BUILDING AN INTEGRATED SYSTEM FOR MANAGEMENT OF PROJECTS ((SOME WATER PROJECTS AS A CASE STUDY))

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ABSTRACT
Many useful softwares in projects management are available now. Ms Project and Primavera are some examples of these softwares. Those programs need to be fed by information by the user. The users usually collect this information from the project and design documents. This collection process needs considerable time and efforts, and usually accompanied of some errors in data transfer process.
In order to reduce the required time and efforts and to eliminate individual errors in data transfer process, an Integrated System is needed. This Integrated System can extract the graphical information from an AutoCAD drawing and transfer it to a digital form suitable for processing in the project management softwares such as Excel and Ms Project.
In this research an Integrated System (IS) was built, to connect three softwares, AutoCAD, Excel and Ms Project, using Active X data transfer technology. The Integrated System was tested using three case studies. Al-Nahrain University waste water network, the Islamic University water supply network, and an irrigation and drainage project. The results indicated the capability of the system to transfer the graphical data into digital data, and to conduct the quantity of survey of the selected projects.
It is worthy to mention that this system requires some modification that is should be adopted in the AutoCAD drawings. The drawings should be performed using layers, and definition blocks for objects. These modifications are simple and can be done easily. Moreover the system was built in a way that gives the ability of adding other case studies (i.e., other types of projects).

الخلاصة
تتوفر العديد من البرامجيات الهندسية المفيده في ادارة المشاريع. مثل هذه البرامج على سبيل الذكر هي (Ms project, Primavera) وغيرها . أن هذه البرامجيات تحتاج الى التغذيه بالمعلومات من قبل المستخدم حيث يقوم المستخدم عادة بجمع المعلومات من المصادر المطلوبه مثل وثائق المقاوله ومخططات التصميم وغيرها. ان عملية جمع هذه المعلومات وادخالها يصاحبها جهد ووقت وقد تتعرض هذه العمليه الى حدوث اخطاء في نقل المعلومات.
ولتوفير الجهد والوقت وتقليل الاخطاء في نقل المعلومات يتطلب انشاء نظام متكامل يقوم باستخلاص المعلومات قدر الامكان من وثائق ومخططات المقاوله وتحويلها من صيغتها الفعليه الى الصيغه الملائمه لتشغيل برامجيات

ادارة المشاريع. Iهذا النظام المتكامل بامكانه استخلاص المعلومات الرسوميه من مخططات ال (AutoCAD) وتحويلها الى ارقام مناسبه للمعالجه في برامج ادارة المشاريع مثل (Excel and Ms Project)
في هذا البحث تم بناء نموذج متكامل لربط البرامجيات (برنامج اوتوكاد، مايكروسوفت أكسيل و مايكروسوفت بروجيكت) بحيث يقوم النموذج باستقراء المعلومات من المخططات التصميميه المرسومه ببرنامج (AutoCAD)وتحويلها مباشره الى برنامج (Excel) وبرنامج(Ms Project) بصيغه عدديه بحيث يمكن التعامل معها بسهوله لايجاد الكميات وبناء نظم اداره المشروع بشكل سريع ومباشر.تم بناء النموذج المتكامل باستخدام البرامجيات اعلاه وربطها بتقنيه (Active X) التلقائيه. تم تجربه النموذج المتكامل على ثلاث حالات دراسيه وهي شبكة مجاري لموقع جامعة النهرين وشبكة ماء لموقع الجامعه الاسلاميه وشبكة قنوات الري والبزل. اثبتت النتائج فعالية النموذج في تحويل المعلومات من صيغتها الرسوميه الى صيغ عدديه يمكن التعامل معها بسهوله ويسر بالبرامجيات المشموله بها.
ومن الجدير بالذكر بان النموذج يتطلب ان يتم رسم المخططات التصميميه ببرنامج الاوتوكاد مع بعض التاشيرات الطفيفه في هذا البرنامج لكي يتمكن النظام بالعمل المطلوب ، مثل اجراء الرسومات بصيغ الطبقات ال(Layers) وحصر الاشكال (Objects) بلوحات التعريف (Blocks) وهي متطلبات بسيطه يمكن تنفيذها بسهوله.كما ان النظام تم بناءه بطريقه مرنه بحيث يمكن اضافة اي حاله اخرى (اي مشاريع اخرى).

KEY WORDS
Integrated System, AutoCAD, Excel, Ms Project, Active X Technology

INTRODUCTION

Construction was a collaborative activity involving a multi-disciplinary team including client, architect, engineer, consultant, contractor, etc. Each member of this team was responsible for certain aspects of the project. Different professions used their own unique processes to undertake their tasks, but often had to rely on information supplied by others. At present, the communication problem between the team members is often a cause for project delay and building defects. Improving the communication link had been identified as crucial to further efficiency gain in construction. (Sun and Aouad: 1999).

With the wide use of Architecture, Engineering, Construction (AEC) software, the traditional cross discipline communication is increasingly manifested as an issue of data exchanged and data sharing between different software applications. (Sun and Aouad: 1999).

The increasing technical complexity of projects created a demand for the integration of construction project information .The development and deployment of new construction industry software applications, improvements in network technology, the application of robotics to the building process, the development of new modeling methodologies and languages and the definition of standards for information exchange all created new opportunities for integration. (Dikbas, Morten and Yitmen: 2000).

Integrated construction management systems had their early start with the automation of scheduling and planning through the use of emerging Artificial Intelligence (AI) techniques (e.g., Levitt et al. 1988; Waugh 1990) as mentioned by (Rankin, Forese and Waugh: 1999). It was found that starting from so-called "first principles" and regenerating all the necessary information that was required for a single application, let alone integrated applications, was a challenging task. Work in this area then took a turn towards integrating the applications that were more widely accepted (scheduling and estimating), through the application of broader information technology approaches, with a higher level of information representation and use of templates or libraries of knowledge structures (e.g., Yamazaki 1995; Strumpf et al. 1996) as mentioned by (Rankin, Forese and Waugh: 1999).

To date, it is generally accepted that integrated construction management systems will be conceptually based on a central information source with which integrated applications and the industry participants will interact (O'Brien 1997) as mentioned by (Rankin, Forese and Waugh: 1999). (Rankin, Forese and Waugh: 1999).

Limitations of Using Stand-alone AutoCAD in Construction Management:

1. in the AEC industry have used today's CAD systems as simply automated drafting tools
2. Information is scattered about the project in an uncontrolled and uncoordinated way, on a variety of information systems and media, so that the design cannot be viewed as a complete entity

3. A problem with these stand-alone CAD applications for construction management is that they are typically used primarily as drawing tools, and are not used to store construction management related data within the drawing. (Marir, Aouad and Cooper: 1998)

Limitations of the Current Traditional Project Management Softwares:

1. These softwares provide sophisticated functions of analyzing the network models of a project so as to scheduling the project
2. these softwares are applicable only to a prepared network model of a project
3. They are mainly used to carry out computations on input data provided by the construction planner. The input data required normally comprise an activity list complete with their estimated durations and logic dependencies
4. Even if the design is CAD-based, the data needed for establishing such model can not be extracted directly by these softwares from the data existing already in the CAD drawings generated at design phase while have to be re-input by the planner

If the construction schedule of a building can be generated directly and automatically from its drawings provided at design phase, it will benefit in at least two ways:

a) To predict the construction schedule at design phase, hence to optimize the design from construction view;

b) To fully utilize the data existing in the drawings for managerial purposes in construction phase, such as scheduling and cost estimating, so as to reduce the tedious human manipulation of data and the potential source for numerous errors. (Wang: 2001)

COMPUTER INTEGRATED CONSTRUCTION SYSTEMS

Computer integrated construction (CIC) systems had a tremendous potential to improve the productivity of the construction industry. (Elzarka: 2001).

Computer Integrated Construction (CIC) as an example of how research and development could deliver significant savings to the construction industry. The concept of (CIC) was that technical information was entered into the computer system once and instantly made available electronically to all project team members. (Frederick and Nancy: 2000).

Elzarka had defined the (CIC) as the use of computer system to integrate the management, planning, design, construction, and operation of constructed facilities. CIC systems automate many of the labor-intensive tasks associated with construction management of new facilities. Through the integration of (3d, 2d) CAD models, database management systems and expert systems , CIC systems allow users to automatically calculate material quantities from CAD models, test the constructability of the design before actual construction; report construction progress graphically and improve collaboration between project member. (Elzarka: 2001)

The main objective of CIC system is to communicate data to all project participants, throughout the project’s entire life cycle and across business functions. (Elzarka: 2001)

The followings are the benefits of (CIC) systems:

An architect transmitted Computer-Aided Design (CAD) files to a construction manager, who automatically extracted areas and quantities for an accurate progress estimate and schedule. As the design was refined, so were the estimate and the schedule.

1. Estimate quantities electronically linked to the schedule for projecting the value of work in place. This allowed for easier and faster construction of a cost-loaded critical path schedule.
2. Suppliers' data bases were made electronically available to designers and builders, who extracted specifications, pricing, and availability information. For example, using a common symbol library, a designer clicked the "door" symbol; all door suppliers were listed. The designer clicked a particular price; availability information was listed.
3. A project's filed office was electronically linked to the home office and design consultants for communicating up-to-date design, schedule, and cost information. For example, a design consultant in a remote location transmitted, rotated, and explained a construction detail on a field superintendent's computer. (Frederick and Nancy: 2000).

SYSTEM INTEGRATION DEFINITIONS

There are many definitions to system integration and the researcher will view the following:

(Thomas: 1992) had define the system integration as "a spectrum of application-linking and data-sharing capabilities".

(Wang: 2000) had define system integration as "the pass of information from one application to another in a way that the information required can directly be used as the input for another application".

(Sun: 1999) had define system integration as "the exchange of data between Architecture, Engineering, and Construction applications".

The researcher defines the system integration as "a system integration that allow various applications to interoperate and exchange data with other applications"

DEVELOPMENT OF THE INTEGRATED SYSTEM

The integration of stand alone AutoCAD, Ms Excel and Ms Project using Visual Basic and Active X Automation technology is proposed as an alternative approach to developing the Integrated Construction System (ICS).

The integration of stand-alone CAD, spreadsheet, and scheduling software using Visual Basic is proposed as an alternative approach to developing integrated systems. One advantage of this approach is that the integration of existing software, already familiar to the user, achieves dramatic reductions in the development effort as well as training time over conventional programming for systems with similar scope.

The program was designed by using Visual Basic as control tool for sharing data between AutoCAD, Ms Excel and Ms Project

THE SOFTWARE USED IN PROGRAM

1. Visual Basic and Visual Basic for Applications
   - Stand-alone visual Basic is designed for general application development
   - Visual Basic for Applications is the edition of Microsoft Visual Basic designed specifically to provide development capabilities inside an off-the-shelf application
   - One of the most advantage of programs developed using VB lies in their graphical user interface GUI, which has the familiar Windows look that users are accustomed to. The same features and controls, like list boxes, dialog boxes, option buttons, and command buttons, can

be incorporated into the applications' screen displays. Visual Basic is a graphically oriented language, so mush of our program can be accomplished with the click of a mouse.

2. Auto Cad
   - AutoCAD is one of the most widely used computer-aided design/drafting (CAD) products on the market today. One of the main reasons for AutoCAD's popularity is its flexibility
   - Computer-aided design (CAD) has been widely used in the construction industry. Its use however has been limited to drafting for so many years that it is sometimes referred to as computer aided drafting.
3. Ms Excel
   - Ms excel spreadsheets have gained wide acceptance for calculation and data analysis
   - Tapping into the increasing capabilities modern computers, spreadsheet applications have been up graded significantly in the last few years to include additional capabilities and presentation options
4. MS project
   - Ms Project is one of the famous programs that used mainly for scheduling of projects. It is used as scheduling tools for construction projects and all other projects in the other disciplines.
   - Ms Project has multi view like critical path and Gant chart can be drawn.
   - Various options like early start, late start or scheduling back words from the completion date are available
   - Important events may be highlighted by specifying them as "milestones"
   - Various sub-projects or multiple networks can also be handled.

TYPES OF CONNECTIONS BETWEEN THE SOFTWARES

1. Dynamic Data Exchange (DDE)
   - Originally created to allow two windows applications to communicate and exchange data
   - DDE is the mechanism that allows two applications to "talk" to each other by continuously exchanging data.
   - In a DDE conversation, one application called the destination application, or client, initiates a conversation with another application called the source application, or server.
   - The information generally flows from the server, or source, to the client. If necessary, the process can be reversed, where the client sends information back to the server.
2. Object Linking and Embedding (OLE)
   - Object linking and embedding (OLE) has taken the capabilities of (DDE) a step further. Instead of simply passing information from one application to another (OLE) allows information to be presented in the same way it would appear in the original application
   - The information can be embedded by simply copying it to the windows clipboard and pasting it into another windows application
3. Active X Automation
   - Active X is Microsoft's term for "activating the internet" using the same technology used in other windows application on the computer
   - Using Active X Automation, the AutoCAD objects can be created and manipulated from any application that serves as an automation controller.

- It enables cross application macro programming-the ability to control one application, such as AutoCAD, from a macro developed in another application, such as Microsoft Excel
- With Active X Automation, the features of many applications can be combined in a single application.
- An Active X controls is a device created to perform a specific task in the used application

THE PROGRAM REQUIRMENTS

The program is built according to some requirements as follows:

1. AutoCAD drawing requirements

For water system and waste water system:

- Each pipe diameter should be drawn in a separate layer (for example pipe of diameter 300mm draw in layer named DIM300).
- Each fitting should be drawn as a block (for example A-angle fitting drawn as block named A).
- For pump station and Gate valve also should be drawn as a block named (PUMP).
- Each manholes should be drawn as a block (for example AS manhole draw as block named AS)

For Irrigation project:

- All channel type should be drawn in one layer named (LC).
- The name of each channel should be entered directly after the draw of channel.
- The name of each channel should be putted in layer named ID like (LC1/DC1/WC1).
- The channels should be drawn in a sequence start from (LC) and then (DC) and (WC).
- The cross sections drawing should be contain the (top level value, ground level value, and bed level value); these values entered as text in different layer name like (TL for the top level value), and so on.
- The sections should be named according to the related channel; the name should be entered in a layer named (ADDRESS).
- The sections should be drawn in a sequence from the first section to the last.
- The channels and sections should be drawn in one drawing

2. AutoCAD scale should be (1:1).
3. The cost of the activities is estimated using material quantities that extracted from the AutoCAD drawing and the cost information entered by the user (the information cost should be as unit cost /meter).
4. The production rate for an activity is assumed to be fixed along the activity duration (production rate should be as quantity/day).
5. The duration of the activities is estimated using material quantities that extracted from the AutoCAD drawing and the productivity rate information entered by the user.
6. The precedence of the activities should be entered by the user.

THE PROGRAM DESCRIPTION

The Integrated Construction System (ICS) is developed to facilitate the construction management of (water system, waste water system, and irrigation system) as case studies projects by integrating the following off-the shelf applications:

1. AutoCAD for reading the required information and data of design.
2. Microsoft Excel spreadsheet to report the bill of quantities in a convenient spreadsheet format for subsequent manipulation and printing.
3. Microsoft Project scheduling system to scheduling the project.

All components of the program are integrated using Visual Basic and Active X Automation technology. Figure (1) illustrates the integration achieved in the program.

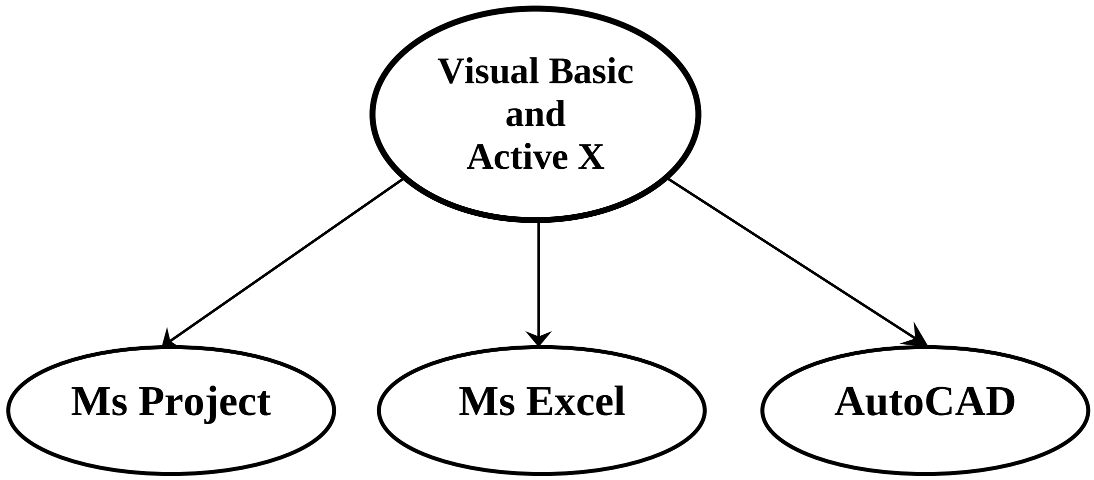


Fig (1) The integration model

To make another application's objects available in the developed VB code, there is a need to set a reference to that application's object library. This can be done by clicking on the project command in VB menu bar and selecting references. The references dialog box lists the references available to the project. To add the AutoCAD objects, the check box next to the AutoCAD name should be selected. The same process can be followed to make other application's objects available in the code of the program like MS Excel and Ms Project. As shown in figure (2).

Since AutoCAD drawing is essentially a data base, extracting and conveying information about drawing entities is not necessary difficult. Active X Automation can be used to obtain key information about the exposed AutoCAD objects and to send this information to a VBA-enabled application like Excel. This approach is useful for the generation of tables like a bill of material or quantity summary.

When the list command is used in AutoCAD, certain characteristics are displayed for the entities selected. For line, the values for the beginning point, end point, and length, as well as the layer name and, of course, the entity type, and line can be seen. The access of much of same information with Active X Automation can be preformed and put in to use in various ways, such as counting the number of entities in a certain layer, or tallying up the total length of certain lines.

The AutoCAD data base is the central repository of all data is stored in the AutoCAD model. It contains the information required to support the activities of cost estimating and scheduling.

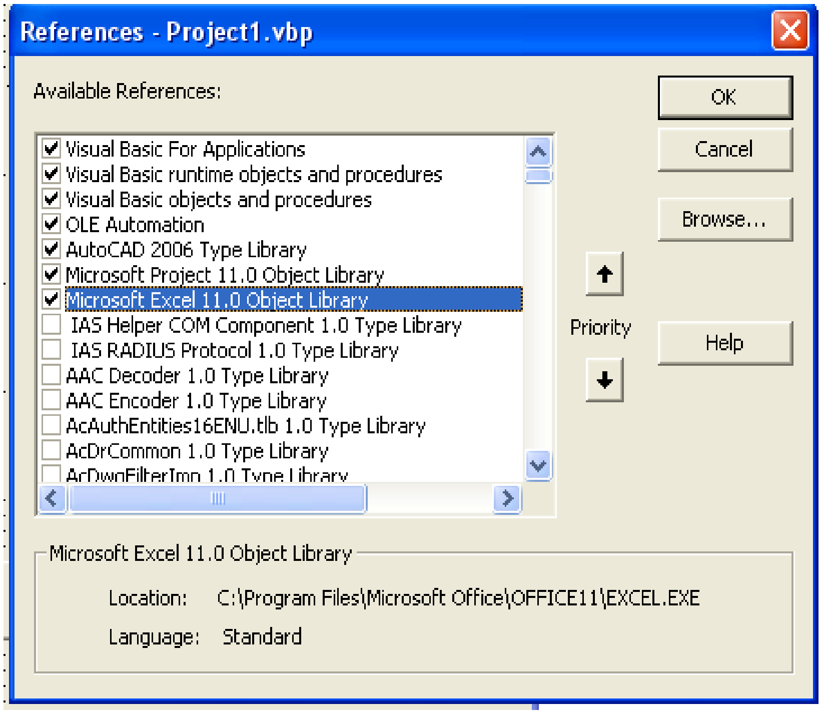


Figure (2) References dialog box

THE IMPLEMENTATION OF THE PROGRAM

Case Study One (Water System Network)

The layout drawing of the water system network is shown in figure (3) for the water system of the Islamic University in Baghdad. The output of the program is as follows:

Figure (3) The Islamic University in Baghdad water system network

1. Excel presentation quantity takes off: as shown in table (1) below

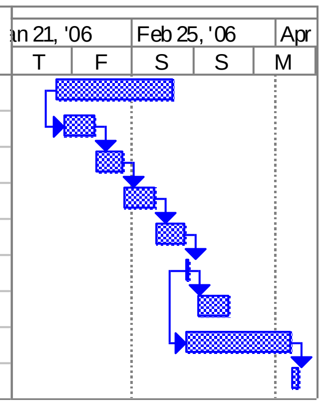
Table (1) The Excel presentation quantity takes off of program

Item	qty	unit	Cost	UNIT	DURATION	UNIT
DIM100	1029.00	meter	10290	ID	21	DAY
DIM150	283.00	meter	2830	ID	6	DAY
DIM200	255.00	meter	2550	ID	5	DAY
DIM250	301.00	meter	3010	ID	6	DAY
DIM300	267.00	meter	2670	ID	5	DAY
J	2.00	each	20	ID	1	DAY
A	12.00	each	120	ID	6	DAY
T	36.00	each	360	ID	18	DAY
GATE VALVE	3.00	each	30	ID	2	DAY
PUMP	2.00	each	20	ID	1	DAY

2. Ms Project scheduling presentation: as shown in table (2) below

Table (2) The Ms Project scheduling presentation of program

ID		Task Name	Duration	Start
1		DIM100	21 days	Mon 2/6/06
2		DIM150	6 days	Wed 2/8/06
3		DIM200	5 days	Thu 2/16/06
4		DIM250	6 days	Thu 2/23/06
5		DIM300	5 days	Fri 3/3/06
6		J	1 day	Fri 3/10/06
7		A	6 days	Mon 3/13/06
8		T	18 days	Fri 3/10/06
9		GATE VALVE	2 days	Wed 4/5/06



The hand calculations as shown in table (3) below:

Table (3) The quantity takes off by hand calculation

Dim 250 (meter)	Dim 300 (meter)	Dim 200(meter)	Dim 150(meter)	Dim 100(meter)	J-junction
69.79	147.47	24.32	33.98	23.24	**SUM=2 unit**
62.03	96.73	56.03	33.81	39.63	**A-angle**
19.25	10.87	21.3	25.21	89.75	**SUM=12 unit**
38.12	6.05	27.69	29.61	28.48	**T-node**
18.8	2.48	96.86	42.59	42.56	**SUM=36unit**
92.7	2.45	28.65	36.53	30.98	**GATE VALVE**
		254.85	28.2	16.68	**SUM=3unit**
SUM=300.69m	**SUM=266.05m**	**SUM=254.85m**	35.48	42.96	**PUMP**
			17.16	151.55	**SUM=2unit**
				91.26	
			SUM=282.57m	179.03	
				20.53	
				21.22	
				39.57	
				17.84	
				57.02	
				99.58	
				36.53	
				SUM=1028.41 m	

Case study two (Waste Water System Network)

The layout drawing of the waste water system network is shown in figure (4) for the waste water system of the Al-Nahrain University. The output of the program is as follows:

1. Excel presentation quantity takes off: as shown in table (4) below

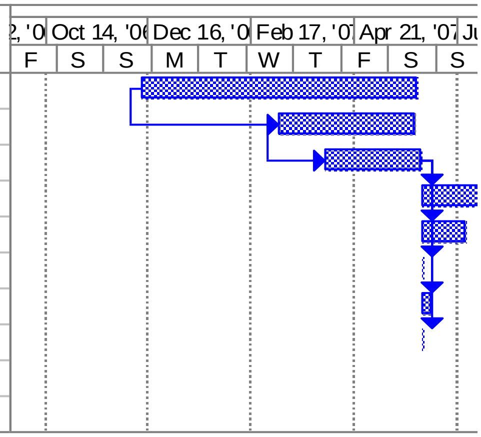
Table (4) The Excel presentation quantity takes off of program

Item	qty	unit	cost	UNIT	DURATION	UNIT
DIM250	1211633.00	meter	12116330	ID	121	DAY
DIM300	602171.00	meter	6021710	ID	60	DAY
DIM400	430863.00	meter	4308630	ID	43	DAY
AS	26.00	each	260	ID	26	DAY
BS	19.00	each	190	ID	19	DAY
CS	1.00	each	10	ID	1	DAY
BD	5.00	each	50	ID	5	DAY
CD	1.00	each	10	ID	1	DAY
PUMP STATION	1.00	each	10	ID	1	DAY
VENT PIPE	1.00	each	10	ID	1	DAY

2. Ms Project scheduling presentation: as shown in table (5) below

Table (5) The Ms Project scheduling presentation of program

ID		Task Name	Duration
1		DIM250	121 days
2		DIM300	60 days
3		DIM400	43 days
4		AS	26 days
5		BS	19 days
6		CS	1 day
7		BD	5 days
8		CD	1 day
9		PUMP STATION	1 day
10		VENT PIPE	1 day



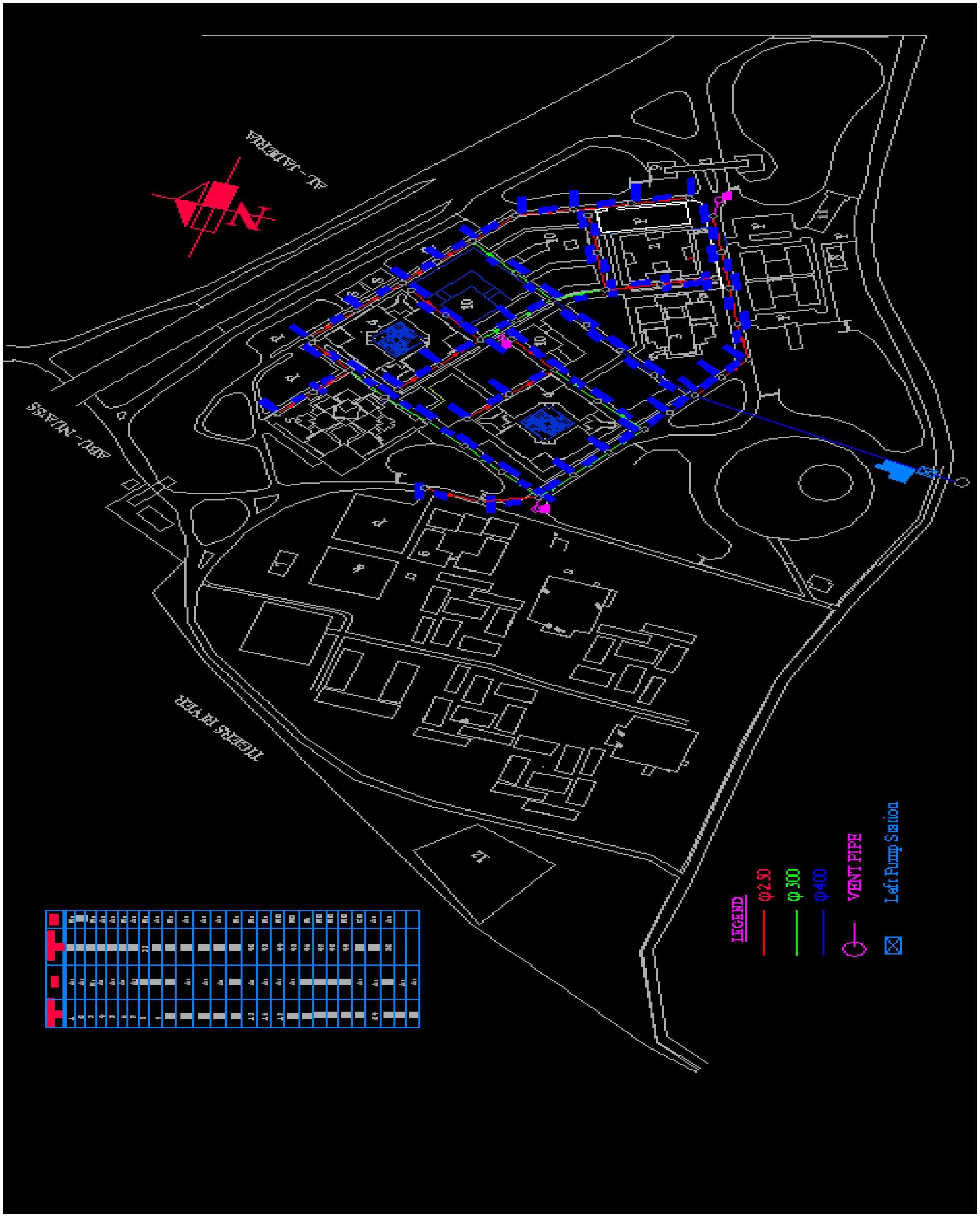


Figure (4) The Al-Nahrain University waste water system network

The hand calculations as shown in table (6) below:

Table (6) The quantity takes off by hand calculation

Dim400(meter)	Dim300(meter)	Dim250(meter)	AS
37299	39809	35043	SUM=26unit
37372	33809	35764	BS
37354	34402	41643	SUM=19unit
25049	40509	45452	CS
24876	49574	47509	SUM=19unit
211278	40803	34262	BD
20165	40879	33849	SUM=5unit
36955	39810	43803	CD
515	39811	43800	SUM=1unit
SUM=430863meter	39750	43806	PUMP STATION
	48158	43807	SUM=1unit
	48107	41183	VENT PIPE
	35747	41334	SUM=1unit
	35508	37370	
	35495	37370	
	SUM=602171meter	42373	
		42374	
		41340	
		41340	
		44863	
		43803	
		40885	
		40885	
		40989	
		40995	
		41379	
		43804	
		48002	
		26303	
		26303	
		SUM=1211633 meter	

Case study three (Irrigation System)

The layout of the irrigation system is shown in figure (5a, b). This layout is a proposal. Three sections for each canal were taken. The output of the program is as follows:

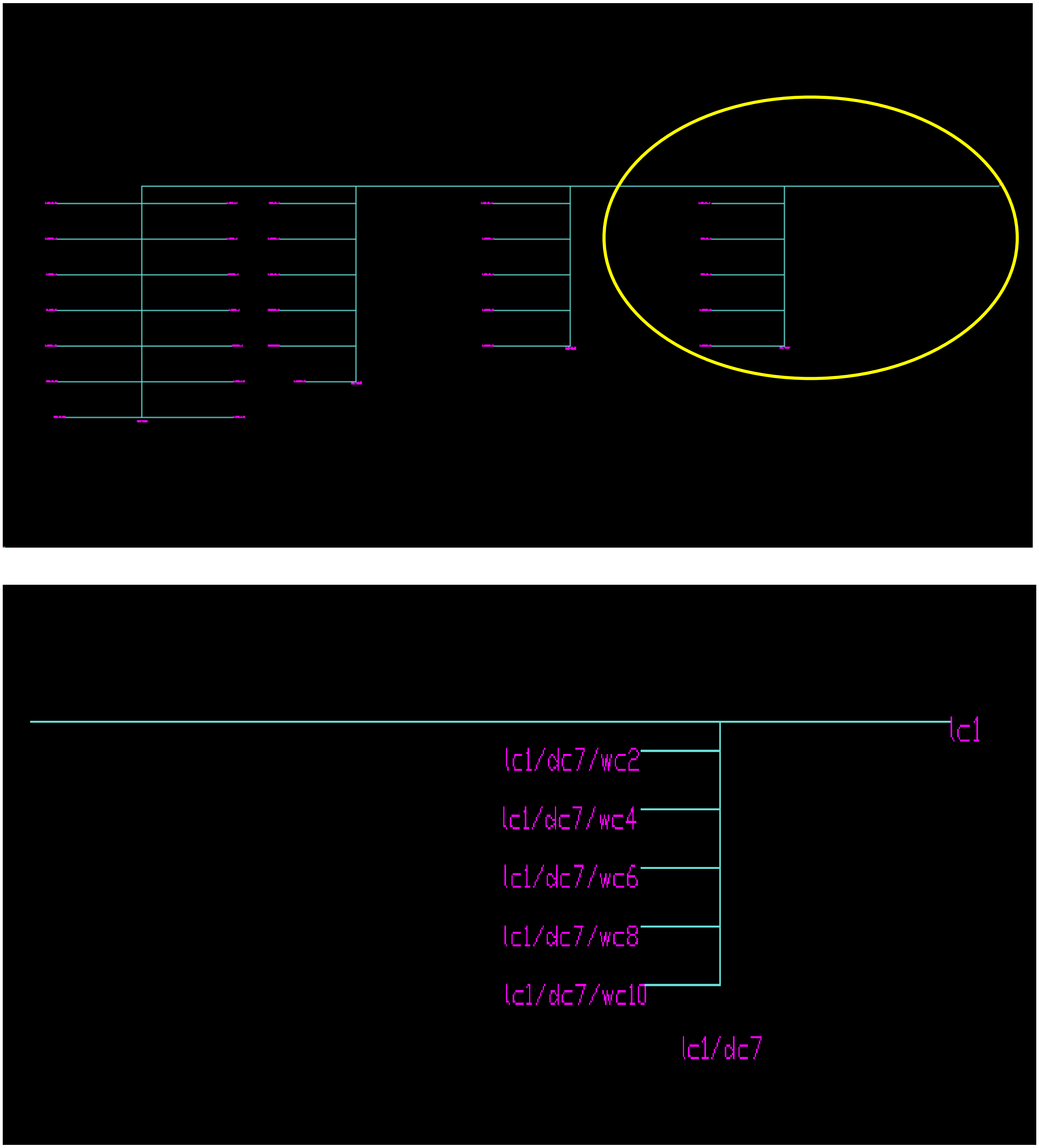


Figure (5a) The proposed irrigation system

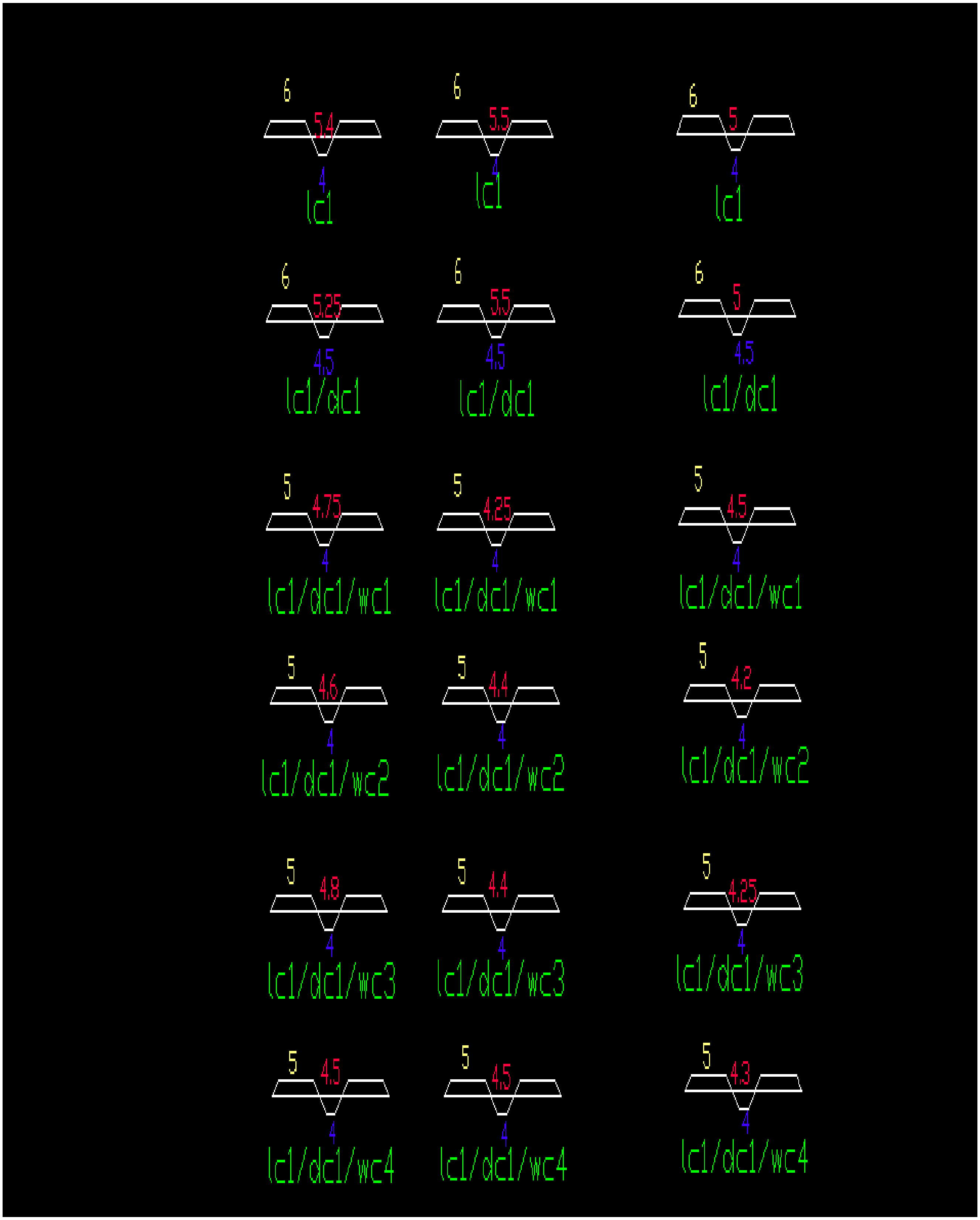

6
5.4
4
lc1
6
5.5
4
lc1
6
5
4
lc1
6
5.25
4.5
lc1/dc1
6
5.5
4.5
lc1/dc1
6
5
4.5
lc1/dc1
5
4.75
4
lc1/dc1/wc1
5
4.25
4
lc1/dc1/wc1
5
4.5
4
lc1/dc1/wc1
5
4.6
4
lc1/dc1/wc2
5
4.4
4
lc1/dc1/wc2
5
4.2
4
lc1/dc1/wc2
5
4.8
4
lc1/dc1/wc3
5
4.4
4
lc1/dc1/wc3
5
4.25
4
lc1/dc1/wc3
5
4.5
4
lc1/dc1/wc4
5
4.5
4
lc1/dc1/wc4
5
4.3
4
lc1/dc1/wc4

Figure (5B) The proposed irrigation system

1. Excel presentation quantity takes off: as shown in table (7a) and (7b) below:

Table (7a) The Excel presentation quantity takes off of program

ID	length	UNIT	AC	AF	UNIT	VC	VF	UNIT
lc1	12000.00	meter	6.43	12.26	sq. meter	643.00	1226.00	meter^3
lc1/dc1	3250.00	meter	3.03	13.06	sq. meter	303.13	1306.25	meter^3
lc1/dc1/wc1	1180.00	meter	1.34	10.44	sq. meter	134.38	1043.75	meter^3
lc1/dc1/wc2	1195.00	meter	1.16	11.12	sq. meter	116.00	1112.00	meter^3
lc1/dc1/wc3	1190.00	meter	1.44	9.92	sq. meter	143.63	992.25	meter^3
lc1/dc1/wc4	1195.00	meter	1.32	10.04	sq. meter	132.00	1004.00	meter^3
lc1/dc1/wc5	1200.00	meter	1.20	10.84	sq. meter	119.63	1084.25	meter^3
lc1/dc1/wc6	1195.00	meter	1.20	10.84	sq. meter	119.63	1084.25	meter^3
lc1/dc1/wc7	1220.00	meter	1.72	8.39	sq. meter	172.13	839.25	meter^3
lc1/dc1/wc8	1195.00	meter	1.13	11.06	sq. meter	112.75	1105.50	meter^3
lc1/dc1/wc9	1260.00	meter	2.33	5.40	sq. meter	232.63	540.25	meter^3
lc1/dc1/wc10	1195.00	meter	1.96	7.12	sq. meter	196.00	712.00	meter^3
lc1/dc1/wc11	1275.00	meter	1.94	7.09	sq. meter	194.25	708.50	meter^3
lc1/dc1/wc12	1195.00	meter	2.09	6.34	sq. meter	209.38	633.75	meter^3
lc1/dc1/wc13	1275.00	meter	1.03	11.90	sq. meter	102.63	1190.25	meter^3
lc1/dc1/wc14	1075.00	meter	2.32	5.73	sq. meter	231.50	573.00	meter^3
lc1/dc3	2750.00	meter	2.59	14.99	sq. meter	259.25	1498.50	meter^3
lc1/dc3/wc2	1070.00	meter	1.62	8.55	sq. meter	162.25	854.50	meter^3
lc1/dc3/wc4	1070.00	meter	1.27	10.98	sq. meter	126.63	1098.25	meter^3
lc1/dc3/wc6	1070.00	meter	1.34	10.42	sq. meter	133.63	1042.25	meter^3
lc1/dc3/wc8	1070.00	meter	1.14	11.44	sq. meter	114.38	1143.75	meter^3
lc1/dc3/wc10	1070.00	meter	1.00	12.20	sq. meter	100.00	1220.00	meter^3
lc1/dc3/wc12	700.00	meter	1.42	9.53	sq. meter	141.50	953.00	meter^3
lc1/dc5	2250.00	meter	2.67	14.34	sq. meter	267.00	1434.00	meter^3
lc1/dc5/wc2	1070.00	meter	1.34	10.77	sq. meter	133.50	1077.00	meter^3
lc1/dc5/wc4	1070.00	meter	1.72	7.96	sq. meter	171.56	796.11	meter^3
lc1/dc5/wc6	1070.00	meter	1.19	10.76	sq. meter	119.18	1076.36	meter^3
lc1/dc5/wc8	1070.00	meter	2.67	4.34	sq. meter	266.75	433.50	meter^3
lc1/dc5/wc10	1070.00	meter	0.81	13.22	sq. meter	80.75	1321.50	meter^3
lc1/dc7	2250.00	meter	1.38	22.15	sq. meter	137.50	2215.00	meter^3
lc1/dc7/wc2	1020.00	meter	2.15	6.11	sq. meter	215.25	610.50	meter^3
lc1/dc7/wc4	1020.00	meter	0.96	12.46	sq. meter	95.63	1246.25	meter^3
lc1/dc7/wc6	1020.00	meter	0.99	12.18	sq. meter	99.00	1218.00	meter^3
lc1/dc7/wc8	1020.00	meter	2.01	6.87	sq. meter	200.88	686.75	meter^3
lc1/dc7/wc10	1020.00	meter	1.09	11.34	sq. meter	109.38	1133.75	meter^3

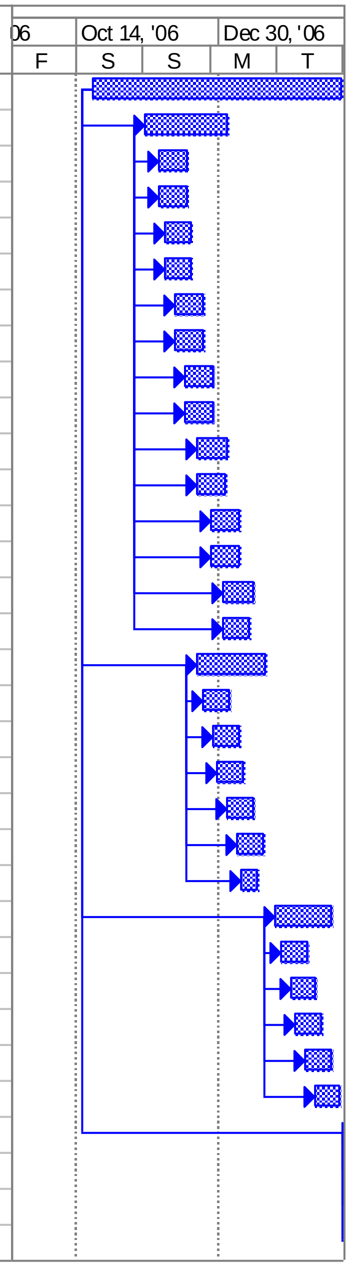
Table (7b) The Excel presentation quantity takes off of program

CUT COST	UNIT	FILL COST	UNIT	duration	UNIT
6430	ID	12260	ID	120	day
3031.25	ID	13062.5	ID	33	day
1343.75	ID	10437.5	ID	12	day
1160	ID	11120	ID	12	day
1436.25	ID	9922.5	ID	12	day
1320	ID	10040	ID	12	day
1196.25	ID	10842.5	ID	12	day
1196.25	ID	10842.5	ID	12	day
1721.25	ID	8392.5	ID	12	day
1127.5	ID	11055	ID	12	day
2326.25	ID	5402.5	ID	13	day
1960	ID	7120	ID	12	day
1942.5	ID	7085	ID	13	day
2093.75	ID	6337.5	ID	12	day
1026.25	ID	11902.5	ID	13	day
2315	ID	5730	ID	11	day
2592.5	ID	14985	ID	28	day
1622.5	ID	8545	ID	11	day
1266.25	ID	10982.5	ID	11	day
1336.25	ID	10422.5	ID	11	day
1143.75	ID	11437.5	ID	11	day
1000	ID	12200	ID	11	day
1415	ID	9530	ID	7	day
2670	ID	14340	ID	23	day
1335	ID	10770	ID	11	day
1715.55	ID	7961.1	ID	11	day
1191.8	ID	10763.6	ID	11	day
2667.5	ID	4335	ID	11	day
807.5	ID	13215	ID	11	day
1375	ID	22150	ID	23	day
2152.5	ID	6105	ID	10	day
956.25	ID	12462.5	ID	10	day
990	ID	12180	ID	10	day
2008.75	ID	6867.5	ID	10	day
1093.75	ID	11337.5	ID	10	day

2. Ms Project scheduling presentation: as shown in table (8) below

Table (8) The Ms Project scheduling presentation of program

ID		Task Name	Duration	Start
1		Ic1	120 days	Mon 10/23/06
2		Ic1/dc1	33 days	Mon 11/20/06
3		Ic1/dc1/wc1	12 days	Mon 11/27/06
4		Ic1/dc1/wc2	12 days	Mon 11/27/06
5		Ic1/dc1/wc3	12 days	Thu 11/30/06
6		Ic1/dc1/wc4	12 days	Thu 11/30/06
7		Ic1/dc1/wc5	12 days	Wed 12/6/06
8		Ic1/dc1/wc6	12 days	Wed 12/6/06
9		Ic1/dc1/wc7	12 days	Mon 12/11/06
10		Ic1/dc1/wc8	12 days	Mon 12/11/06
11		Ic1/dc1/wc9	13 days	Mon 12/18/06
12		Ic1/dc1/wc10	12 days	Mon 12/18/06
13		Ic1/dc1/wc11	13 days	Mon 12/25/06
14		Ic1/dc1/wc12	12 days	Mon 12/25/06
15		Ic1/dc1/wc13	13 days	Mon 1/1/07
16		Ic1/dc1/wc14	11 days	Mon 1/1/07
17		Ic1/dc3	28 days	Mon 12/18/06
18		Ic1/dc3/wc2	11 days	Thu 12/21/06
19		Ic1/dc3/wc4	11 days	Tue 12/26/06
20		Ic1/dc3/wc6	11 days	Fri 12/29/06
21		Ic1/dc3/wc8	11 days	Wed 1/3/07
22		Ic1/dc3/wc10	11 days	Mon 1/8/07
23		Ic1/dc3/wc12	7 days	Thu 1/11/07
24		Ic1/dc5	23 days	Mon 1/29/07
25		Ic1/dc5/wc2	11 days	Thu 2/1/07
26		Ic1/dc5/wc4	11 days	Tue 2/6/07
27		Ic1/dc5/wc6	11 days	Fri 2/9/07
28		Ic1/dc5/wc8	11 days	Wed 2/14/07
29		Ic1/dc5/wc10	11 days	Mon 2/19/07
30		Ic1/dc7	23 days	Mon 3/12/07
31		Ic1/dc7/wc2	10 days	Fri 3/16/07
32		Ic1/dc7/wc4	10 days	Thu 3/22/07
33		Ic1/dc7/wc6	10 days	Wed 3/28/07



The hand calculations as shown in table (9) below:

Table (4-12) The quantity takes off by hand calculation

ID	length	UNIT	AC	AF	UNIT	VC	VF	UNIT
lc1	12000.00	meter	6.43	12.26	sq. meter	321.50	613.00	meter^3
lc1/dc1	3250.00	meter	3.03	13.06	sq. meter	151.56	653.13	meter^3
lc1/dc1/wc1	1180.00	meter	1.34	10.44	sq. meter	67.19	521.88	meter^3

CUT COST	UNIT	FILL COST	UNIT	duration	UNIT
3215	ID	6130	ID	240	day
1515.625	ID	6531.25	ID	65	day
671.875	ID	5218.75	ID	23	day

As shown from the two out put of the program and hand calculation there is no any difference between the two estimates of quantities. But the estimate of the program can achieve in easy way and in short time.

CONCLUSIONS

1. This research described in details the development and application of a Computer Integrated System (CIS) aiming at illuminating the idea of data sharing in construction management phases of a project.
2. (CIS) which was developed with Visual Basic and Active X Automation technique, can automatically interpret AutoCAD drawing of a (water system, waste water system, and irrigation system), extract the data needed for construction management and generate a bill of quantities and schedule.
3. The presented examples shows that the bill of quantities and the schedule generated by (CIS) for the sample projects are practical and applicable and the integrated system do the work efficiently.
4. The process of the developed system is so easy and can be achieved by just a mouse clicking and entering the required information's for cost and duration estimation.
5. The ability to develop a Computer Integrated System (CIS) should entice more contractors to use these systems. The AutoCAD software available today, with its ability to link to external programs has made such development possible. The utilization of (CIS) systems will become more and more important as the popularity of the design/build project delivery system continues to increase. In the design/build approach, more business functions are performed by the same company and as a result, their integration to share data becomes more vital.
6. (CIS) has automatically changed the drawing items to digital numbers and the user can deal with these digital numbers in an easy way more than the drawing items.
7. If there is any change in the design of drawings the project manger can easily re-run the program to get the correct quantities again and to check it before and after change with respect to cost and duration.

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