been widely understood or adopted. To obtain full effect, these practices require thorough understanding, training and the availability of supporting systems such as Envision.

Enabling Technologies

Envision is built on a number of key technologies that enable the principles of Lean Construction to be easily implemented within a project. These technologies are explained to bring into context some of the unique benefits of Envision.

Cloud Computing

Significant innovations in virtualisation [4] and distributed computing, as well as improved access to high-speed Internet have enabled cloud computing to become a viable alternative to traditional application hosting and storage technology. In simple terms, cloud computing is a set of pooled computing resources and services delivered over the internet. Typically, cloud computing services are characterised by being (a) provided on demand, (b) capable of scaling to meet demand and (c) fully managed by the provider.

Cloud computing is typically provided "as-a-service" over the Internet and can be in the form of Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), or Software-as-a-Service (SaaS).

Software-As-A-Service

This type of cloud computing delivers a single application through the browser to customers using a multi-tenant architecture [5]. On the customer side, it means no upfront investment in servers or software licensing; on the provider side, with just one application to maintain, costs are low compared to conventional hosting because of economies of scale. Ennova has designed and implemented Envision to leverage the Software-as-a-Service model thereby

providing its customers with great flexibility and lower costs.

Open Source Software

Envision has been built using Ruby on Rails and PostgreSQL which are the same technology adopted by leading companies like NBN, Yellow Pages, Twitter and Groupon. Ruby on Rails is the premier software platform for web-applications and offers a range of compelling benefits over traditional Microsoft and Java platforms including:

- Speed of development
- Integrated test automation
- 8 years of active community development
- Flexibility and extensibility

Open source software is a key competitive differentiator for Ennova enabling new features and enhancements to be incorporated very rapidly.

Mobile Computing and Smartphones

Mobile computing devices are able to access the internet through either a wireless network or a 3G mobile network. These devices are becoming increasingly powerful and offer a number of advantages as a software delivery platform as they enable the use and collection of data remotely. This saves significant time, increases productivity and also enables the capture of data that would otherwise be overlooked because of the effort involved using traditional methods.

Smart Phones and Tablet Devices

The Apple iPhone and iPad represents the current state-of-the-art in smartphone and tablet device technology. Both devices have touch screens that improve usability by allowing documents to be rotated, zoomed and panned - a feature which is helpful for navigating large documents like drawings.

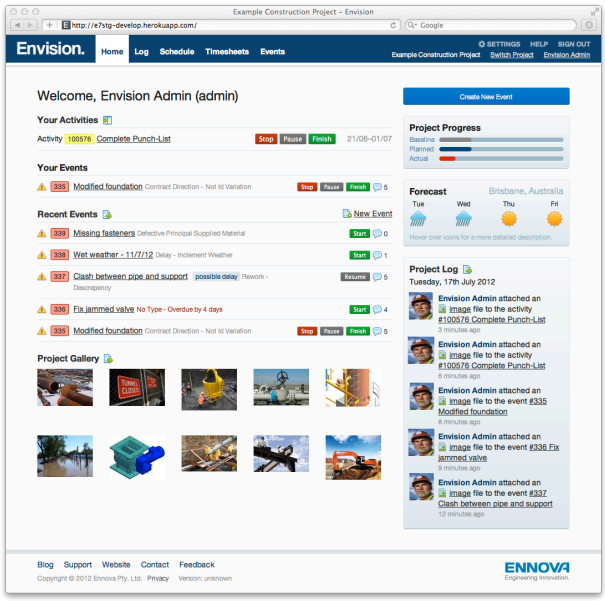
The iPhone can record photos, video, audio, GPS and theodolite data, compass directions, browse the internet and run applications.

The iPad is a tablet style device that can browse the internet, run applications (iPad & iPhone) and record GPS and theodolite data.

Ennova has developed Envision to support the use of an iPhone and iPad for viewing and gathering field data. When used in conjunction with Envision these mobile devices enable the near real-time collection of field data relating to progress, events and time tracking. Additionally, the application has been developed to function when outside network coverage and can then be synchronised when in WiFi or 3G network coverage.

Features and Capabilities

The product features of Envision are designed to provide an integrated approach to executing and controlling construction projects.



Dashboard

The dashboard is the starting point for navigating a project and provides a view of the key project metrics. It also provides a view of time-based alerts for certain Event types that must be completed to avoid contract time-bars. Other dashboard features include local weather, recent photos and a timeline of work started, paused or completed.

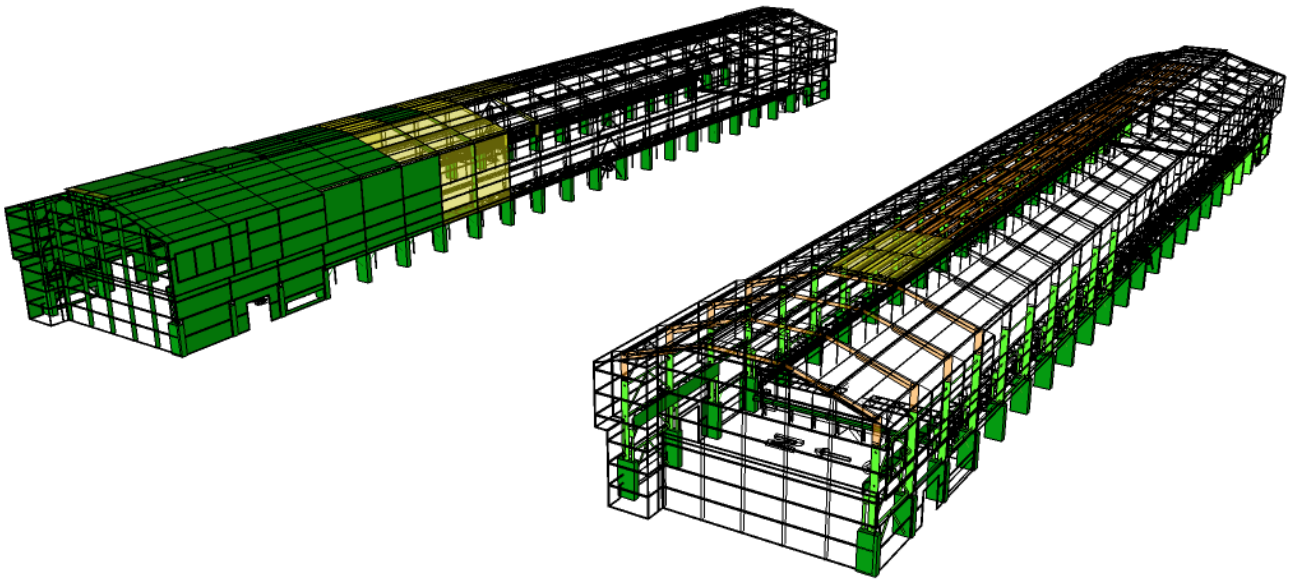
Scheduling

Envision does not replace project management tools like Primavera or MS.Project but instead enables the schedule to be visualised in the context of a graphical 3D (BIM) model. This allows existing planning systems to maintain scheduling logic.

Schedule progress can be updated from mobile devices in the field, a native iPhone application or alternative refreshing from the master version of the schedule.

Envision enables the baseline contract schedule, the forecast sequence/timing and the actual site progress to be visualised as an animation between specified dates or at a particular point in time. Direct visual comparison between planned and actual progress is an effective method of demonstrating progress and identifies critical schedule activities.

Below is a comparison of planned and actual progress for the same construction model. Different colours and opacities are used to differentiate between work completion states (not started, in-progress, paused and complete).

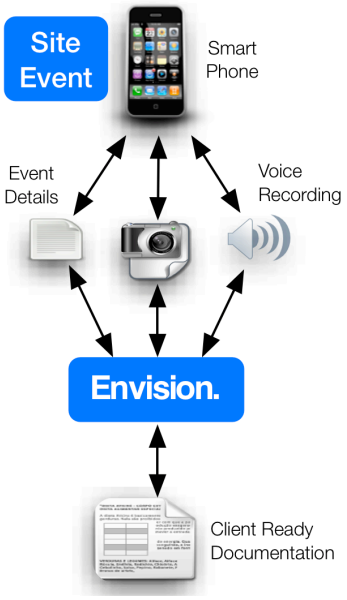


Event Management

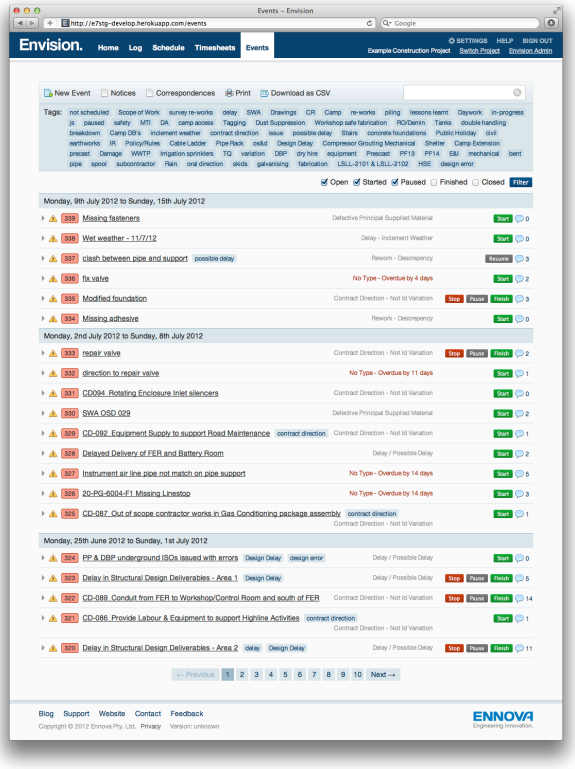
Envision allows field personnel to log events of any type directly from a smartphone. The Envision native iPhone application enables the capture of information such as photographs, videos, voice recordings and text comments.

Typical events include delays, site instructions, inspection defects, variations in scope, inspection requests for completed works, issue punch list items etc.

Events can be used to record labour and equipment time and therefore justify claims for extension of time or additional costs.

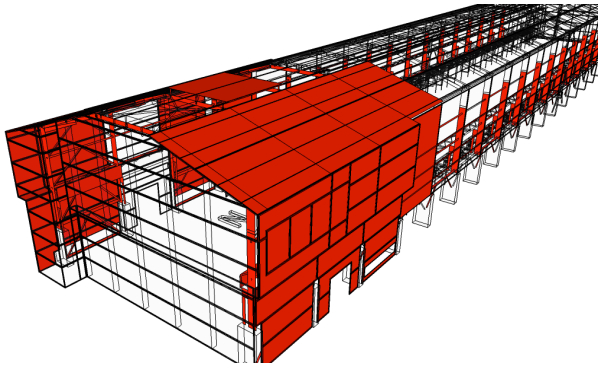


The Event management feature also includes the ability to create specific documents from configurable templates such as delay notices, inspection requests, non-conformance reports or any other contractual documents.



When used in conjunction with a 3D model and the construction schedule, the event management feature can highlight components within the 3D model that are affected by the logged event. This feature is invaluable in demonstrating the impact of an event on the construction schedule.

The model below shows Events highlighted against the affected components of the 3D construction model

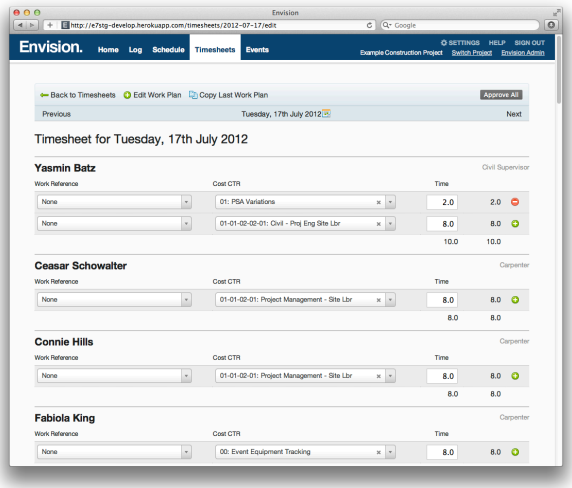


Automated Documentation

Envision incorporates a template driven documentation engine that can be configured to build a extensive range of document types. Example documents include: Delay, Direction, Defect, Rework, etc. Templates are configured to auto-populate project data fields and to include uploaded content like photos and other documents. Once created, documents can be stored and transmitted to the client or other contractor.

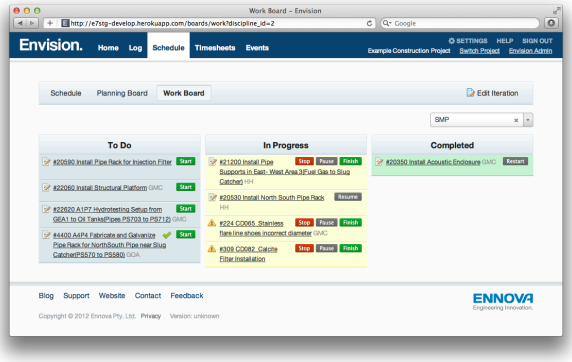
Time Tracking

Although Envision doesn't replace traditional ERP systems, the time tracking features provide a simple and effective interface for capturing time against field activities and events. Typically this data is recorded at a higher level of detail than is necessary for Enterprise systems and therefore is able to support productivity analysis and time spent resolving field issues. Since time capture is simple, productivity issues can be identified in near real-time. Consolidated times can are exported to enterprise systems for cost accounting and invoicing.



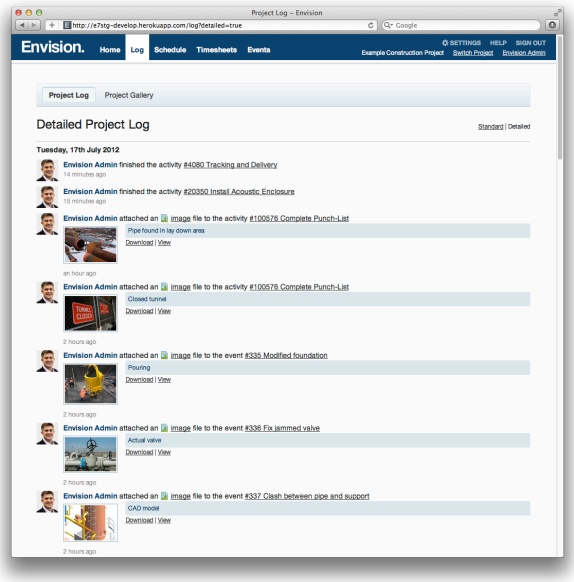
Work Packages and Kanban

The Envision Work Package features leverage the principles and Lean Construction and WorkFace planning. WorkPackages are composed of schedule activities (obtained directly from the construction schedule - Primavera or MS.Project) and all the dependencies required to complete the activities (materials, drawings, specifications, ...). The status of WorkPackages are visualised using a Kanban [6] board that enables drag-and-drop of WorkPackages between different work flow steps. The work flow steps can be customised to suit specific project requirements.



Project Log / Timeline

As events are raised, activities are completed and photos recorded, the Envision log provides a summary that allows users to gain an overview of project progress and recent site events in the form of timeline.



Reporting and Business Intelligence

Envision offers customised dashboards to managers at all levels (project through to corporate & executives) to enable pro-active monitoring of key data using, where possible, simple graphical charts. By embracing a 'measure to manage' philosophy, management are kept informed and are able quickly respond as required.

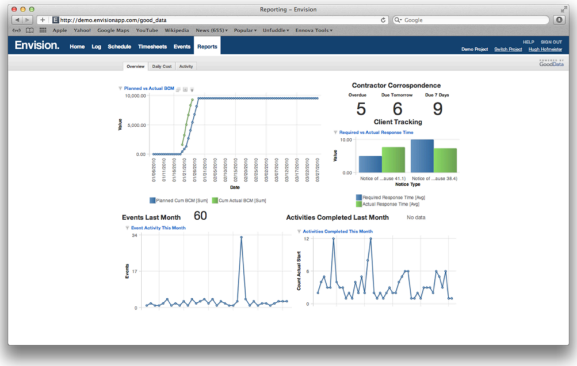


Figure 15 *Envision customisable business intelligence*

Integration with Systems

The application architecture of Envision readily supports customisation and integration with external systems. Integration options include web-service or neutral file exchange. As an example, Ennova have developed integrations with enterprise systems such as Primavera, MS.Project, SAP and Aconex.

Improving Productivity

Field productivity is a critical factor in the successful delivery of construction projects. The potential for increasing productivity is typically very significant as studies [9, 10, 11] suggest there is a significant level

of non-productive time occurring within most construction projects.

The example below demonstrates the impact of small interruptions on the actual productive tool time available within a site day.

Sample Productivity Analysis	
Site Activity Breakdown	Time (mins)
Available site time per day (10hrs)	**600**
Non-Productive Paid Time	
Bus to/from site	20
Toolbox and safety meetings	20
Travel to/from the work face (x 3)	75
Tools out/away	30
Wash up (x 3)	15
Morning break	20
Total	180
Non-Productive Paid Time	**0.3**
Recoverable Events (Variations, etc ...)	
Missing material	20
Site access blocked	20
Client direction	120
Design error/clarification	20
Total	180
Recoverable Events (Variations, etc ...)	**0.3**
Non-Recoverable Events	
Faulty power tool	5
Safety permit not complete	5
Store delays or missing stock	10
Difficulty locating materials	10
Total	30
Non-Recoverable Events	**0.05**
Productive Tool Time	**210**
Reduction in Available Tool Time	**0.5**

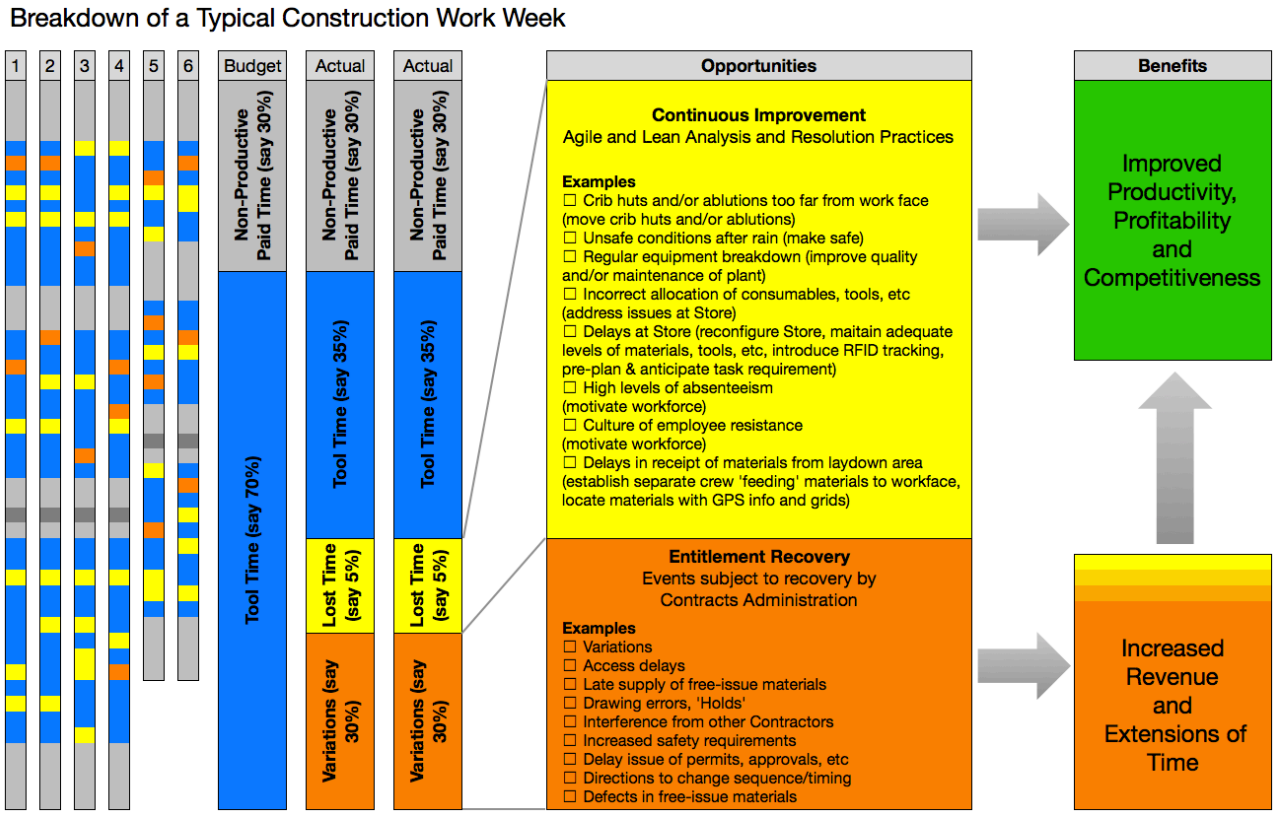
In the above example, which is typical within the construction industry, a saving of only 20 minutes per day could deliver an increase in available tool time of 10%. Given the small profit margins that exist within many projects, this small increase could result in significant benefits to the overall project.

Envision makes it practical to identify, track and analyse circumstances that contribute to productivity improvements on major construction projects. Once identified, Envision provides project staff with the information to improve productivity and a means to measure and review the impact of improvements through the following:

- Enabling collaboration between on and off site staff
- Making information accessible in the field
- Monitoring and reporting progress
- Tracking unplanned works and events
- Enabling collaborative planning and problem solving
- Recording lessons learned for future projects

The practices that can contribute to improved productivity are described below in the context of Envision.

Productivity Improvement Practices	
Practice	Description
WorkFace Planning	WorkFace Planning ensures a smooth flow of work with all dependencies satisfied with the Work Package thereby increasing field productivity
Tracking Field Progress	Daily tracking of field progress is necessary for realistic planning and the management of risks and opportunities
Tracking Project Events	Daily tracking of field events involves recording all unplanned work and interruptions and is essential to identify productivity improvements
Weekly Work Planning	Planning work ahead ensures that necessary dependencies are satisfied prior to commencement and ensures optimal resource utilisation
Critical Path Activity Management	Managing the completion of critical path activities is essential to avoid related activities being inadvertently blocked
Visual Work Planning	Making work activities, progress and responsibility visible provides transparency and creates team engagement
Limited Context Switching	Limiting the work crews switching between different work fronts increases productivity by minimising setup and teardown activities and is achieved by ensure all dependencies are satisfied prior to commencing work
Continuous Improvement	Continuous improvement within a project is achieved by regularly reflecting on the differences between planned and actual work completed, then addressing the root causes of differences
Access to Information	Access to documentation such as drawings, specifications, schedules, etc enables rapid resolution of in-field queries
Track Labour and Equipment Costs	Daily tracking of actual costs against budget provides early feedback and creates management accountability



Reducing Disputes

Disputes in the Australian construction industry have been estimated to cost $7B annually. However, the majority of disputes could be avoided were the respective parties to maintain adequate records and establish a causal link between costs incurred and originating event. Envision enables contractors to keep such records and establish those links.

The CRC for Construction Innovation have developed a Guide to Dispute Avoidance and Resolution [12]. This guide offers suggestions to assist in the avoidance and resolution of disputes. Envision facilitates implementation of many of these suggestions:

Disputation Reduction Practices	
Practice	Description
Avoid Contract Time-Bars	Time bars limit the time allowed for the notice and submission of documentation needed to substantiate contact variations or extensions of time
Establish Causal Relationship	Identify relationship between cause and effect on cost and time and allocate responsibility.
Document Labour and Equipment Costs	By tracking actual verse budget cost and activity durations it is possible to establish relevant levels of accountability at all levels of a project. Any trends, favourable or otherwise, can be monitored to ensure forecast projections are addressed and, where necessary improvements made. Alternatively, where appropriate, genuine improvements acknowledged and rewarded.
Mitigate the Effects of Delay and Disruption	There is an ongoing obligation to mitigate the effects of delay and disruption and to demonstrate that appropriate effort has been applied to that mitigation. Therefore, important to document the alternative mitigation strategies available and record those actions taken.
Accurately Allocate Costs Against Events	To avoid the potential for ambit or 'global' claims (the main source of disputation in the Australian construction industry) it is important to be able to accurately allocate costs and time impacts against specific events.

Additional Envision Benefits

In addition to improved productivity and reduced disputes, Envision provides a range of tangible project benefits.

Reducing Administration Effort

Envision enables field staff to collect and store information at its source. This process alleviates the need for a team of field personnel to record and process field information. As a result, this reduces the dependency on scarce, skilled, administrative resources such as contract administrators, quantity surveyors, planners, site clerks, quality assurance, expeditors and other personnel.

Increasing Project Revenue

Every major project in the Australian construction industry experiences variations, delays and a degree of disruption. Unfortunately, most contractors forfeit substantial revenue associated with variations, delays and disruption costs because the contractual notification provisions are not satisfied and relevant records not kept.

Most, construction contracts entitle contractors to payment for variations, extensions of time, delay/ disruption costs, etc. To preserve an entitlement to such payment contractors must maintain accurate, relevant records and provide timely notification to avoid strict time-bars. To date, such record-keeping and notification has been difficult, time consuming, spasmodic and, where implemented, requires significant administrative and clerical resources.

Envision enables the contractor to generate the respective notifications and maintain the relevant records to establish an entitlement to recover time and costs. Because the information collected through Envision is relevant, timely and largely indisputable (photos etc), the likelihood of disputes arising in respect to cost/time impacts is substantially reduced. Furthermore, the usual frustration arising from poor notification, is overcome by the issuance of notifications through Envision.

Improving Risk Management

Envision's mobile capability enables field supervisors to complete much of their reporting without having to leave the work face and return to the site office. This results in increased levels of supervision with corresponding improvements in both productivity and risk management. Where risks are identified, especially safety-related risks, the relevant information, including photos, etc, can be readily transmitted to the responsible parties. Such responsiveness can reduce the levels of idle time associated with safety-related matters.

Improving Project Collaboration

Many projects associated with the resources sector are in remote locations and therefore always away from the contractor's offices. Envision enables project personnel to monitor their own progress as well as share relevant information with their peers on site and with senior management in the office. The same information provides a comprehensive record of progress and replaces the traditional site diaries that should be, but seldom are, maintained by all supervisor and site management personnel. The ability to collaborate, both with others on site, and with management off site creates a culture that encourages the sharing of ideas and 'lessons learned'.

Sample Business Case

The benefit to a contractor of utilising the full potential of Envision on a single construction project may be summarised in the following example of typical construction project with a turnover of $100M per annum using very conservative values.

Sample Business Case	
Attribute	Value
Project labour value ($ Million)	$100
Project duration (months)	12
Site establishment/disestablishment (months)	2
Construction duration (months)	10
Working days (per month)	25
Indirect project costs (Site establishment, project team, major plant & equipment, stores, camp, ... excludes direct labour)	35%
Direct project costs (Direct labour & equipment for 6 day roster)	65%
Project burn-rate indirect costs (per day)	$140,000
Project burn-rate direct costs (per day)	$260,000
Productivity Gains	
Saving in direct project costs (based on 5% productivity improvement)	$3,250,000
Saving in indirect project costs (based on 10% reduction in duration)	$4,200,000
Revenue Gains	
Recoverable delay costs (based on 1 month delay)	$6,500,000
Recoverable variations (based on 10% variations)	$10,000,000

Sample Business Case	
Attribute	Value
Total Gain	$23,950,000
Percentage Gain	24%

Example assumes a hard-dollar contract, 6 day roster, FIFO, limited design and/or procurement effort, free issued materials.

The example demonstrates that only a small increase in productivity combined with recovery of delays and variations can provide a substantial improvement in project returns.

Summary

Envision is a purpose built construction management software platform that leverages a range of innovative web-based technologies. When properly implemented, Envision is capable of helping constructors optimise project outcomes by improving field productivity and reducing project disputes. The use of mobile computing enables real-time capture of field information that improves decision making and supports critical path management of construction activities providing benefits to all project levels.

About Ennova

Ennova specialises in web and mobile technology for the construction industry. Ennova's staff have over 30 years experience working in the construction industry on project engineering, project controls and commercial management. Ennova understands industry needs, working closely with employees at all levels within companies. This industry knowledge, hands-on approach and deep technical strength has enabled them to build and customise Envision to suit the needs of the construction industry.

References

1 What is Lean Construction?, Howell, G., Proceedings IGLC-7, Berkeley, USA, 1999

2 The Last Planner System of Production Control, Ballard, G., PhD Thesis, University of Birmingham, 2000

3 Schedule for Sale - WorkFace Planning for Construction Projects, Ryan, G., AuthorHouse, 2009

4 Virtualization, Wikipedia, 2010

5 Multitenancy, Wikipedia, 2010

6 Application of Kanban to the Management of Construction Work Packages, Smith, A., Ennova Pty Ltd, 2010

7 Agile and Lean Applied to Construction, Smith, A., Ennova Pty Ltd, 2011

8 Mitigation of Risk in Construction, McGraw Hill Construction, 2011

9 Non Value-Adding Activities in Australian Construction Projects, Sugiharto, A., Construction Management and Maintenance of Building Structure, 2002

10 Causes of Construction Cost and Time Overruns, Baloyi, L. and Bekker, M., Acta Structilia 2011

11 Preliminary Study on Causative Factors Leading to Construction Cost Overrun, Memon, A. et al, Journal of Sustainable Construction Engineering & Technology, Vol 2, Issue 1, June 2011

12 Guide to Leading Practice for Dispute Avoidance and Resolution, CRC for Construction Innovation, 2009