Estimating and Project Control

Product Overview

November 2014

Construction Computer Software has specialised in the development of software for the construction industry for the past 35 years. Our expertise is in estimating and financial control of site operations, planning, measurement and project management systems, and site systems such as materials and document control.
Contents

Introduction to Construction Computer Software ........................................... 5

Major users ...................................................................................................... 7

Training Courses ............................................................................................ 12

Estimating .......................................................................................................... 15
   Underlying Concepts .................................................................................... 15
   Interface with the Estimator ......................................................................... 15
   Libraries ......................................................................................................... 15
   Rounding ......................................................................................................... 16
   Candy Environment ....................................................................................... 16
   Limits ............................................................................................................... 16
   The Estimating Environment ........................................................................ 17
   Worksheet drilldown sequence ..................................................................... 18
   Macro Bill Items ............................................................................................ 19
   Split Rates and Combinations ..................................................................... 20
   Dual Currency Bills ....................................................................................... 21
   Indirect Costs ................................................................................................. 22
   Manage Indirects Post contract ................................................................. 22
   Master Library ............................................................................................... 24
   Estimating Definitions and Settings ............................................................. 25
   Subcontract Adjudicator ............................................................................. 26
   Trade Totals Display ..................................................................................... 28
   Plant, Labour and Steel Calculation Tables ................................................. 29
   Estimating Reports ....................................................................................... 30

QTO – Quantity take-off ................................................................................ 31
   Measurement ................................................................................................. 31
   Templates ....................................................................................................... 31
   Drawings ....................................................................................................... 31
   BIM ................................................................................................................ 32
   Bill of Quantities ........................................................................................... 32
   Reports .......................................................................................................... 33
   Export ........................................................................................................... 33

Valuations ........................................................................................................ 35
   Job modelling ................................................................................................. 35
   Monthly valuations ....................................................................................... 35
   Analytical pricing of variations .................................................................... 35
   Allowable cost reconciliation ....................................................................... 35
   Reporting ....................................................................................................... 35
   Subcontract Payment ..................................................................................... 35
   Forecast to completion ................................................................................ 35
   Engineering information .............................................................................. 35
   Feedback to Estimating ............................................................................... 35
   Monthly Valuations ...................................................................................... 36
Multiple progress quantities .......................................................... 36
Analytical pricing of variations .................................................. 36
Report Writer .................................................................................. 37
Budgeting & Cost Coding ............................................................... 37
Job Modelling ............................................................................... 37
Detailed coding structures and analysis .................................. 38
Final and remaining values forecast ......................................... 38
Allowance reconciliation and engineering information ........ 38
Resource Project Codes ................................................................. 39
Cost rates and worksheets ......................................................... 40
Subcontract Payment .................................................................. 44
Valuations Reports ........................................................................ 47

Planning ......................................................................................... 49
Flexibility ...................................................................................... 49
Accuracy ....................................................................................... 49
Detail ............................................................................................. 49
Resourcing .................................................................................... 49
Organising ..................................................................................... 49
Progress ....................................................................................... 49
Information schedules ............................................................... 49
Integrating the Estimate and Program .................................. 49
Time/location .............................................................................. 49
The Standard Bar Chart ............................................................... 50
Program Manager ......................................................................... 50
Calendars ..................................................................................... 51
Facilities and features on the bar chart ................................ 52
Importing from the Bill of Quantities ...................................... 54
Filtering the Program .................................................................. 54
The Contract Program ................................................................. 56
Recording the As-built Program ................................................. 56
Managing Information Requirements ........................................ 57
Resource Allocation ..................................................................... 59
Resource Cross-Reference .......................................................... 60
Resources and Production ........................................................... 60
Resource Histograms and Optimisation .................................... 61
Resources and Progress ............................................................... 62
Resource Cross-Reference Histogram ....................................... 62
Time Location editor ................................................................... 63
Report Manager ........................................................................... 64
Planning Reports ........................................................................ 65

Forecasting ..................................................................................... 67
Integrating the Estimate with the Program ......................... 67
Program view of the Bill of Quantities .................................. 68
Bill of Quantities with Forecast ............................................... 68
Forecasting using the Estimate Link ....................................... 69
Cost loaded program ................................................................. 70
Estimating by Pricing the Program ......................................... 71
Project Cash flow ....................................................................... 72
Forecasting Reports ................................................................................................................. 73

**Cash Flow** .......................................................................................................................... 75
   How it operates ......................................................................................................................... 75
   Using linked data from the Program and Estimate ............................................................... 76
   Cash Flow analysis ............................................................................................................... 77

**Earned Value** ...................................................................................................................... 79
   Terminology .......................................................................................................................... 79
   Underlying Concepts ............................................................................................................. 80
   The Baseline budget .............................................................................................................. 80
   Schedule performance .......................................................................................................... 80
   Cost to-date and forecast ...................................................................................................... 80
   Cost performance .................................................................................................................. 80
Introduction to Construction Computer Software

Background
Construction Computer Software (CCS) was started by a group of engineers and contractors in 1978. The directors and shareholders of the company are all working members and are actively involved in the business. The company is conservatively financed, has always been profitable and has no borrowings. All the company’s activities, including on-going research and development, are internally financed. Our current balance sheet and other financial information is available for inspection if necessary.

Product
We produce a modern software suite called Candy, focused on project control in the construction industry, a field in which we have gained enormous experience. We have specifically targeted the contractor’s software requirements, from taking-off, pricing and planning a project, controlling at site level, through to the final certificate. We have a wide international client base which exposes us to a variety of local requirements and new techniques. These are continually included into the software.

Candy is a ruggedised product, built for construction site conditions and unsympathetic treatment by construction personnel. It is a 32-bit Windows application and runs on all modern Windows operating systems, either stand-alone or networked, and on Windows Terminal Services.

Location
We are primarily based in South Africa. Most of the technical work and all software development of Candy is conducted from our head office in Cape Town.

Our Centurion office is the sales and support centre for Africa, the Far East and Pacific region. This office also supports our distributors in the U.K., Portugal, India and New Zealand. We also have an office in Dubai to handle sales and support in that region, and have established a presence in India through a local distributor. We have recently opened a sales and support office in Perth, Australia.

Personnel
We have a focused and motivated team with a well-proven background. Collectively, our technical staff have over 200 years of experience in the construction industry of which more than 50% has been spent working for major construction companies. CCS is well staffed with almost 40 people dealing with development and support. Because of the complex nature of modern software we also have IT specialists as part of our development team.

Support
Our distributors provide support and training in their host countries and also handle installation and implementation of the system. They are backed-up by the support staff from South Africa who conduct frequent visits to the distributors. When the installation or training load requires, South African support staff will step in and assist the local distributor.
Support personnel are constantly available to provide help or resolve problems and our world-wide contact numbers are published with the system to ensure that there is always help a telephone call away. Users have direct access to the relevant programmers of the software to discuss changes or new requirements. This keeps us constantly in touch with our clients and ensures that we supply the appropriate product. The latest version of the software is always available from our web site.

Training
We undertake regular training courses in many countries, covering all aspects of Candy. Instructors are experienced both in the construction industry and the operation of the software.

CCS offers a full training programme of one- and two-day courses to acclimatise new users and to introduce existing users to new techniques and facilities. Students are encouraged to explore those features outside of their usual domain, so that integration with colleagues becomes easier.

Certain ‘core’ courses are available to students from any company and are given in a central training facility. First-time users of Candy would typically require a two-day core course. ‘In-house’ courses are arranged with and given to employees of a single company, in which case, courses are usually given at the company’s premises.

Details of our normal training programmes are included in this overview.

Renting the software
Candy is rented on a monthly basis. The Candy rental agreement includes all software upgrades, all new versions and all support and any reasonable changes to suit specific user requirements. There are no other charges.

Software rental has the advantage of avoiding high initial capital costs and allows for immediate tax recovery on the monthly costs. Systems can be taken off rental at a month’s notice and additional systems can be rented for short periods at peak times.

Licenses
The operation of Candy is protected by a software licence that can be installed on stand-alone machines or can be located centrally on a network. In the latter case, fewer licenses may be installed, since it is unlikely that all users are logged onto the system simultaneously.
Major users

Candy is installed in the offices of thousands of users around the world, among them large multinationals, small contractors and consultants, and across the entire range of the industry. Offices, distributors and call-centres in Australia, Germany, Hong Kong, Portugal, Singapore, South Africa, New Zealand, Thailand, United Arab Emirates (Dubai) and the UK and India service these installations.

This provisional client list changes regularly. The list is weighted by global distribution, rather than number of installations.

Algeria

Lena Construções
Opway
Zagope (Andrade Gutierrez)

Angola

ALDO
Angolaca
Anteros Angola
ARC Angola
Certave
CFRL
CLEAR
Coeng
Concreta
Conduril
Construções ARC
Construções Gabriel Couto
DCE
Edifer Angola
Elan
Empreiteiros Casais
Engpower
Entek
Griner
Hagen
Imovias
MCAVias
MCSA
Monteadriano
Mota-Engil
Noráfrica
Omatapalo
Palama
Ramalho Rosa Cobetar
Rial Angola
Sá Machado & Filhos
Siccal
Sines
Soares da Costa
Somague / Habitar

Tecnovia Angola
Teixeira Duarte
Terponte
Zagope (Andrade Gutierrez)

Azores

Ediçor
Eng. Luís Gomes
Marques, Lda.

Australia

Acciona
AJ Lucas
Ammjohn
Ampcontrol
Aurecon
Bellerive Homes
BHP Billiton
Brookfield Multiplex
Bouygues
Built Environs
Decmil
Downer EDI Engineering
Electrix
Fairfield Services
GHD
Hatch
Abengoa Australia
John Holland
Laing O’Rourke
Lend Lease Engineering
Mainland Civil
MACA Civil
Mcore Services
Monford Group
NOVO Rail
Probuild Civil
Rail Corp
RUC Mining
SEMPAC
Thiess
Tiltcorp
Turner & Townsend
UGL
Water Infrastructure
WBHO Civil
Xstrata

Bahrain

Arados /3D International
Contrack International Inc.
Nass Contracting Co

Brazil

Alves Ribeiro
EMPA
Monteadriano
Mota-Engil
Sadesul
Somague MPH (Sacyr)
Tiner Brasil
VSL Systems
Ytoara

Bulgaria

Glavbolgarstroy

Canada

Hatch

Cape Verde

Armando Cunha
CVC
Empreitei Figueiredo
MonteAdriano
Mota-Engil
Sogei

Caribbean

Carillion
Bouygues Jamaica
Johnston International
**Czech Republic**  
Mota-Engil Central Europe

**Chile**  
Hochtief Chile

**China**  
Dragages  
Colombia  
Mota-Engil Colombia  
Cinterex

**Congo**  
Zagope (Andrade Gutierrez)

**Denmark**  
MT Hojgaard

**Egypt**  
Orascom  
The Arab Contractors

**France**  
Bouygues Travaux Publics

**Gambia**  
MA Kharafi  
Gana  
Mota-Engil

**Germany**  
Bilfinger + Berger  
Hochtief International  
Strabag

**Ghana**  
Mota-Engil  
PW Ghana Ltd  
Taysec

**Greece**  

**Hong Kong**  
AMEC Construction  
Cheng Tak Wai  
Chun Wo  
Dragages HK  
Gammon Construction  
Hong Kong Constr.  
Hsin Chong Constr.  
Kumagai Gumi  
Lam Construction  
Leader Construction  
NECSO Entracanale  
Paul Y  
Penta Ocean  
Sun Fook Kong

**Hungary**  
Mota-Engil  
Magyarország Rt  
Duna Aszfalt Kft.  
Swietelsky Vasúttechnika Kft.

**India**  
AFCONS  
ASCON  
CEC  
Desai Construction  
Envirox  
Geodesic Techniques  
Kunnel Engineers Cons.  
Larson & Toubro  
Nagarjuna Constructions  
Patel Engg  
Punj Lloyd  
Voltas

**Indonesia**  
Balfour Beatty Sakti

**Ireland**  
Ascon  
Bennett Construction  
Howley Civil Eng.

**Italy**  
Salini Costuttori  
Saipem (ENI Group)

**Japan**  
Kajima Corp.  
Taisei

**Jordan**  
Al Wajih Contracting  
Mid Contracting

**Kenya**  
Brolaz East Africa  
Mugoya

**Kuwait**  
Al Ahlia Contracting Group  
Burhan Int. Construction  
Kharafi National  
Mushrif Trading and Contracting  
United Building Company

**Lebanon**  
MAN Enterprises Limited  
Qualco S.a.l

**Mauritius**  
BCE  
Cogir  
Ireko Design  
M&R Gamma  
Sotravic

**Mexico**  
Mota-Engil Mexico

**Morocco**  
Lena Construções  
Sá Machado & Filhos

**Nigeria**  
Bouygues  
Dys Trocca Valses  
Orascom
Mozambique
CETA
Conduril
Emocil
Empreiteiros Casais
Gabriel Couto
Irmãos Moreiras
Lúcio da Silva Azevedo & Filhos
M. Couto Alves
Mota-Engil
OPCA/Opway
Soares da Costa
TEC
Tovisi
Zagope

Netherlands
BAM International

New Zealand
AECOM
Blacktop Construction
Brian Perry Civil
Brightwater Engineering
City Care Christchurch
Downer EDI
Delta
Dempsey Wood
Dominion Constructors
Doug Hood Mining
Electrix
Fletcher Construction
Fulton Hogan
Harker Underground Cons
HEB Construction
Hick Bros
JFC
McConnell Dowell
Stronger Christchurch
Infrastructure Rebuild Team
Parfitt Construction
Pipeworks

Oman
Al Ansari Trading Enterprises
Al Turki Enterprises
Bahwan (BEC)
Carillion Alawi
Douglas OHI
Habtoor Leighton Group
Larsen and Toubro Oman
Target
Taylor Woodrow

Peru
Cosapi
GYM (Graña y Montero Group)
Mota-Engil Perú
PyC
San Martin (ICA Group)

Poland
M&I
Mota-Engil Polska
MSF Polska

Portugal
2GM
ABB
AFAvias
Alberto Couto Alves
Alves Ribeiro
Amândio Carvalho
Ambiáguas
Anorte
Anteros
António Alves Ribeiro & Filhos
António da Silva Campos
AOC (Grupo Oliveira Cristina)
Armando Cunha
Avanconstrói
Bemposta
Boaventura & Boaventura
Brumatlântica
Bysteel
Carpincasais
Casimiro Ribeiro & Filhos
CCAD
CICCOPN
Clear
Cobelba
Conduril
Constarte
Constrope

Construações Pragosa
Construtores
Contacto
COPI
Correcta
Costa & Carvalho
Costeira
Different View
Domingos da Silva Teixeira (DST)
Ecociaf
Ediçor (Azores)
Edifer
Empreiteiros Casais
Etermar
FCM Grupo
Ferreira
Fitonovo
Fonseca & Fonseca
Futurbuild
Garcia, Garcia
Gabriel A.S. Couto
Graviner
Grupo DG
Grupo SUMA
HCI
IGC
Irmãos Cavaco
Irmãos Moreiras
ISEP – Instituto Superior de Engenharia do Porto
IST - Instituto Superior Técnico
Joaquim Ângelo da Silva
Joaquim Fernandes Marques & Filhos
José Avelino Pinto
Lena Construções
LS&JM
Lúcio da Silva Azevedo & Filhos
M. Couto Alves
Manuel Rodrigues Gouveia
Marques, Lda. (Azores)
Marsilop
Matriz
MonteAdriano
Montiviga
Mota-Engil
Multinordeste
Nicolau de Macedo
Norasil
Obrecol
OFM
Candy Overview

References

Oliveiras
OPWAY
Pinetree
Planirest
Politérmica
Ramalho Rosa - Cobetar
Ramos Catarino
Restradas
Rodrigues & Camacho
Rosas – Construtores
Sá Machado & Filhos
Santana & Cia.
Soares da Costa
Socopul
Somague
SPIE Batignolles
STAP
Submerci
Tecnovia
Teixeira Duarte
Tomás de Oliveira
Transjet
Undel
Universidade do Algarve (UAL)
Universidade da Beira Interior (UBI)
Universidade Nova de Lisboa (UNL)
VSL Sistemas Portugal
Zagope (Andrade Gutierrez)

Qatar
Al Huda Engineering Works
Al Jaber Engineering Co
Al Jaber Trading & Contracting
Al Nakheel Agriculture and Trading
Boom Construction Company
Brookfield Multiplex Medgulf
Construction Development
Contracting and Trading
Contraco
Contrack
Domopan Qatar
Galfar Al Misnad Engineering and Contracting
Gulf Contracting Co
Habtoor Leighton Group
HBK Contracting Co
Hochtief Solutions Middle East
Imperial Trading and Contracting
International Trading Contracting
Marbu Contracting
Midmac
Petroserv Limited
Qatar Building Company
QD-SBG Construction
QDVC
Redco International Trading and Contracting
Urbaco General Contracting
Villas
Yuksel Insaat A.S.

Romania
Mota-Engil

Saudi Arabia
Abdullah A.M. Al Khodari & Sons
Al Arrab Contracting Company
Al Mabani General Contractors
Al Yamama
El Seif Engineering Contracting
Energy and Power Contracting
Modern Arab Construction
Mohammed Bin Ladin Company
Olayan Volta Contracting
Saudi Oger Ltd
Toledo Arabia (ACWA)

Singapore
Who Hup

South Africa
Basil Read
Bophelong Construction
Concor Engineering
Cycad Pipelines
Fraser Alexander
Giuricich Bros.
Grinaker LTA
Group Five Construction
Isipani Construction
Murray & Roberts Construction
NMC Construction Group
Power Construction
Transnet Ltd t/a Protekon
PTH Construction
Rainbow Construction

Spain
CETI
Dragados
ACCIONA
CETI
Dragados
Ferrovial-Agroín
Sacyr

Sweden
NCC (Solna)
Skanska

Tanzania
Caspian Construction
G5 & Italframe
NCC Tanzania/Zambia
Noremco

Thailand
Bilfinger+Berger
Bougyes
Christiani & Nielsen

Turkey
STFA Deniz Insaati Insaat San.
Ve Tic.
Yuksel Insaat
Uganda
Mota-Engil

Roshcon Construction
RUC Mining
Ruwacan
Stefanutti Stocks
WBHO
WK Construction
**United Arab Emirates**
Al Futtaim Carillion
Al Habtoor Engineering Enterprises Co.
Al Jaber L.E.G.T. Contracting (ALEC)
Al Naboodah Contracting
Al Naboodah Laing O’ Rourke
Al Nasr Contracting Co.
Al Nekhreh Contracting Company
Al Sahel Contracting Co.
Al Shafar General Contracting
Al Tayer Stocks
Amana Pipeline Construction
AMB Building
Arabian Construction Co.
Ascon
Civil Power General Contracting
Consolidated Contractors Company (CCC)
Convergent Value Engineering
Dutco Balfour Beatty
Gammon and Billimoria
Kier Dubai
Khansaheb Civil Engineering
Leighton Contracting Abu Dhabi
Lootah
Macair
Manser Saxon
Murray and Roberts Contractors M E
NSCC International
Obayashi Corporation
Oger Abu Dhabi
Overseas AST
Pivot Engineering and General Contracting
Punj Lloyd Limited
Samsung Engineering and Construction
Seidco General Contracting
Sun Engineering and Contracting
System Construct
Target Engineering Construction
Taylor Woodrow International Limited

**United Kingdom**
Amey Group
Babcock Rail
Balfour Beatty Group
BAM Nuttall
Barhale Construction
Bechtel
Carillion Construction
Costain
Galliford-Try-Morrison
Kier Group
Lagan Construction
Laing O’Rourke
Morgan Sindall
Network Rail
Skanska
United Utilities

**USA**
Cinterex
Training Courses

One- and two-day courses on getting the best results from the software are offered. These courses bring new users up to speed and encourage existing users to take advantage of the powerful features of Candy. New and better ways of using Candy are encouraged and users will be shown how to be more productive in their work. Users will be encouraged to explore those features outside of their usual domain, so that integration with colleagues becomes easier.

The Core courses are given to students from any company and so are usually run in our training facilities; the ‘In-house’ courses are arranged with and given to employees of a single company, in which case the course may be run at the company’s premises.

Essential core courses

C103 – Principles of Planning
A one day course suitable for Planners, Site Engineers, Site agents, Contract Managers and Estimators

The course cover definitions, objectives and philosophy of planning and programming, tender and project planning, short–term programmes, precedence networks. Practically, students will learn to draw and calculate a network, plot a bar chart, allocate resources, and plat resource histograms. They will also develop a good understanding of the principles upon which Candy Planning is based.

C201 – Construction Estimating & Valuations
A two-day course suitable for Estimators and Quantity Surveyors new to Candy.

The course covers all aspects of the estimating system, including bill creation, worksheets and resources. By the end of the course the student will have learned and applied subcontract adjudication, pricing, mark up, valuations, subcontract liability, material adjudication, generating certificates and allowable control.

C202 – Construction Planning and Programming
A two-day course suitable for Planners, Site Engineers, Site agents, Contract Managers and Estimators new to Candy.

Detailed instruction will be given to produce a working program. Students then continue with planning and controlling the project, and recording the as-built program as well as managing the information from the design teams as required by the program. Effective reporting on the project status across all levels of management will be taught.

Students cover bar charts and the linking of activities, activity types and allocating resources. The information and long lead schedules are covered as well as monitoring progress and update reports. By the course’s end, students should be able to produce complete programmes to control a project.

C301 – Integration of Estimating and Planning
A one-day course suitable for Estimators, Planners, Site Engineers, Contract Managers and Quantity Surveyors who are familiar with Candy and SitePlan.

The course concentrates on the integration of Estimating and Planning to create forecasts, budgets and a more detailed cash flow analysis.
**Specialised in-house training**

**C101 – Bill Preparation**
A one day course suitable for Estimators and Estimator’s assistants who are involved with entering and importing ASCII files from other packages, as well as compiling bills of quantities using Candy. Overprinting of the client’s bill for tender submission will also be covered.

**C102 – Materials Received**
A one day course suitable for site clerks involved in capturing delivery notes and other site costs.

Reconciling the materials received to the head office ledger, generating reports for cost and bulk material reconciliation are covered in detail.

**C104 – Principles of Estimating**
Suitable for Estimators, Site Engineers, Site agents, Contract Managers.

The course covers objectives, preparation, planning, analysing, finalising and submission of a tender. Candidates will learn to do a tender summary, kick-off meeting agenda and draft P & G’s. Practically, candidates will calculate basic rates, worksheet calculations and splitting rates into resource groups. They will also develop a good understanding of the principles upon which Candy Estimating is based.

**C203 – Contract Allowables & Cost Analysis**
Suitable for Quantity Surveyors, Site Engineers, Site agents, Contract Managers and Commercial Managers.

This course is designed to help the post-tender commercial team use Candy Valuations effectively to generate monthly valuations, price variations, and to manage their contracts “To-date, Remaining and At-completion” Costs & Allowables.

**C302 – Quantity Surveyor Workshop**
A one day course suitable for Quantity Surveyors and Project Managers who submit the Client certificate and generate the monthly cost report.

Aspects of checking the original tender, re-modelling, entering accounting codes for cost reconciliation, as well as generating engineering and production information for site control are discussed.

**C303 – Planning Workshop**
A one day course suitable for Planners, Site Engineers, Contract Managers who are familiar with the Candy Planning but are not using its full potential.

This course concentrates on controlling the project, managing the information required by the program, integration of the program with the estimate to provide forecasts and reporting on the state of the project. Filtering, recording as-built programs, information schedules, resource histograms, resource optimisation and pricing the program are covered in detail.

**C401 – Post-tender Advanced Course**
A two day course suitable for Quantity Surveyors who are not using the full potential of Candy for the post-tender control of their construction projects.

Topics covered include job re-modelling, valuations, implementation of resource-based, locational and functional project control, integration of Estimating and Planning to create forecasts, budgets and a more detailed cash flow analysis.
Management seminars
C402 – Analysis & interpretation
A half day seminar for executives and managers who require an understanding of the information that can be generated by Candy, but do not necessarily require hands-on training.
Estimating
The Contractor’s Estimating System

Estimating is the major component of Candy and it exchanges data with all other components of the system. It is a resource and production based analytical estimating system that divides naturally into pre-tender and post-tender, and includes:

- Take-off and bill preparation
- Electronic bill importing
- Estimating
- Subcontract enquiry and adjudication
- Material adjudication and enquiry
- Project analysis
- Valuations
- Cost reconciliation
- Subcontract control and liability

Underlying Concepts

Candy Estimating is based on a schedule of quantities to be priced (the Bill of Quantities). This schedule is either supplied by the client or created by the contractor.

Each item is priced on a standard Candy make-up sheet known as a worksheet. The worksheet is a free format document on which the estimator expresses his ideas and calculations in a manner very similar to manual methods. This is done by applying production calculations to resources. A resource in its simplest form is a bought-out item of material, labour, equipment, etc., that has a unit rate. Resources themselves can be assembled on worksheets to price compound resources, known as complex resources, e.g. concrete, which is made up of simple resources such as cement, sand, stone, etc.

Composite bill items, such as concrete including formwork are priced using a compound bill item known as a macro item. A macro represents a sub-bill, which may contain other macros or standard items. This approach of using basic building blocks enables virtually any data to be extracted, analysed and reported.

All the relevant data produced by the estimator is immediately available for use on site to control the project using the Candy Valuation post-tender facilities.

Interface with the Estimator

One of the fundamental design considerations in Candy is the user interface and making screen objects easily recognisable to the user. Once the underlying concepts have been understood Candy is easy to use.

The ability to set up pricing structures so that a single change is reflected in many places speeds up the pricing process and helps to prevent errors of omission. It is particularly suited to the principle that 80% of the value is contributed by 20% of the items. For effective tendering these are the items on which the estimator should concentrate his efforts.

Candy is essentially a toolbox providing a variety of tools to get the job done. In many cases the user has a choice of methods to achieve the same result and selects the one appropriate to his needs or preference.

Libraries

Tender preparation is speeded up considerably by the use of pricing libraries. Any estimate can refer to any other estimate as its source of Master data.
Data is automatically copied from the current Master as required and not imported in bulk. This ensures that the estimate is not cluttered with unused data and minimises the size of the files. Data in the Master can be viewed from the estimate and a different Master or previous job can be selected at any stage.

Libraries are simply estimates containing standard data and corporate information which complies with company procedures and methods. Libraries can be established to suit different disciplines, types of work and clients.

Libraries are usually created and enhanced by copying selected data from current estimates. It is, of course, extremely important that this data is checked carefully and documented for use in future tenders.

Rounding
The bill is extended and totalled accurately to the decimalisation set by the user. Changing the decimalisation of the rates and/or amounts can have an appreciable effect on the tender total, but will still be arithmetically correct.

While there are no errors due to computation, discrepancies may be noted on internal split rate reports, which are caused by rounding. When a number is broken down into its components it is impossible to eradicate rounding errors without tampering with the figures. Since estimating itself is not an exact science, rounding errors have been left exposed. However, in certain cases, where data breakdowns may be submitted to clients (e.g. Grossed up breakdowns), the numbers are balanced by adjusting one of the broken-down components.

Candy Environment
The software has been designed so that the user need never leave the Candy environment to perform everyday chores such as backing up, bill importation, deletion and copying of files, preparation of external files for data transfer etc.

Limits
There is no practical limit to the numbers of the major elements, (pages, bill items, resources) that can be defined. For example the maximum number of Price codes, Resources, Cost codes etc. is in excess of 65000. However, limits are imposed on minor elements such as Trades (52), Resource Types (9), Currencies (16), Global Variables (200) etc. Restrictions to numeric values are generally imposed by field size rather than the magnitude of the number. Quantities cannot exceed 2.1 billion while rates and amounts are limited to 18 digits.

Estimating Screen Shots
The following pages are annotated screen shots which illustrate various aspects of Candy Estimating. Although the screens have been filled with documents to show as much data as possible in a few pages, the Candy approach to the user interface is clearly demonstrated.
The Estimating Environment
Estimators spend most of their time working with the documents in this screen shot. They are positioned on the screen and sized to suit the task at hand. Candy documents are laid out in columns and the user selects the columns required and arranges them in a convenient order. Several different views of the same information can be set up for different purposes.

On the left of the screen are the estimator’s working documents and on the right his reference documents:

Estimate Nett Bill
The bill is used to enter bill items and edit descriptions. This example is in multi-page mode, which treats the bill as a continuous document so that it is not necessary to jump from page to page. It can be zoomed to show multi-line descriptions, one line per item, or just section totals.

E20021 Price code worksheet
The build-up of the rate for a bill item or a complex resource is entered on a worksheet. This worksheet shows the build-up for Price code E20021 which is used to price item B on page 3 of the bill.

Master Price code Listing
This document on the right in blue displays pre-priced items in the Master sorted in trade order. It is zoomed to one line per item. Items can be dragged from here and dropped on the bill to copy the pricing from the Master to the estimate.

Estimate Resource List
The Resource list displays both simple and complex resources, sorted by code. Resources can be dragged from a resource list and dropped on a worksheet. The Estimate Resource List document shows the final rate, the usage of each resource in the estimate and the date when the resource’s rate was last updated.
Worksheet drilldown sequence
The series of worksheets shown here highlights the hierarchical structure of complex resources.

F301 Price code worksheet
This is the build-up for Price code F301, used to price both item B on bill page 4 and item J on page 7.

24416 Complex worksheet
This is a level 7 complex resource, used in the build-up of F301 and describes the make-up of the formwork gang.

2225 Complex worksheet
This is a level 8 complex resource which details the rate build up for a Carpenter.

2385 Complex worksheet
This is a level 9 complex resource showing the build-up of On Costs for artisans.

Estimate Resource List
This resource list shows the resources available in the estimate. On the right of the document is the attribute column in which resources can be tagged with various attributes. For example the R attribute indicates a root complex. Many analysis reports have an option to stop further analysis at root complexes (e.g. the number of Carpenter days is usually more important than the amount contributed to the Holiday Fund).
Macro Bill Items

Macros have a hierarchical structure 9 levels deep. The simplest type, level 9, is priced with Price codes only, whereas more complex macros (levels 8–1) may be priced with Price codes or any other simpler macro level.

A macro has a pricing quantity which is the quantity priced on its build up. The macro’s rate, as used in the Bill or higher-level macros, is its priced value divided by its pricing quantity. The pricing quantity is entered in the header area of the mini-bill.

Item F on page 5 of the bill is priced using Macro mini-bill 9L8372.

The quantity entered against each Price code in a mini-bill is the quantity required to determine the Macro’s pricing quantity. It may be entered in one of the following ways:

- As a formula, entered in the header area of the mini-bill, as shown for item B. The formula for each item may use the Variables displayed on the line above the formula or it may be a stand-alone expression.
- On a multi-line Quantity Calc sheet document, as shown for item D.
- Directly in the Quantity column as shown for item J which is independent of the controlling variables.

With its use of quantities calculated by Formulae using Variables, Macro 9L8372 could serve as a template for pricing similar manholes where the dimensions differ simply by adjusting the Variables.

In contrast to item F’s Macro, item E on page 5 is priced with a single very involved Price code worksheet which includes all the complex and simple resources normally used to build up rates for Price codes in several trades.
Split Rates and Combinations

Resource combinations provide a mechanism for splitting the rate of a Price code where the client requires a breakdown of the rate, which does not correspond to the Resource types. This screen shot shows two views of bill page 3 with grossed up rates.

Gross Split Rate Bill
This has been zoomed to show multiple description lines and is set to single page mode, which shows page totals for all Amount columns. The Split Rates columns show each rate split into the resource types defined for this estimate. The rightmost two columns show the mark-up percentage applied to the rate, and whether the Price code has its own individual mark-up or uses the percentage applied to its trade.

Gross Combo Bill
This has been zoomed to show one line per item. In this estimate the seven resource types are reduced to four by allocating them to Resource Combination columns, each with its own column heading, for presentation to the client.

Estimating definitions and settings
This dialog shows the settings of combination column headings and the allocation of resource types for combination columns. Resource Types themselves are defined on dialogue 1.2.
Dual Currency Bills
Candy employs dual currency bills, and an estimate may define up to 16 currencies. Currency allocation is determined at resource level – a Currency Code may be entered for each simple resource.

A dual currency bill splits each rate and amount into Local and Foreign components. Assuming that this tender is for a client in Hong Kong, the Local component comprises all resources priced in Hong Kong dollars and the Foreign component comprises those resources priced in all other currencies, including the Pricing currency (e.g. NZ dollars).

Upper Gross Dual Currency Bill
The upper Gross Dual Currency Bill document shows the Local and Foreign split expressed in Hong Kong dollars as it would be submitted to the client.

Lower Gross Dual Currency Bill
The lower copy of the same document expresses the split in New Zealand dollars suitable for management review.

Estimate Resources: Currencies
Resources bought in a foreign currency have a Base Rate in the currency indicated by the Currency Code. The Base Rate is converted to the Final Rate which is expressed in the estimate’s Pricing currency (in this case New Zealand dollars) by applying the currency conversion factor and any taxes or duties. Only the Final Rate is shown on worksheets so that the estimator works in a familiar currency even if the tender’s local currency is different.

Estimating definitions and settings
The Definitions and Settings dialog shows Currency codes, foreign currencies and their exchange rates. Amending an exchange rate causes a complete recalculation.

The Tax codes definitions define the taxes and duties which may be levied on resources. Amending a tax percentage on this document affects all resources to which the tax code was applied.
Indirect Costs

The Indirect Costs Bill is a second bill in the estimate. It is completely separate from the Client’s bill and can be controlled by its own simplified version of the construction program. It can be priced using any Price codes or Macro in the estimate. Many reports have the choice of either including or excluding Indirect Costs.

Indirect Costs Bill

Priced items in the Indirect Costs Bill are either time-related (bars with red and white stripes) or value items (bars with blue and white stripes). The rate for time-related items is applied per time-unit of the item (e.g. Day or Month). Value items spread their total value over their duration.

The members of a team required during a particular phase of the work can be tied to a bar in the summary program so that the time on site for the team can be adjusted by changing the duration of a single bar.

Time-unit Definitions

Units listed in this table identify Price codes with a time-related unit. Any unit not in the table is considered a value item. The table also provides a conversion from the Price code unit to a day – the base unit of the bars, e.g. Week is defined as a 5-day week.

Spreading Indirects over the bill items

If you require the Indirect costs to be included in bill items, they can be spread over bill items in a controlled manner. What has to be spread and where is set-up by the User early in the bid process. At finalisation the spread can be re-done at the last minute with confidence.

Spreading Indirects can be done on specific bill items or trades and gives the flexibility to block any bill items that must not receive the spread.
Manage Indirects Post contract
For each valuation the Indirects will update to reflect the previous, period, current and remaining allowables based upon the based indirects, the values can be updated to take into account variations, re-allocations and month end adjustments and the time based activities can be extended or reduced as required. This will achieve an accurate allowable and cost to completion.
Master Library

The estimator can refer to a library, or any previous job as a source of information for pricing the current estimate. The current source is called the “Master”.

Estimate Nett Bill

Pricing an item on a bill page is as easy as selecting a priced build up from the Master Price code listing, dragging it to the item on the bill page and dropping it. A new item can be created between adjacent items by dropping the Price code on a blank line between the items. If the bill items are numbered according to one of several standard schemes, Candy can re-number the page items as often as required.

Master Price code Listing

This lists the Price codes in the current Master. The first character of a Price code denotes its Trade, so Price code documents show the Price codes sorted by Trade and Price code. There are several ways to jump to a particular section in a document with thousands of entries.

Change Master

The six most recently used Master jobs are listed by the Browse Recent Masters button. Alternatively, the Browse Companies/Jobs button runs the Company/Job Manager dialog.

From this tree-view any job in any company may be selected as a Master to the current job.
Estimating Definitions and Settings

One container gives access to all secondary code definitions (for analysis and summary report and all settings controlling the behaviour of Candy Estimating.

Essential definitions

Secondary codes are optional except for Trades and Resource types, which are copied from the Master when the estimate is set up. The order of Trades is followed by all trade related reports while the order of Resource types dictates the headings of Split Rate columns.

Price code related definitions

Task codes and Work codes may be allocated to Price codes. The table of Unit shortcuts serves as a typing aid and ensures consistency when manually entering a bill. The Global variables are used in the production calculations on Price code worksheets when a single, centrally defined value is applicable throughout the pricing.

BOQ related definitions

A Bill code may be allocated to bill items to group related bill items for summary or analysis reports, and is independent from codes associated with the Price code. Location codes are used on Quantity Calc-sheets which may be used to derive the quantity for a bill item.

Resource related definitions

Cost codes and Group codes are used for sorting and totalling resources in analysis reports. Production Codes and Man-hour codes identify and provide unit conversion factors for resources involved in production reports. Tax codes and Currency codes are used to calculate the final rate of a simple resource from its base rate. Resource combinations provide a mechanism for splitting the rate of a Price code where the client requires a breakdown of a rate not corresponding to the Resource types.

Local settings

The General settings, Decimalisation and Printing options dialogues establish settings applicable to the current job only and may well vary from one job to another.

Global settings

The Financial radix and Column width settings apply to Candy as a whole and control the behaviour of all jobs.

Notes and recovery

The Note pad and Tender details dialog provide means for the estimator to note details of the tender. The Recovery bin is a safety-net to preserve complex elements which may have been deleted in error.
Subcontract Adjudicator

Subcontract packages are defined on Subcontract Adjudicator documents. An estimate can have any number of subcontracts.

A Subcontract Adjudicator document collects items of work, which comprise a subcontract, and compares rates submitted by subcontractors to undertake the work. The estimator can either import blocks of items from the bill or enter individual items directly on the adjudicator document. The rates from the preferred subcontractor can be sent back to the estimate to update resource rates.

Subcontract Package Manager

The Subcontract Package Manager shows the six sub-contract packages in this estimate.

Subcontract Package: Earthworks

The OWN RATES column on the Earthworks adjudicator shows the rates imported from the bill as a benchmark. The quantity of 9500m³ for item B from page 3 is tagged with a ‘Q’ to indicate that the estimator has amended the adjudicator quantity, so it no longer agrees with the billed quantity. This may be due to an over or under-measure detected in the bill, which could affect the adjudication and prove advantageous. A factor may be applied to all the rates in a column (a discount of 5% has been taken on Diggers and 10% extra for risk allowed on Burrows). A currency code can be allocated to a column if a subcontractor submits his prices in a foreign currency.
Subcontract Adjudication (of Earthworks)
Where a subcontractor has not priced an item, the highest and lowest rates of the others are used to make up the range. If required, a third total based on a preferred column can also be shown. A dubious rate submitted by John Hole, which is shown tagged with a ‘P’ is the cause of the Total Provisional amount.
**Candy Overview**

**Estimating**

**Trade Totals Display**

The Trade Totals Display shows the estimate’s total value broken down by trade and resource type. Several options are available, for example, Nett or Gross Totals can be displayed, and indirect costs can be included or excluded. If the estimate needs recalculation, this is done automatically. Pie-graphs showing columns broken down by trade or trades broken down by resource type can be plotted from the Trade Totals Display.

![Trade Totals Display](image)

**Estimate Job Size**

This quickly gives the measure of an estimate. The Price codes and resources reported are the number of entries in the databases; they may not all be used.

![Estimate Job Size](image)

**Confidence Check**

This may be run at any stage but should certainly be done before finalisation of the tender. It highlights any possible errors which will need investigation or justification. It also performs checks on the integrity of the estimate’s databases and reports any detected discrepancies.

![Confidence Check](image)
Plant, Labour and Steel Calculation Tables

Candy includes a spreadsheet utility which exchanges data with the estimating system. Sample template spreadsheets for building off-line calculators for equipment and labour rates are supplied. The user may add additional columns to these spreadsheets and formulae for calculations can be changed.

The spreadsheets are particularly useful when rates are to be built up in more detail than is appropriate on a standard worksheet, or where the utilisation calculation on a worksheet line depends upon the value of previous lines, for example the insurance on a machine may be 2% of its value.

Plant Calculator – LOCAL
The resource code and descriptions are imported from the estimate. Once the rate calculations are finalised, rates are sent back to the estimate. As the pricing is completed the spreadsheet is updated to fetch utilisation values from the estimate. These values can then be further manipulated on the spreadsheet.

Directly Employed Labour
The labour rates in this estimate were in fact built up using complex resources, but could alternatively have been calculated on a spreadsheet like this one. Updating the spreadsheet with utilisation values would allow the values for all component costs to be shown on the spreadsheet.

Structural Steel Tables
This is a template lookup table. Other Candy spreadsheets refer to it to fetch relevant data.
Estimating Reports

Dedicated reports

Bill reports
Bill of Quantities
Trade Spreadsheets

Worksheet reports
Print Worksheets
Individual Worksheets
Worksheets in Bill Order
Indirect Costs Worksheets
Price code Worksheets by Value
Worksheets used only in Macros
Macro Worksheets
Macro Bills
Print Worksheet Chains

Resource Analysis reports
Bill Resource Analysis
Indirect Costs Resource Analysis
Bill+Indirect Resource Analysis
Analysis by Group/Class
Resources by Bill Item
Bill Items by Resource
Bill Production Rates
Resource Percentage Report
Resource Group/Class Summary
Group/Class Analysis
Complex Resource Analysis

Wastage reports
Wastage Analysis
Price Code Wastage Allocation
Complex Wastage Allocation

Project Code reports
Project Codes Report
Project Codes Resource Analysis
Project Codes Quantity Analysis
Project Codes Production Rates
Project Codes Quantity Summary
Worksheets by Project Code
Unallocated Project Codes List
Undefined Code Allocations
Allocations for Specified Code

Miscellaneous listings
Trade Listing in Bill Order
Resource Listings
Buying Schedule
Section Index
List Mark-up
List Selling Rates
Resource Employed by Trade
Engineering Work Code Summary
Dual Currency Bill Listing
Bill Percentage Listing
Print Quantity Calculation Sheets

Check and Review reports
Page/item Checksum Report
Pricing Check Report
Provisional Listings
Gross/Selling Balance
Cross Reference List
Page Total Report
Price Code Quantity Analysis
Rate Discrepancy Report
Bill Tracers
Worksheet Calculation Line Check

Analysis reports
Value Analysis
Currency Analysis
Tax Analysis
Macro Spreadsheet Analysis
Trade Currency Analysis
Resource Type Currency Analysis
Resource Percentage Analysis
Cost Factor Analysis

Presentation reports

Bill of Quantities
Nett BOQ - Carried fwd / Brought fwd
Nett Bill of Quantities - Collection pages
Nett Bill of Quantities - Page totals
Compact Nett Bill Listing
Nett Bill Listing with Worksheets

Specialised Bills
Currency Analysis Bill

Indirect Costs
Indirect Costs Report
Indirect Costs Bar chart
Indirect Costs Bar chart with Histogram
Simple Indirect Costs
Indirect Costs Monthly Forecast

Price code Lists
Nett Price code list

Resource Lists
Resource List

Trade totals
Trade Total Graph
**Quantity take-off (QTO)**

The fundamental goal of Candy Quantity take-off is to add or extract quantity information from construction design drawings or models. Quantities measured in the take-off items are fully referenced and auditable in the Candy Bill of quantities.

Candy QTO is unique, as multiple bill items can be measured and have a live link to the Candy bill with all the functionality of the Candy Project software.

**Measurement**

The length, number, arc, and area measurement tools allow the user to create quantities from working drawings.

The drawing area has simple navigation with pan, zoom, rotate, and the measurement tools snap to lines, intersections and points on PDF or DWG files.

These measurements, along with formulae, variables, and mathematical functions enable the user to create, re-measure and progress Bills of Quantities.

**Templates**

User customised templates can be created for fast, accurate and efficient measurements for repetitive type measures. Save time by linking multiple bill items to shared measurement which include variables, bill items and formulae.

**Drawings**

QTO supports 2D mark-up and 3D model take-off and can manage multiple files types i.e. tiff, pdf, dwg, dxf or dwfx in one package. Drawing layers are managed within QTO and text annotation tools are provided.
BIM
QTO extracts quantities directly using the model tree, manages live Revit files and integrates directly with AutoDesk Navisworks for real time collaboration on BIM projects. Any 3D object can be isolated to identify the 3D object in the model tree.

Bill of Quantities
There is a live link between the take-off items and the items in the Estimate and Valuations with the full functionality of the Candy project software. The QTO reference columns provide a fully auditable link between the take-off and bill document. QTO supports measures for bill creation, progress or final quantities.
**Reports**
Customised reports of the detailed take-off together with the marked up and annotated drawings are available.

**Export**
QTO data can be exported to Excel.
Valuations

The Contractor’s Post-tender Control

Candy Valuations provides continuity between Estimating and the post-tender commercial control. All the information used to price the tender is immediately available at post-award. All post-tender commercial functions can be carried out by site staff using the facilities within the Candy Valuations module.

Job modelling
The tender information can be rapidly remodelled to reflect situations that have arisen since the tender was submitted. Buying savings, production adjustments and subcontract revisions can be incorporated into the project. Accurate new budgets and forecasts can be prepared rapidly.

Monthly valuations
Monthly applications for payment are produced by entering either a progress quantity or a percentage complete against progressed bill items. The progress quantity build up can be recorded using measurement sheets. The available progress quantities are Claimed, Paid and Actual, and a number of derived quantities, such as Quantity to Completion, are also available.

Analytical pricing of variations
Adding variation items to the original contract document is simple. They can either be priced using free-format analytical worksheets from the estimate and modified as necessary or built up from first principles. Alternatively, a split rate can be entered if the full breakdown is not required. All items can have both internal and external rates.

Allowable cost reconciliation
Bill items can be collected under one or more Project Codes to produce summaries for resource based, locational and task-orientated cost, production and quantity analyses. The information can be produced in a format compatible with the site costing system. Alternatively it can be exported to a spreadsheet or accounting system for the preparation of the monthly operating statement.

Reporting
Presentation-quality reports are available for external use and a wide range of standard reports provide detailed analyses for internal use.

Subcontract Payment
Items can be copied from both the Subcontract Adjudicator and the Valuation Bill to the Subcontract Payment module. For management and payment of domestic and labour only subcontractors.

Forecast to completion
The integration of Candy Estimating and Planning enables monthly forecasts of both cost and value to completion to be generated using the link between time and money.

Engineering information
In addition to catering for financial control of the construction project the Valuations module provides essential engineering information as a by-product of the valuation process. Full analytic detail of the budgeted use of resources for any part of the project or code structure can be produced. This type of information is particularly useful when working in conjunction with a client on a Partnership or Open Book type project when the method of carrying out the work is a joint decision and all details are to be declared.

Feedback to Estimating
Using Candy Valuations initiates valuable interaction between the site commercial team and the estimating department. Accurate and regular feedback provides a competitive advantage to many enterprises involved in estimating and the management of construction projects.
Monthly Valuations

Candy Valuations provides continuity between the pre-tender and post-tender functions. All the information used to price a tender is immediately available after award. The Valuation System is an extension of the Estimating System and consequently all the latter’s facilities are available for contract control.

The re-measurement of the project can be carried out using straightforward quantity take off sheets for each bill item. Full details of the measurement sheets can be printed to substantiate the final measurement.

Multiple progress quantities

Entering either a cumulative progress quantity or a percentage complete against bill items that have changed produces monthly applications for payment. The progress quantities available are: Claimed, Paid and Actual with current and previous values for each. A number of derived quantities, such as Month’s Quantity and Quantity to Completion, are also available.

Analytical pricing of variations

Adding variation items to the original contract document is simple. They can be priced using the free-format analytical worksheets from the original estimate, or existing worksheets copied and modified as necessary, or built up from first principles. Alternatively, a split rate can be entered if the full breakdown is not required. All items can have both internal and external rates.
Report Writer
The Valuation Report Manager produces presentation-quality reports for external use, and a wide range of standard reports provide detailed analyses for internal use.

Budgeting & Cost Coding

Job Modelling
Tender information can be re-modelled rapidly to reflect situations arising since the tender submission. Buying savings and subcontract revisions are quickly incorporated into the project to prepare new budgets and accurate forecasts.
Detailed coding structures and analysis

Bill items can be collected using Project Reporting codes to analyse the bill, either in combination or singly. Reports show full analytical detail or summaries into resource types such as labour, plant, material, etc.

The three industry standard approaches to controlling a construction project are catered for:

**Locational:** Coding of bill items collects the value of work executed in a particular location or section of a project.

**Task Orientated:** Coding of bill items via a Task or Work code allocated to the bill item’s Price code collects the value of work executed to perform a particular task.

**Resource Based:** Coding of bill items via a Group or Cost code allocated to the resources used on the worksheet of the Price code which prices the item, collects the value of resources of a similar nature.

The three independent coding structures can be combined to produce such information as “the resource code breakdown for a particular task in a specific area”.

This information can be formatted for export to a spreadsheet or an accounting system for the preparation of the monthly operating statement. Cost information can be imported to generate a monthly cost reconciliation.

The analysis of the current value into the user’s cost code structure is the basic building block for the forecasting facility in Candy Planning.

Final and remaining values forecast

The integration of Candy Valuations and Planning allows monthly forecasts of both cost and value to completion to be generated using the unique linking of time and money.

Allowance reconciliation and engineering information

Site based commercial staff can work in conjunction with the engineering staff to produce critical engineering information.

Full analytic detail of the budgeted use of resources for any part of the project or code structure can be produced. This type of information is essential when working in conjunction with a client on a Partnership or Open Book project when the method of carrying out the work is jointly decided and all details are declared.
Resource Project Codes
The screenshot below shows the resource list for the project and the Project codes that can be applied to resources to analyse their value by cost code. The Production codes are used to produce useful engineering information about the project, such as the number of man-hours that should have been expended for the work done to date and the rates of production that should have been achieved for the tasks performed.
Cost rates and worksheets

At estimate stage, bill items are priced in Candy using Price code worksheets. The worksheets use resources to calculate their net rates. These net rates are multiplied by the billed quantity to provide, what is referred to in Candy, as the Allowable.

At post-tender stage, cost rates can be entered against resources where rates have changed, and Price code Cost worksheets, can be created to derive the cost to completion for items using the resource cost rates and/or where the method of construction or production has changed.

Bill items can therefore have Allowable rates (the net rates) as well as Cost rates. The Allowable rates together with the anticipated Final quantity calculate the Baseline budget while the Cost rates together with the Remaining quantity calculate the Cost to Completion.

Cost rates

Cost rates can only be used at post-tender stage and are only available once the Valuation process has commenced.

It is only necessary to enter Cost rates for resources that have new rates. If no Cost rate is entered for a resource, the Allowable (net) rate is used. Similarly, it is only necessary to create Cost worksheets for Price codes where the method or production has changed – if there is no Cost worksheet, the net worksheet is used with resource Cost rates when calculating costs.

When resource rates change, the new rate is entered in the Cost rate column of the resource list – see the rate for diesel and for OPC Bulk shown below. Any complex resources or Price code worksheets that use these resources will change automatically as well.

If there is no cost rate against a resource it will simply use the Allowable rate (Final rate in the resource list), so blank Cost rates in the resource list quickly identify those resources that have not changed.

Complex resource worksheets always have a Cost rate displayed against them as they are calculated using the resource Cost rates on their worksheets.
Cost worksheets
If the method or production of a Pricing code has not changed then there is no need to make a Cost worksheet. To determine the cost of the Price code the Allowable worksheet will simply be used and resource Cost rates will be substituted during the calculation.

If the method or production has changed, then a Price code Cost worksheet should be used to estimate the costs to completion. In the example below, the production on the Cost worksheet has been increased resulting in a lower overall rate.

Valuation documents and reports have access to the cost data for bill items allowing each item to display its Cost to Completion as shown here:
Costs: Previous, To Date, Remaining and Final

The Cost to date can be imported electronically from a job costing or accounting system or from any ASCII file. Costs should always be captured against Cost (or expense) codes and, if available, Task codes for activity based costing.

When the next valuation is set up, To-Date costs become Previous costs. Costs-To-Complete are calculated from the Cost rates entered against resources and Cost worksheets recording changes in method and/or production multiplied by the remaining quantity. The cost at completion is calculated by adding the cost to date and the cost to complete based on Final quantities.
Allowable vs. Costs Analysis – Previous, To Date, Remaining and Final

The allowable to date becomes the previous allowable when the next valuation period is set up. The allowable to date is based on the actual quantity of work done multiplied by the net (or allowable) rates. The allowable to complete is calculated using the allowable rates based on the remaining quantity (final less actual), while the total allowable is calculated from the allowable rates multiplied by the final quantity.
**Subcontract Payment**

Progress measurements, payments and liabilities to domestic and labour-only subcontractors constitute a major part of the commercial control of a construction project.

Labour-only subcontractors often have a 'many to one' relationship with bill items whereas domestic and nominated subcontractors usually have a 'one to one' relationship. In other words, many labour-only subcontractors may work on the same bill items whereas domestic subcontractors tend to be specialists who handle their bill items exclusively.

Labour-only subcontractors are often paid on a weekly or bi-weekly basis with measurement assistance from the main contractor, whereas domestic subcontractors are paid monthly after submitting detailed progress claims.

The Candy Subcontract Payment system provides individual subcontract bills for each subcontractor. These items form a sub-set of the main bill and are intrinsically tied back to the main bill items. Each subcontractor has their own individual rates and awarded quantities against these bill items making up the subcontractor’s awarded or contract value.

![Subcontract Manager Screen Shot](image)

### Allocating bill items to a subcontract

Subcontracts already setup and priced in the Subcontract Adjudication system can be brought directly into the Subcontract Manager including rates from a chosen subcontractor.

New subcontracts can be entered in the Subcontract Manager and the bills populated by dragging items from the main BOQ. Once a new subcontract and its bill are established, it is awarded to a Subcontractor and his rates are entered into the subcontract bill.
Many subcontractors to a bill item

Many subcontractors can be allocated to a bill item, each with his own quantity and rate. The ‘Over/Under Qty’ column highlights bill items that have not been fully allocated to subcontractors.

The main contractor’s actual valuation quantity

The Due Quantity on the subcontractor bills determines the Actual Quantity in the main bill valuation document. Once a subcontractor has been assigned to a bill item, the Actual Quantity should no longer be entered manually but come from the Due Quantities of the subcontract bills.

Generation of the Subcontractor Payment Certificate

Weekly, bi-weekly and/or monthly payment certificates can be generated from the Subcontract Manager. The subcontractors paid amount is calculated from the measurement of work done to date (due quantity) multiplied by the subcontractors rates for the items of work done. Due Quantities accrue to the Actual Quantity in the main bill and reflect any liability created by under-payment to the subcontractor. Additional work such as day works, variations and repairs carried out by a sub-contractor are recorded under Extras, while contra charges are recorded as “Charges”. Materials on site, escalation and advance payments for each subcontractor are recorded for the current period. These together with the subcontractor’s certificate from the bill for the current period are assembled as a payment certificate or advice.
Subcontract Liability

The Due Quantity is an assessment of the real quantity that has been completed by the subcontractor and contributes to the Actual Quantity in the main bill. However, the quantity Paid to the subcontractor may differ from the Due Quantity and the difference is regarded as the liability.

From the Subcontractor selector, a button produces the current state of the subcontract liability as shown below:
Valuations Reports

Dedicated reports

Bill Reports
- Interim Payment Claim
- Valuation Listings
- Trade Spreadsheets
- Dual Currency Listing
- Value Analysis
- Turn-about Document

Resource Analysis Reports
- Valuation Resource Analysis
- Resources by Bill Item
- Analysis by Group/Class
- Valuation Production Rates
- Resource Percentage Report
- Resource Group/Class Summary
- Group/Class Analysis
- Complex Resource Analysis

Project Codes Reports
- Project Codes Report
- Project Codes Resource Analysis
- Worksheets by Project Code
- Project Codes Production Rates
- Project Codes Quantity Analysis
- Project Codes Quantity Summary

Wastage Reports
- Wastage Analysis

Housekeeping Reports
- Page Checksums
- Tracers
- Location Code Check

Worksheet Reports
- Print Worksheets
- Individual Worksheets
- Worksheets in Bill Order
- Indirect Costs Worksheets
- Price Code Worksheets by Value
- Worksheets used only in Macros
- Macro Worksheets
- Macro Bills

Presentation reports

Bill of Quantities
- Nett BOQ - Carried fwd / Brought fwd
- Nett Bill of Quantities - Collection pages
- Nett Bill of Quantities - Page totals
- Compact Nett Bill Listing
- Nett Bill Listing with Worksheets

Indirect Costs
- Indirect Costs Report
- Indirect Costs Bar chart
- Indirect Costs Bar chart with Histogram
- Simple Indirect Costs
- Indirect Costs Monthly Forecast

Price code Lists
- Nett Price code list

Resource Lists
- Resource List

Trade totals
- Trade Total Graph

Specialised Bills
- Currency Analysis Bill
Planning
The Contractor’s Planning System

Candy Planning provides a powerful critical path network system designed specifically for the construction industry. It can be used effectively by a non-planner, but has the features and functionality required by the professional. Above all, it is straightforward to use and helps to plan a better project.

It has four primary objectives:

- Planning and controlling the project and recording the as-built program
- Managing the information from the design teams as required by the program
- Effective reporting on the project status across all levels of management
- Integration with the estimate to provide cost/value forecasts and cash flow analysis

Flexibility
Drawing a bar chart, maintaining a detailed precedence network or a combination of these two methods are possible. The network can be entered in a precedence fashion or as a linked bar chart that automatically creates the precedence network.

Accuracy
Network loops and activity duplication is checked as activities are entered, reducing input errors and timeous manual checking.

Detail
Activities may have notes and comments for annotating program reports or recording site conditions. Networks can be split into any number of sub-networks, which can in turn be sub-networked across nine levels. Information can then be summarised into logical sections and hidden or displayed as required.

Resourcing
Resources are categorised into simple and gang resources. Resources are effortlessly allocated to activities in the program in order to assess and manage the resource requirements for the project. Resources are analysed using on-screen and report histograms.

Organising
Powerful filtering mechanisms are provided for regrouping activities by code, description, float or any user specified data.

Progress
Progress can be recorded to provide an as-built record of a project, while the original network is kept as a base program to be used for comparison against actual progress.

Information schedules
Auxiliary Long Lead and Information Schedules are provided for tracking and recording off-network operations such as client decisions, design work and lengthy delivery items. The predicted consequences of late information delivery can be imported into the program to show the effect on the overall program.

Integrating the Estimate and Program
Items from the bill of quantities can be allocated to the program activities. This allows resource or financial information from the estimate to be reflected against the time frame calculated in the program.

The resources used in the bill of quantities can also be plotted as histograms. Any changes to either the program or the estimate will immediately be reflected in the forecast and the histogram.

Time/location
Time/Location is a method of summarising and graphically representing a program against axes of time and location. This facility is suitable for linear activities typically found in programs of hi-rise buildings, roads and rail lines. Changing durations in the Time/Location chart editor is immediately reflected in the bar chart.
Program Manager

New programs are created in the Program Manager, and it is the entry point for starting up existing programs.

Programs can be organised into groups under meaningful headings. Each program can have additional information stored against it as shown on the bottom right hand panel.

Programs can be created, copied, and backed up in the Program Manager.

There are also facilities for exporting and importing Candy Planning programs to and from other planning software.
Calendars
The calendar is used to specify non-working days in the project. The Project Calendar (PC) is provided automatically when a new program is created. The number of working days in a typical week can be set and holidays can be marked to represent the contract calendar.

Additional calendars can be set up to handle holiday patterns required for unusual activities or trades – for example a six day week and weekend only calendar have been set up in addition to the Project Calendar in the screen below.

Comprehensive notes can be kept about each day in the calendar, both as a remark in the Daily Diary column or on the notepad provided for each day.

The calendar can also be viewed in year planner format as shown in the background.
Facilities and features on the bar chart
Creating a program is easy – just draw the activity bars on the screen using the mouse. As an activity is made it is given the name “New Activity” which can be edited on the bar chart. Bars can be linked together by stretching a logic link between activities (as shown below). Alternatively, the activity name can be entered in the description column together with its activity number, duration, codes and predecessor/successor information. If no activity number is supplied, Candy Planning will number it automatically. Links from activities can be put into the Link Anchor Box for later connection to the appropriate successor or they can be entered manually in the successor column.

Where necessary the duration for an activity can be calculated and documented as shown below in the Duration Calc sheet for A060. The Birds Eye view provides an overall picture of the network, and can be used to jump to anywhere in the program with a single click. The right click menu offers several other facilities for managing and documenting the program, such as the activity note pad shown below.
Candy Overview

Planning

Activity Notes

Activity Notes

Activity: **A060 - Clear site/Remove topsoil**

Remark: Fan Foundation & Store Area

Note: Store Building Area

The area bounded by guidelines F/S7 and S/3/G is restricted by an existing reinforced concrete retaining wall on two sides, which must be left intact.

Activity duration calc sheet

Calculation Sheet Total: **20**

Calculation

- 120 metres * 50 metres / 400 m³/day
- 40 metres * 10 metres / 400 m³/day

Result: 15 Gridlines A/1-7 and 1/A-F

5 Gridlines F/5-7 and 5/F-J
Importing from the Bill of Quantities

Where a well-structured Bill of Quantities is available, the program can be imported from the Candy Estimating module. This is often a good platform from which to build the program. Bill section headings are imported as activities and adjusted to suit the program, adding activities as required and removing those that are not relevant.

During the import, the bill items are linked to the activities as they are created providing a good foundation for the time/money model of the project.

The program shown here has been imported from the bill of quantities and some of the activities have been adjusted and linked to represent the duration and sequence of work.

Unlinked bars are activities that have not yet been adjusted and are still as they were when imported from the BOQ – five days long starting at day 5.

Filtering the Program

Filtering is a powerful feature in Candy Planning. This filter example has found all activities that include the word “excavate”. The other activities are shown in a dull grey, or can be hidden to display only the items found by the filter.

For example, this could be used to print a report of excavation subcontract items, showing only the excavation activities or highlighting them in the context of the whole program.

A large selection of standard filters is supplied, including filters to help debug logic errors in the network. Alternatively, any of the Planning module columns of data can be used to filter the program. Filters can be applied to reports as well.
The Contract Program
The original program is automatically saved when progress is first recorded. This is the base program and reflects the contractual situation. It is always available for comparison to the current program.

Here the base program bars are shown in blue behind the current bars. Progress and dates for Long Lead information are recorded against the base program. Slip relative to the base program is used as a measure of performance against the original plan.

Recording the As-built Program
At regular intervals, every two weeks, monthly or before site meetings, etc, the actual progress achieved can be recorded against the program. Where comments are required to record events that affected progress, the progress notepad or keyword facilities can be used.

When activities are put on hold, the progress restraint system will record the stop-start dates and their knock-on effects. This information is built up over the contract and when viewed against the base program, shows the as-built progress on the background of the original program.
Managing Information Requirements

Getting the information required to build a project is one of the major problems in construction. Owner’s decisions are delayed as late as possible, design teams are often under-resourced and tenant requirements are not forthcoming. SitePlan includes a Long Lead item control system for planning and managing off-site design, procurement and nominated sub-contract events.

These items are tied to the program and their “drop-dead” dates reflect the current program requirements. Delays from the Long Leads are recorded and the impact is reflected in the program. All delays and their knock-on effects are kept by the system and are available as backup to settlement claims.

A parallel system, the Information Schedule, is used to manage information required to construct the activities on the program. For example, the structural engineer is prompted for bending schedules early enough to get the rebar cut, bent and to site on time for the individual concreting activities.

An extensive reporting facility is available for the Long Lead and Information Schedule systems to provide the owner and professional teams with clear reports of their decision and design obligations.

The screens below show the Long Lead control system.

The document above describes a series of Long Leads. The cursor is on a program activity that is dependent on a chain of offsite operations. These are listed below the activity, with the duration that each requires and the responsible party’s code.

The start and finish dates shown for each item in the sequence must be adhered to or the activity, “Fan base”, will be delayed past its start on 22/04/02. In this example, the owner is away and will not approve the design until 28/04/02, delaying the Fan base by 20 days.
The effect of the delay is transferred to the program and the results are shown in the next example where for simplicity only one long lead delay is shown. The leftmost column shows the delay while the second column shows the knock-on effect on the rest of the program.

The End Slip column shows how the affected activities are slipping relative to the original base program and the float columns show how the activities have become critical compared to the original program. The worst float is \(-20\), i.e. the project is currently forecast as 20 days behind the required completion date.
Resource Allocation

*Candy Planning* has access to two kinds of resources: those from a priced *Candy Estimate* and the planner’s resources. The latter are discussed here while the analysis using *Estimate* resources is mentioned in the section under the link between Planning and Estimate.

An unlimited number of resources may be defined in the program or copied over from a library program. There are two types of resource, simple and gang. The simple resources can be grouped together to form gang resources. For example, a bricklaying gang can be made up of a bricklayer and half a labourer. Both gang and simple resources can be allocated to activities. In an analysis of resources, the bricklayer and labourer would be extracted from the gang resources for their respective histograms.

In the screen below, activities are shown on the left with the resources allocated to them. An activity’s bar is drawn as many times as there are resources allocated to it. The black bars show how the resources are spread over portions of the bars, accurately positioning the resource duration on the activity duration.
Resource Cross-Reference
This screen shows the resources and identifies the activities that use each resource as well as the quantity and position of the resource usage on the bar. This is the inverse view of the previous screen and allows the planner to consider the flow of a resource through the activities. In this view it is very easy to optimise and level the use of a resource.

Resources and Production
Calculating the duration of an activity depends on the quantity of the dominant resource, the team size, the number of teams and the production output from a team. Candy Planning handles these calculations and will produce a suggested duration that can be used or modified. Columns that control the calculation are shown below.

A quantity take-off sheet is provided for every activity to calculate its quantities. The take-off is in a free-format and can be annotated to identify the measurements.
Resource Histograms and Optimisation

Resource histograms can be calculated and displayed against the bar chart. Activities that do not use the resource being analysed can be filtered out. These “rejected activities” can either be shown in a light grey or hidden altogether. The screen below shows the rejected activities greyed out so that the other activities can be seen in context.

Moving an activity to level a histogram peak puts a resource restraint against the activity and reschedules it at the date indicated. This gives the planner an immediate feedback on the effect of manually sequencing the resource usage and its impact on the end dates.
Resources and Progress
As the project progresses, and the actual starts and ends of the activities are recorded, the histograms of resources against the original plan reveal the effects of delays. The screen below shows the original cumulative histogram for REBAR in blue and the current situation in green. Due to information delays, the program has been delayed and activities using the REBAR resource now overlap, causing an increased production as can be seen by the steeper green histogram. Even so, at the middle of May, the shortfall in production against the original program will amount to some 60% of the resource total.

Resource Cross-Reference Histogram
An alternative view to analysing the screen above is to isolate a particular resource and display the activities that use it. The cumulative histograms below clearly identify the activities that contribute to these curves. In this case there is not much latitude as the activities that cause the steep production are all critical and cannot be moved without adversely affecting the end date.
Time Location editor

Time / location charts are known by various names such as Line of Balance, Time / Chainage, March Charts, Sloping Barcharts etc.

The Time/Location chart is a method of summarising and graphically representing a program against axes of time and location. They are suitable for projects of a linear nature, for example railways, motorways, pipelines, tunnels, mine shafts and high rise buildings. They are also useful for mass housing projects and production control such as hotel room fit-outs.
Report Manager
All reports in Candy Planning are managed through the Report Manager. Numerous standard template reports are provided covering all aspects of construction planning. These can be copied and altered as required. Company standard reports can be set up and stored as My Reports.

Reports can be annotated with textual comments, scanned digital photographs and outline drawings such as site layouts. Speech bubbles can be used to refer to specific points on the bar chart, and activities may be coloured by resource, area, responsibility etc. The reports can be easily tailored to match corporate fonts, logos and colours where presentation quality is required.

Reports can be printed individually or grouped into a binder that can be printed as a book. Printing Resource Histograms, below, would print all reports in that set with a contents page and continuous page numbering.
Planning Reports

Presentation reports

Activity Lists
Standard Activity List
Activity Logic

Bar charts
Standard Bar chart
Current and Base Program Bar Chart

Resource Histograms
Resource Histogram
Histogram - Monetary Values
Histogram - Current vs. Base Program
Numeric Resource Histogram
Activity Density Histogram

Resources
Bar chart with Resource Allocations
Resource List with Bar chart

Management Reports
Contract and Target Dates
Contract Dates
Target Dates
Progress Diagnosis

Information/Long Leads
Information Required Bar Chart
Detailed Long Leads Bar Chart
Bar chart with Long Lead symbols

Networks
Precedence Network Report

Calendars
Calendar Listing
Year Planner

Time/Location
Time/Location Report
Forecasting
Forecasting value, quantity and resource

Monthly forecasts of bill amounts, resources and quantities generated from a dynamic link between the estimate and program provides invaluable information for feasibility and progress monitoring of a construction project.

- Dynamic integration of bill items and program activities
- Forecast monthly budget and quantity of bill items
- Forecast monthly revenues per bill item or activity
- Forecast and schedule monthly resource usage and value
- Produce graphical and numeric histograms for budget and resource forecasts
- Produce “s-curves” of budget and revenue
- Provide source data for cash flow preparation and modelling

Integrating the Estimate with the Program

Items from a bill of quantities in Estimating can be allocated to the activities of a program. A bill item can be allocated to many activities, specifying the quantity allocated to each activity and where in the activity it is to be spread. If a bill item is not completely allocated, the unallocated quantity is highlighted.

Alternatively, the bill items and/or headings can be imported from the estimate to create program activities. As the activities are extended, the bill item amounts, resources and quantities are spread accordingly.

The result of this linking process is a Bill of Quantities with a program attached as shown below. The first three columns are the bill of quantities as it exists in the estimate. The next columns specify the activities with the bill quantity to be spread over the activity. The last two columns hold the start and end positions of the spread over the bar.
**Program view of the Bill of Quantities**

This screen shows the program with the bill items that are allocated against each activity (the inverse of the previous screen).

For clarity the activity bars are drawn as many times as there are bill items allocated to them. The dark bar within each activity is the position where the bill item is to be spread. The allocation can be done on either this view or the one above, depending on the user’s preference.

The user controls the text shown on either side of the bars. In this screen the bill quantity that is allocated to a bar is shown before the bar.

When an activity is progressed, the quantity of the bill items allocated to the bar that should have been completed is calculated. This is the measurement of the internal quantity completed to date and can be used as the basis for the monthly valuation.

**Bill of Quantities with Forecast**

The bill item knows how it is priced and the program knows the time over which the bill item is being spread as well as the quantity involved. Candy Forecasting can therefore calculate the amount of money to be spent on each bill item per month. The screenshot below shows this forecast expenditure as a budget for the bill of quantities.
Forecasting using the Estimate Link

Candy can break a bill item’s pricing down to individual resources, and then further to cost codes. Knowing the time frame of the bill item spreads, forecasts at cost code level are automatically generated.

This process depends only on the link that is built between the Planning and Estimating and requires no further effort from the user.

The resources used in the estimate can be plotted as histograms using the program’s knowledge of when the bill items will be performed. These histograms usually take the form of reports and are not shown here.

Any changes to either the program or the estimate will be immediately reflected in the forecast or histograms.
Cost loaded program

Program activities can be displayed with the forecast cost or revenue amounts. Bill items, contributing the value, have been linked to the activities which allow for the costs to be “loaded” against the activities.

The planned cost or revenue at a particular stage of the job can easily be quantified and compared against.
Estimating by Pricing the Program

If there is no bill of quantities, the program can be priced using Candy Estimating. Activities use standard Price codes in their pricing. The Price codes can be either Time dependent, Quantity dependent or simply an Amount. Time dependent items use the activity duration multiplied by the “LocalQty” to derive the PricingQty, while Quantity dependent items use the activity quantity multiplied by the “LocalQty” and Amount type items only use the local quantity.

Many Price codes can be applied to a single activity. The document at the top of the screen shown here is a program with Price codes applied to the activities. The activity under the yellow cursor, for example, has two items priced against it: one time and one quantity dependent, identified by T and Q in the Type column.

The full power of the estimating module is available for pricing the program, including access to library Masters and previous estimates. An estimating worksheet and resource list that have been used to price this example are shown below.

Once the pricing of the program is complete, it can be exported to Estimating to create a bill of quantities. This process uses the activity names to create section headings in the bill, and the Price codes that were used to price the activities become the bill items. The resultant bill of quantities is shown at the bottom of the screen.
While exporting the priced activities to the bill of quantities, the bill items are automatically linked to the originating activities. This gives the bill of quantities the ability to display a bar chart of the activities to which the bill items have been allocated.

Immediately this is done, all the program/bill-linked facilities, such as the budget forecasts and histograms of the estimate resources are available to the project.

Once the bill is in the Estimating module, alterations and additions can be made to the bill and the pricing can be fine-tuned. Sub-contract adjudication, mark-up etc., can be applied as for any standard estimate. At any stage, the bill/program data can be transferred to the Project Cash flow module for detailed cash flow analysis. This will ensure that any changes made to the bill of quantities or to the program are included in the cash flow.

**Project Cash flow**

The aim of the Cash Flow program is to model the cash flow for a construction project so that the effect of interest rates, currency fluctuations, payment lags and other criteria can be understood and handled in the most optimum manner.

The Cash Flow program uses combined data from the Estimating and Planning modules to perform a full cash flow taking into account pre-payments, loans, retention, interest on borrowings and savings, and payment leads and lags. The Cash Flow deals with multiple currencies when used in the estimate, as well as escalation restrictions.

This is a generalised model that will describe most situations and provide a quick analysis with a minimal amount of input. It will assist in assessing the effect of changes to the project financing and help to focus on the important issues.
Forecasting Reports

Estimate-linked Histograms
- Estimate-linked Histogram
- Numeric Estimate-linked Histogram

Linking to Bill of Quantities
- BOQ with Activity Progress
- Bar chart with BOQ

Forecasting with BOQ Links
- BOQ with Resource Usage Forecast
- Bill Code Budget by Class Code
- Class Code Budget
- Currency Analysis
- Valuation/SitePlan Discrepancies

Program Pricing
- Priced Activity List
Cash Flow

Project Cash Flow Analysis
Interest and inflation determine the future value of money and should be accounted for at an early stage as they can have an adverse impact on the viability of a project. The aim of the Cash Flow module is to build a financial model of the construction project so that these factors can be understood and handled in the most effective manner.

An enormous amount of raw data is required to do an effective cash flow analysis. To make this task simpler and to reduce input errors, Candy Cash Flow can draw information from both the estimate and the project program. This allows variations to be tested easily and the latest bid figures to be included as they are made available.

How it operates
The Cash flow module needs the start and duration of the activities to be analysed, as well as their selling value and the costs broken down into labour, material, plant etc. This is the activity information.

The activity information can be entered manually, but for anything but a trivial estimate this is a huge task. Trade or section summaries can be imported directly from the estimate in which case the start and duration for each section must be entered manually from the program. This usually produces a surprisingly accurate cash flow, but on larger more complex projects it is often necessary to go into greater detail.

The manner in which the cash flow calculation handles lags on payments, retention, NPV, interest rates, and all the other factors that must be accounted for must also be entered by the user. These parameters are vital to the modelling of the anticipated project conditions, although only a few have major impact on the results. Parameters can then be varied to understand their influence on the bank balance during the project and the resulting profit at the end.

The following parameters can be entered by the user to control the cash flow calculation:

- Interest rates on saving and borrowing
- Retention on main contract and on subcontractors
- Pre-payments and loans
- Valuation payment plans and restrictions
- Payment lags on suppliers & subcontractors
- Inflation and escalation conditions
- NPV factors for contractor and client
Using linked data from the Program and Estimate

Once the program and estimate have been linked, detailed information from these two systems can be imported by the cash flow program. This ensures that no items are omitted and that the figures close with the estimate. This integration of estimate, program and cash flow provides a very effective tool for modelling the anticipated outcome of a project.

When multiple currencies are present in the estimate, these are imported as well. The exchange rates between the currencies and the tender currency are imported from the estimate, and the user can stipulate future movement of the exchange rates over the project duration. The cash flow can be viewed in any of the currencies.
**Cash Flow analysis**

This screenshot shows the two primary documents from the Cash flow module - the cash flow input document in the foreground and the results document in the background.

The input here was imported directly from the estimating system, bringing in the cost and value of the sections defined in the bill of quantities. The starts and durations for each item have been entered manually. The line cursor is over the item Concrete, which is programmed to start in week five and continue for eight weeks. The value of the work is 301,831 and the costs are 37,236 for labour, 78,262 for plant and 122,823 for material.

Parameters such as retention conditions, lags on payments etc. were also entered. So the labour cost column, for example, knows how to spread its costs over time and when the actual payment will be made to the labour force - in this case every seven days. The document menus access these parameter settings. The Calc Cash flow button uses the input document and the parameters to perform the cash flow calculation and produce the Results Document.

Note the items Supervision and Plant & Transport at the top of the Input Document, which have cost but no value - the values were spread into the bill items in the estimate.

The Results Document contains the results of the cash flow calculation. The columns from left to right are: week ending date (time runs down the page), week number, % complete of cost and value, and the Bank Balance. The latter is made up of the Inflow and Outflow of money, derived from interest charges (or gains), payments from the client (less retention) and payments of costs. The retention column shows amounts held and released, and the capital in/out column reflects pre-payments, loans etc. The breakdown of escalated costs column splits escalated cost into resource types, Labour, Plant, Material etc.

The Cash Flow Analysis Summary table half way down summarises the cash flow - in this case the tender profit was 16.46%, but taking escalation into account drops it to 15.62% and if NPV is applied, it drops further to 14.70%. Maximum funding required for this model is 628,120 and the financing cost is 3,340.
**Earned Value**

The Contractor’s Performance system

Earned Value Management refers to an entire family of curves and their derivatives used for the control and measurement of a contract’s performance. The principle of Earned Value is to forecast and track Allowable and Cost against a Baseline budget.

- Forecast generated from bill linked to program
- Forecast stored as baseline
- External application cost import
- Cost performance variance and index
- Schedule performance variance and index
- Cost to and at completion forecasting
- Monthly cost and schedule performance trends
- Graphical analysis
- Re-basing due to scope changes and variations
- Variation and change management

---

**Terminology**

Candy identifies a few more terms and uses different terms from the original Earned Value (DoD) definitions. These have better meaning from a contractor’s perspective.

<table>
<thead>
<tr>
<th>Candy terms</th>
<th>Conventional terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline budget</td>
<td>Budgeted Cost of Work Scheduled (BCWS)</td>
</tr>
<tr>
<td>Allowable Forecast</td>
<td></td>
</tr>
<tr>
<td>Allowable to-date</td>
<td>Budgeted Cost of Work Performed (BCWP)</td>
</tr>
<tr>
<td>Cost to-date</td>
<td>Actual Cost of Work Performed (ACWP)</td>
</tr>
<tr>
<td>Variance to completion</td>
<td></td>
</tr>
<tr>
<td>Cost to Completion</td>
<td>Estimate at Completion (EAC)</td>
</tr>
<tr>
<td>Cost at Completion</td>
<td>Variance at completion (VAC)</td>
</tr>
</tbody>
</table>

---
Underlying Concepts

The Baseline is established at the start of the project and should not be changed except to reflect changes in scope. There are two parts to the Allowable and Cost curves, namely “to-date” and “forecast”.

Earned Value in its fullest extent requires monthly forecasts of the three curves (base, allowable and cost) over time. In Candy this is easily achieved by linking the bill of quantities to a program. However, even if the program link is not available or not practical, very useful control information can be derived by keeping the past history of Allowable and Cost to-date and forecasting these values to project completion.

The Baseline budget

During bid stage, the estimators would have linked the bill of quantities to the program to get a sense of the cash flow requirements. Even if the program is a coarse summary of the detailed schedule it is usually sufficient to identify important issues related to the cash flow.

When the bid is awarded, the estimators would normally ‘clean up’ the estimate and formally hand it over to the project team with the contractual Selling rates established. It is the responsibility of the project team to re-investigate the material and subcontract prices, assess buying savings and finalise the construction methods in order to finalise the nett rates and establish the Baseline budget.

Where possible this should be done in conjunction with the construction program to set the Baseline over the project duration. Candy has all the facilities needed to link the bill of quantities to a program. Recording the Baseline is then simply a button press. However, linking the program and the bill is a non-trivial task and is often over complicated when using a program that is far too detailed. Allowable to-date and forecast

The Allowable curve starts off as a replica of the Baseline. However, it will inevitably change as soon as the project starts and the actual progress varies from the original budget.

As the monthly Actual quantities are updated in the Valuation bill of quantities, so the Allowable to-date curve emerges and the Forecast Allowable, which uses the Remaining quantities, will also change.

As changes in the scope of the project are entered in Candy Valuations, they will immediately be reflected in the Forecast Allowable curve as will any extension to the end date. It is essential that these scope changes are reflected in an adjusted Baseline to keep the Allowable and the Baseline information in synch.

Schedule performance

The Schedule Performance Index (SPI) is defined as the Allowable to-date divided by the Baseline at time now. If the project is behind progress the index will be less than one and if ahead of progress greater that one. This SPI is a good indicator of progress and by recording the indexes to-date and calculating the forecast indexes, trends can be assessed well in time to take corrective action.

The SPI, however, is objective and takes no account of the critical path and does not indicate if critical activities are lagging and “good” progress is being achieved by completing non-critical activities.

The Schedule Variance (SV) is the difference between the amount earned (Earned Value) and the baseline amount that should have been earned to date.

Cost to-date and forecast

Candy does not cater for actual costs – these have to be acquired from the enterprise accounting system. Using compatible coding between the two systems (or via ‘lookup’ tables) the latest costs can be imported electronically into Candy. This will allow Candy to plot the Cost to-date curve. If this data is not immediately available from the accounting system and lags the time now date, then Candy will use the Cost Rates to estimate the cost history until such time as the updated information is available.

Cost forecasting is done at grass roots level with the adjustment of resource cost rates and Price code worksheets for the remainder of the contract.

Cost performance

The Cost Performance Index (CPI) is defined as the Allowable to-date divided by the Actual Costs to-date. If the job is costing more than the Allowable
the index will be less than one and if it is making money, the index will be greater that one. This index is a good indicator of the cost situation and by recording the indexes to-date and calculating the forecast indexes, trends can be assessed well in time to take corrective action.

The Cost Variance (CV) is the difference between the amount earned (Earned Value) or allowable and the Actual Cost amount incurred to date.

Like the SPI, the CPI also takes no account of the critical path. However, the float status of the activities has no effect on this index and can be ignored.