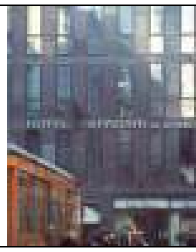
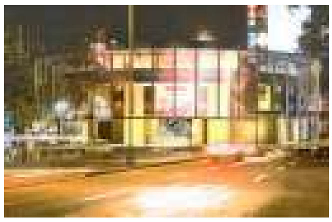
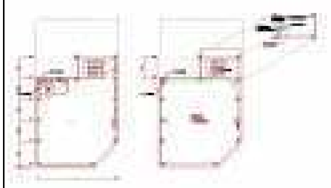
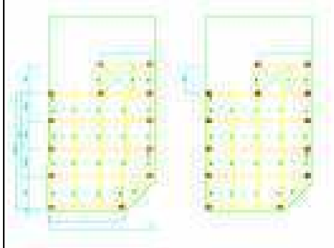
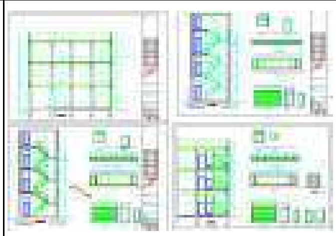
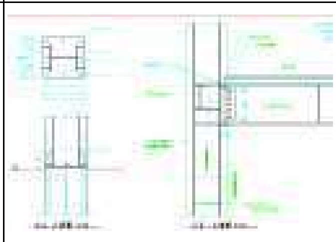
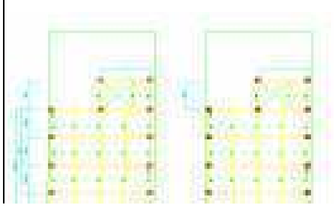
附錄二

屏東市商業辦公大樓新建工程—設計營造溝通資訊

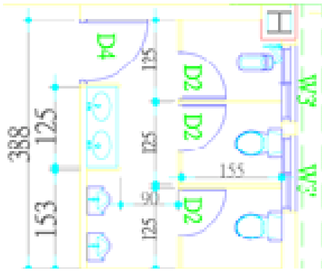
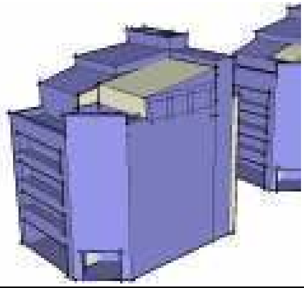
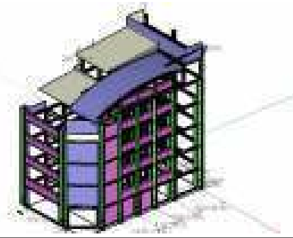
合作團隊

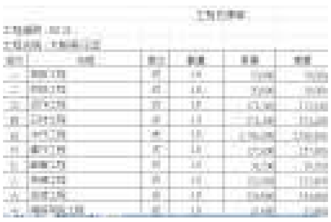
A:建築師(規劃設計單位)
B:土木技師(監造單位)
C:營造廠商(營造單位)
D:業主

A:建築師─工程專案早期(圖片檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
450	2000/8/31	E:\C2-屏東大眾證券\屏東大眾 5 樓平面參考案例 0317	**5 燈桌 2000-03 傢飾.jpg**	室內觀景及家俱擺飾呈現圖。		D
467	2001/7/31	E:\..\屏東大眾 5 樓平面參考案例 0317	**wall paper may 2001 p.13.jpg**	外窗透光示意圖，及特殊建材的典範示意圖。		D
334	2001/8/28	E:\..\屏東大眾參考立面資料\立面_建築外觀量體	**KPF.p.80.jpg**	建物量體俯視圖，此為模型參考圖。		D
164	2001/9/27	E:\..\屏東大眾參考立面資料	**Hermes53.jpg**	建物外為景觀圖，及大樓建材呈現圖。		B,C, D
314	2002/6/7	E:\..\屏東大眾參考立面資料\立面_建築外觀量體	**HIP HOTELS-ITALY P.134.jpg**	建物戶外景觀，及建材參考圖。		D
213	2002/8/23	E:\..\屏東大眾參考立面資料\立面_建築外觀量體	**0822-3.jpg**	建物外觀量體參考圖，及玻璃建材的參考可能。		D

A:建築師(規劃設計單位)—工程專案早期(CAD 檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
155	2004/11/29	E:\C2-屏東大眾證劵\屏東大眾原始的 CAD 檔	TD71-A.dwg	各樓層平面圖		B,C
156	2004/11/29	E:\C2-屏東大眾證劵\屏東大眾原始的 CAD 檔	WD71-A.dwg	結構設計工程		B,C
146	2004/12/4	E:\C2-屏東大眾證劵\屏東大眾相關估價資料	CR3-1.dwg	各樓層結構圖。		B,C
150	2004/12/4	E:\..\屏東大眾相關估價資料	CR3_T1.dwg	開口細部圖，剖面圖，A 橫向剖面圖，C 視綜向剖面圖，樓梯結構剖面圖。		B, C
149	2004/12/4	E:\..\屏東大眾相關估價資料	CR3_S1.dwg	梁柱結構細部圖。		B, C
146	2004/12/4	E:\C2-屏東大眾證劵\屏東大眾相關估價資料	CR3-1.dwg	各樓層結構圖。		B,C

A:建築師(規劃設計單位)─工程專案中期(圖片檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
173	2005/3/10	E:\C2-屏東大眾證券\屏東大眾參考立面資料	jeiai-2.gif	外圍環境參考資料,及建材參考。		B, C, D
161	2005/3/18	E:\C2-屏東大眾證券\屏東大眾參考立面資料	DSC05707.JPG	建物戶外景觀,及建材參考圖。		B, C
699	2005/4/11	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_04_09 屏東灌漿	DSC06340.JPG	速固網及水泥的選用		B, C
693	2005/5/2	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_04_09 屏東灌漿	DSC06334.jpg	牆面磁磚的選用 1		C
693	2005/5/2	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_04_09 屏東灌漿	DSC06334.jpg	外牆磁磚的選用 2		C
808	2005/5/20	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_05_08 屏東新建	DSC07088.JPG	水泥表面粉刷的選用		B, C

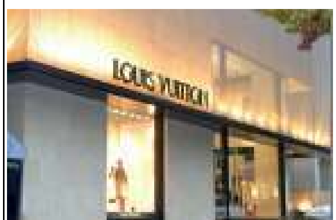
A:建築師(規劃設計單位)─工程專案中期(CAD 檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
55	2005/3/12	E:\C2-屏東大眾證券	廁所圖 2.dwg	廁所配置模擬圖。		D
75	2005/3/22	E:\C2-屏東大眾證券	給邱教授的圖-940320.dwg	給工程師的 CAD 模擬圖。		B,C, D
106	2005/4/26	E:\C2-屏東大眾證券\屏東大眾 3D\大眾 Setchup	屏東 005-4-25.skp	大眾證卷的立面透視模擬圖。		B,C,D
111	2005/5/5	E:\C2-屏東大眾證券\屏東大眾 3D\大眾 3D	structure2.skp	屋頂建設模擬圖，其圖是內部鋼金架構模擬圖。		B,C, D
98	2005/5/8	E:\C2-屏東大眾證券	structure_0507.skb	建物整體鋼金建設模擬圖，含屋頂建構模擬圖。		B,C, D
88	2005/6/14	E:\C2-屏東大眾證券	structure_0612.skp	建物前方架構模擬圖，含鋼金及建物外面牆壁示意圖。		D

A:建築師(規劃設計單位)─工程專案中期(文字檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
49	2005/3/11	E:\C2-屏東大眾證券	屏東.rtf	設計會議 設計變更 排煙開口 消防法規檢討		
53	2005/3/31	E:\C2-屏東大眾證券	工程問題 2005-3.doc	工程會議 設計變更		B
118	2005/4/4	E:\C2-屏東大眾證券\屏東大眾3D\屏東大眾相關估價資料	20020306 第一次報價.xls	單價分析表		B,C, D
133	2005/4/4	E:\C2-屏東大眾證券\屏東大眾相關估價資料	20020306 第一次報價.xls	營造報價單 單價分析表		B,C, D
45	2005/6/13	E:\C2-屏東大眾證券	大眾證~1.DOC	空間需求 設計需求	 空間需求：	D

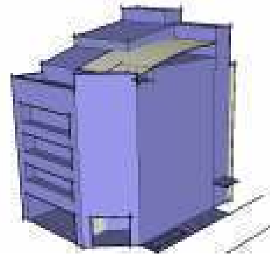
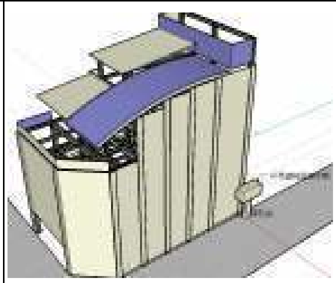
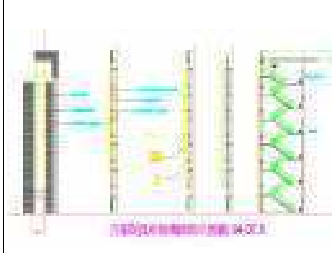
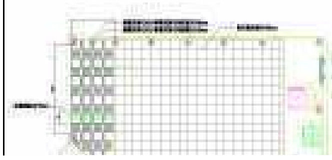
A:建築師(規劃設計單位)─工程專案晚期(圖片檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
1225	2005/9/20	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01280.JPG	速固牆內骨架局部完工圖、局部貼磁磚，及 H 型鋼橫梁建構完成。		C
1280	2005/9/20	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01297.JPG	速固牆局部建構，樓梯骨架建構完成。		C
1325	2005/9/20	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01306.JPG	管線配置，及水泥灌模，牆面有速固牆與內骨架建構。		C
1242	2005/9/20	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01369.JPG	建構重整，及鋼面切割修正圖。		C
1253	2005/9/30	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01376.JPG	H 型鋼鷹架建構，及外有防汙網設置。		C
1277	2005/9/20	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01393.JPG	樓地板錨釘建構，及地板基台配製完工。		C

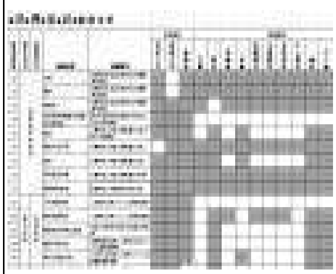
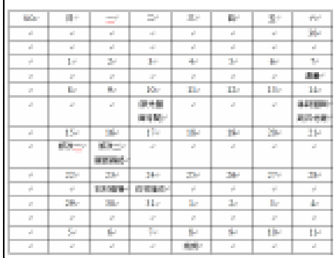
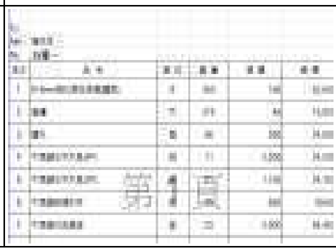
A:建築師(規劃設計單位)─工程專案晚期(圖片檔)

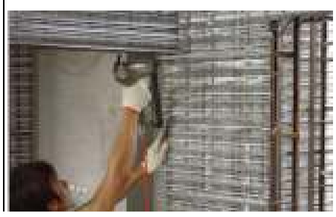
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
1279	2005/9/30	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01395.JPG	建物立面工程，及外有房汙網設置，地點位於東側立面。		C
1296	2005/9/30	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01408.JPG	騎樓位置，石材牆面已完成，一樓磁磚未完成。工程進度		C
1301	2005/9/20	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01412.JPG	石材牆面貼壁完成，及鋁門窗已裝框。完成塞水路。工程進度。		C
1306	2005/9/20	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01416.JPG	最後電箱設置位置，此圖爲東側立面前端方向。		C
1326	2005/9/20	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01429_exposure.JPG	建物外觀進度工程，鷹架已拆除，外有防汙網設置。		C
1330	2005/9/30	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01434.JPG	電表、開關出口，工程進度。		C

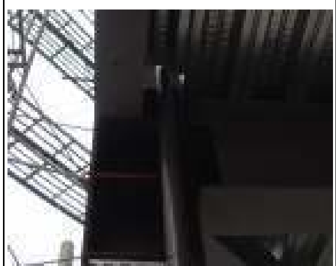
B:土木技師(監造單位) ─工程專案早期(圖片檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
187	2001/2/4	E:\C2-屏東大眾證券\屏東大眾參考立面資料	森林三.jpg	立面設計參考資料， 自然景觀， 森林步道		A,C
192	2001/4/18	E:\..\屏東大眾參考立面資料	遺石.jpg	立面設計參考資料， 人造石景， 優靜步道。		A,C
186	2001/8/23	E:\ ..\屏東大眾參考立面資料	日本最新景觀設計 3 p.214.jpg	立面設計參考資料， 人造石景。		A,C
184	2001/10/4	E:\ ..\屏東大眾參考立面資料	建築立面 16.jpg	石材立面設計案例， 一樓開口設計。		A,C
209	2001/10/4	E:\ ..\屏東大眾參考立面資料\類型_天橋_空橋	建築立面 07.jpg	立面設計案例，鋼骨設計。		A,C
194	2002/3/26	E:\ ..\屏東大眾參考立面資料	養惠_00002.jpg	立面設計案例，石材立面設計。		A,C

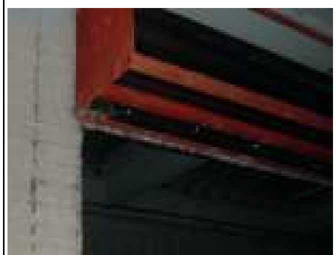
B:土木技師(監造單位) ─工程專案中期(圖片檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
504	2005/3/22	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_03_20 屏東新建	DSC05778.JPG	主結構，鋼骨結構，鋼骨吊裝		A, C
701	2005/4/11	E:\..\屏東大眾工程進度照片\2005_04_09 屏東灌漿	DSC06342.JPG	速固牆灌漿，水泥灌漿		C
712	2005/4/28	E:\..\屏東大眾工程進度照片\2005_04_23 屏東新建	DSC06429.JPG	速固牆灌漿，水泥灌漿		C
773	2005/5/8	E:\ ..\屏東大眾工程進度照片\2005_05_08 屏東新建	DSC00010.JPG	速固牆灌漿，水泥灌漿		A, C
829	2005/5/14	E:\ ..\屏東大眾工程進度照片\2005_05_08 屏東新建	DSC07109.JPG	丁掛磚牆面，外牆工程，瓷磚勾縫		A, C
840	2005/5/14	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_05_08 屏東新建	DSC07120.JPG	室內工程，牆面粉刷，水泥工		C

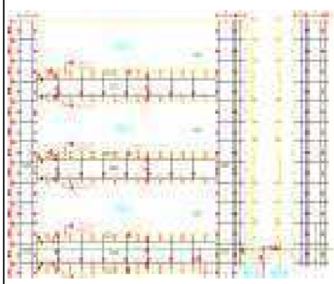
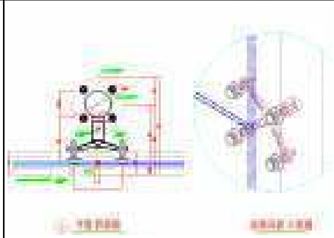
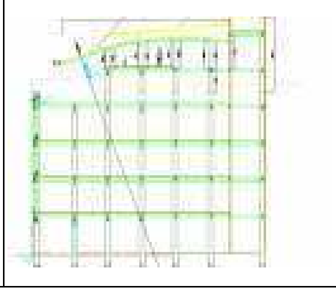
B:土木技師(監造單位) ─工程專案中期(CAD 檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
473	2005/3/23	E:\C2-屏東大眾證券\屏東大眾水電圖	1-e3.dwg	水電圖，水電工程，水電升位圖		A, C
112	2005/4/26	E:\..\屏東大眾 3D\大眾 3D	屏東 2005-4-25.skb	3D 模擬圖，量體設計，外觀模擬		A, C, D
476	2005/5/24	E:\ ..\屏東大眾外牆騎樓牆面	屏東市廣東路 1F 騎樓牆面修正 94.05.21-2.dwg	石材工程，變更設計，石材分割圖，石材施作說明		A, C
79	2005/5/24	E:\C2-屏東大眾證券	0521_立面檢討.skp	屋頂變更設計， 變更設計，曲面屋頂，屋頂 3D 模擬		A, C, D
77	2005/7/5	E:\C2-屏東大眾證券	鋁料玻璃梯間_940706.dwg	外牆工程，設計變更建議，設計變更，樓梯間外牆玻璃設計，曲面玻璃設計		C
4	2005/8/9	E:\C2-屏東大眾證券	2005_08_09 一樓舖面.dwg	一樓地板石材分割圖，石材工程，地板工程		C

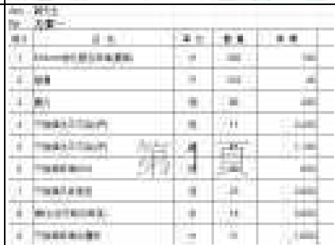
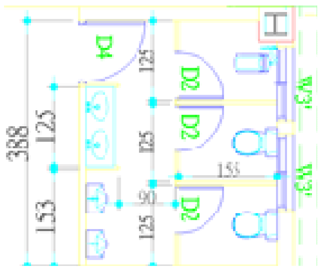
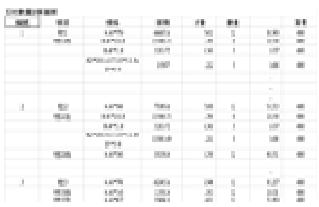
B:土木技師(監造單位)－工程專案中期(文字檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
130	2005/5/17	E:\C2-屏東大眾證券\屏東大眾 3D\屏東大眾相關估價資料	驗收清單.xls	工程驗收，驗收項目，驗收清單，檢驗規範		CC
145	2005/5/17	E:\C2-屏東大眾證券\屏東大眾相關估價資料	驗收清單.xls	工程驗收，驗收項目，驗收清單，檢驗規範		C
63	2005/5/31	E:\C2-屏東大眾證券	石材簽約時間.doc	石材工程，石材確認，簽約，石材開始施作		C
119	2005/6/11	E:\C2-屏東大眾證券\屏東大眾 3D\屏東大眾相關估價資料	940609 證券分公司二次機電工程.xls	機電工程報價，施作項目，機電追加工程		C
126	2005/7/4	E:\C2-屏東大眾證券\屏東大眾 3D\屏東大眾相關估價資料	賴先生.xls	外牆曲面玻璃報價，玻璃工程，外牆工程，樓梯兼外牆工程，報價		C
141	2005/7/4	E:\C2-屏東大眾證券\屏東大眾相關估價資料	賴先生.xls	外牆工程，樓梯兼外牆工程，報價		C

B:土木技師(監造單位) ─工程專案晚期(圖片檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
1260	2005/9/20	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01381.JPG	屋頂防水工程，屋頂灌漿，泥作工程，屋頂追加工程		C
1273	2005/9/20	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01390.JPG	泥作工程，屋頂追加工程		C
1265	2005/9/30	E:\ ..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01385.JPG	速固牆工程，釘速固牆綱絲網，樓版施工		C
1249	2005/9/30	E:\ ..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01374.JPG	速固牆工程，釘速固牆綱絲網。		C
1247	2005/9/30	E:\ ..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01372.JPG	速固牆工程，釘速固牆綱絲網，鐵工。		C
1248	2005/9/30	E:\ ..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01373.JPG	速固牆工程，釘速固牆綱絲網，鐵工。		C

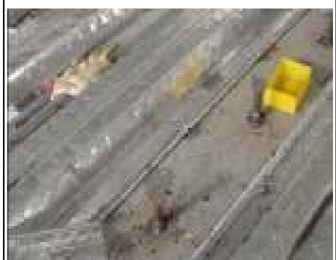
C:營造廠商 (營造單位)─工程專案中期(圖片檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
492	2005/3/20	E:\C2-屏東大眾證劵\屏東大眾工程進度照片\2005_03_20 屏東新建	DSC05766.JPG	鷹架工程，鋼結構工程，主結構吊裝		B
486	2005/3/22	E:\C2-屏東大眾證劵\屏東大眾工程進度照片\2005_03_20 屏東新建	DSC05830.JPG	主結構吊裝		B
490	2005/3/22	E:\C2-屏東大眾證劵\屏東大眾工程進度照片\2005_03_20 屏東新建	DSC05832.JPG	鋼結構工程，柱墩基礎螺絲，雨水排水管，PVC 管，埋設管材		
488	2005/3/22	E:\C2-屏東大眾證劵\屏東大眾工程進度照片\2005_03_20 屏東新建	DSC05833.JPG	雨水排水管，PVC 管，埋設管材		
498	2005/3/22	E:\C2-屏東大眾證劵\屏東大眾工程進度照片\2005_03_20 屏東新建	DSC05772.JPG	鷹架工程，鋼結構工程，主結構吊裝		B
501	2005/3/22	E:\C2-屏東大眾證劵\屏東大眾工程進度照片\2005_03_20 屏東新建	DSC05775.JPG	鷹架工程，鋼結構工程，主結構吊裝		B

C:營造廠商(營造單位)─工程專案中期(圖片檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
595	2005/4/5	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_03_20 屏東新建	DSC06277.JPG	速固牆、開口工程、釘網絲網		B
589	2005/4/6	E:\..\屏東大眾工程進度照片\2005_03_20 屏東新建	DSC06275.JPG	速固牆、釘網絲網、牆體鋼筋、溫度鋼筋		B
636	2005/4/6	E:\ ..\屏東大眾工程進度照片\2005_03_20 屏東新建	DSC06312.JPG	牆體鋼筋、溫度鋼筋、開口工程、電信箱體預埋		B
754	2005/5/8	E:\..\屏東大眾工程進度照片\2005_05_08 屏東施工照片	DSC00021.JPG	大門工程、鐵捲門安裝、灌漿養護		B
1028	2005/6/4	E:\ ..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC09070.JPG	石材進場、石材切割、石材吊裝、乾式施工法		B
1116	2005/6/10	E:\ ..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC09204.JPG	柱頭補漿、灌漿工程、		B

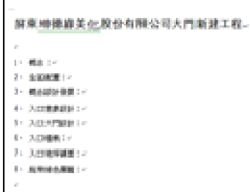
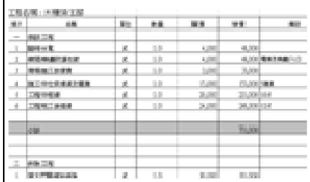
C: 營造廠商(營造單位)─工程專案中期(CAD 檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
3	2005/5/17	E:\C2-屏東大眾證券	09021.dwg	鋼筋配筋設計圖、結構圖、配筋細部圖		A, B
412	2005/5/30	E:\..\屏東大眾結構玻璃_報價單\肯望科技股份	TWN-127-H01.DWG	結構玻璃抓勾、零組件細部圖、防震墊片、不鏽鋼爪具、強化膠合玻璃		A, B
69	2005/6/1	E:\C2-屏東大眾證券	給勝_5_31.dwg	立面設計圖、頂層變更設計、追加工程設計		A, B
64	2005/6/9	E:\C2-屏東大眾證券	結構技師修正後.dwg	結構設計圖、結構頗面圖、追加工程、頂層變更設計		A, B

C: 營造廠商(營造單位)─工程專案中期(文字檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
410	2005/5/26	E:\C2-屏東大眾證券\屏東大眾結構玻璃_報價單	田鋁股份有限公司_設計分析結構.doc	結構玻璃工程範例、不鏽鋼爪具、結構玻璃、造型雨批工程、強化膠合玻璃		A, B
416	2005/6/2	E:\C2-屏東大眾證券\屏東大眾結構玻璃_報價單\肯望科技股份	賴先生.xls	結構玻璃估價單、單價分析、材料試算		A, B
144	2005/6/12	E:\C2-屏東大眾證券\屏東大眾相關估價資料	重量.xls	H型鋼計算書、重量計算、估價、估價檢核		A, B
140	2005/8/27	E:\C2-屏東大眾證券\屏東大眾相關估價資料	石材_6.xls	石材面積計算、估價、估價檢核		A, B
123	2005/8/31	E:\C2-屏東大眾證券\屏東大眾 3D\屏東大眾相關估價資料	石材_0828.xls	石材面積計算、石材分割設計、估價、估價檢核		A, B
139	2005/8/31	E:\C2-屏東大眾證券\屏東大眾相關估價資料	石材_0830.xls	石材面積計算、石材分割設計、估價、估價複核		A, B

C: 營造廠商(營造單位)─工程專案晚期(圖片檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
1275	2005/9/20	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01296.JPG	速固牆工程、C形槽鐵架設、速固牆骨架工程		
1305	2005/9/20	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01302.JPG	水電配管工程、消防管線、出線盒預埋、電信管路工程		
1226	2005/9/20	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01358.JPG	水電配管工程、出線盒預埋		
1232	2005/9/20	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01362.JPG	鋁門窗工程、塞水路		
1246	2005/9/20	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01371.JPG	水電配管工程、消防管線、出線盒預埋、電信管路工程		
1246	2005/9/20	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01371.JPG	頂層灌漿作業、防水工程、速固牆敲除、開口工程、施工錯誤		

C: 營造廠商(營造單位)─工程專案晚期(圖片檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
1309	2005/9/30	E:\C2-屏東大眾證券\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01419.JPG	立面石材工程、勾縫作業、外牆工程、乾式施工法		A,B
1265	2005/9/30	E:\..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01385.JPG	頂層灌漿作業、防水工程、速固牆工程、配筋、水電管線預埋作業		B
1262	2005/9/30	E:\ ..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01382.JPG	頂層灌漿作業、防水工程、速固牆工程、配筋、		B
1222	2005/9/30	E:\ ..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01355.JPG	樓地板工程、		B
1219	2005/9/30	E:\ ..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01353.JPG	樓地板工程、速固牆工程		B
1219	2005/9/30	E:\ ..\屏東大眾工程進度照片\2005_06_05 屏東新建進度部份	DSC01353.JPG	速固牆工程		B

C: 營造廠商(營造單位)─工程專案晚期(文字檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
128	2006/2/13	E:\C2-屏東大眾證券\屏東大眾 3D\屏東大眾相關估價資料	邱教授估價.xls	工程估價、工程規劃、單價分析、時程規劃		A,B
143	2006/2/13	E:\C2-屏東大眾證券\屏東大眾相關估價資料	邱教授估價.xls	工程估價、工程規劃、單價分析、時程規劃		A,B

D:業主━工程專案(文字檔)						
編號	日期	完整目錄	檔案名稱	MataData	原始資料	相關單位
51	2005/3/4	E:\C2-屏東大眾證券	屏東坤德綠美化股份有限公司大門新建工程.doc	設計需求、設計概念、功能需求分析		A,B
121	2005/4/5	E:\C2-屏東大眾證券\屏東大眾 3D\屏東大眾相關估價資料	屏東新建.xls	工項分析、估價複核		A,B
136	2005/4/5	E:\C2-屏東大眾證券\屏東大眾相關估價資料	屏東新建.xls	工項分析、估價複核		A,B
59	2005/5/13	E:\C2-屏東大眾證券	星期六談大眾銀 0513.doc	設計需求、設計溝通會議		A,B

附錄三

程式碼 3.1 單機資訊群集之程式實作原始碼

程式碼 3.2 單概念知識擷取之程式實作原始碼

程式碼 3.1 單機資訊群集之程式實作原始碼

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
                    "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
  <title>User Concept Dataset</title>
  <script src="http://code.jquery.com/jquery-latest.js"></script>
  <script src="gears_init.js"></script>
  <script>
/*
 單機資訊群集之程式實作原始碼
 資料來源：利用網頁瀏覽的資訊，擷取重要資訊
 資料儲存：由使用者決定儲存重要資訊至用戶端資訊群集
 資料再利用：使用者可以彈性決定，網路資訊瀏覽，或單機資訊群集資料蒐尋
                    單機資訊群集的資料，可經過相似度運算，獲得高
相關的概念知識，
            作爲「分散式合作設計營造」溝通概念知識
 --------------------------------------------------------------------------------   */
  //javascript function utility
  //Datatime related 2009-5 bjsean
    function twDate(d,m) {
        //d: date() object, m:display mode:"dwt", d:date in 'yy/mm/dd', w:weekday,
t:time in 'hh:mm:ss'
        //                    m: default = 'd'
        var weekday=new Array("日","一","二","三","四","五","六");
        var redate = '';
        if (m==undefined) { var m='d'; }
        if (m.toLowerCase().indexOf("d") > -1){
            redate +=d.getFullYear()+'/'+(d.getMonth()+1)+'/'+d.getDate();
        }
        if (m.toLowerCase().indexOf("w") > -1){
            redate += '('+weekday[d.getDay()]+')';
        }
        if (m.toLowerCase().indexOf("t") > -1){
            redate += ' '+d.toTimeString().substr(0,8);
        }
```

```
            return (redate);
        }
        function twNow() {
            return twDate(new Date(),'t');
        }
        function s2minisec(str){
            //string format date_taken= "2009-07-10T09:03:47-08:00";
            var sd = str.split("T");
            sd[0] = sd[0].replace(/-/g, "/") //g: means global, that is all of '-' will replace
by '/'
            sd[1] = sd[1].substr(0,8);
            var tt = sd[1].split(":");
            var msec = Date.parse(sd[0]);
            msec += tt[0]*60*60*1000+tt[1]*60*1000+tt[2]*1000;
            return msec;
        }
        //jQuery: text input value effect , "TYPE YOUR SEARCH HERE…"
        function populateElement(selector, defvalue) {
            $(selector).each(function() {
                if($.trim(this.value) == "") {
                    this.value = defvalue;
                }
            });

            $(selector).focus(function() {
                if(this.value == defvalue) {
                    this.value = "";
                }
            });

            $(selector).blur(function() {
                if($.trim(this.value) == "") {
                    this.value = defvalue;
                }
            });
        }
    </script>
    <script>
```

```
    //Initial variables declaration.
    var sTag = "Architecture design";
    var nPic = 10;
    var arrSerch = new Array();
    var iSearch = 0;
    var db = google.gears.factory.create('beta.database'); //Create a SQLite database
instance
    var tableName = 'user_concept';
    var fieldDef = ' (Url text, CreaterUserId text, correlatedUserId Text, Metadata text,
Timestamp int)';

    //var arrFld = new
Array("Url","CreaterUserId","correlatedUserId","Metadata","Timestamp");
    var arrFld = new Array("Url","CreaterUserId","Metadata","Timestamp");

    //Database initial proccess: open table in the database.db
    function db_init(tableName, fieldDef){
       //open datebase name = 'database-p101'
       db.open('database-p101');
       //Create table name 'user_concept' for user concept on local pc id='p101'
       //fields: Url, CreaterUserId, correlatedUserId, Metadata, Timestamp
       db.execute('create table if not exists '+ tableName + fieldDef);
    }

    //append new record into table: SQL command: Insert into fldName1, fldName2
value (?,?, array(value))
    function arrayIns(tableName, arr){
       var flds = arr.length;
       if (flds>0) {
            var ff = '?';    //first field
            for (var i=1;i<flds;i++){    //from 2: second field
                 ff += ", ?";
            }
            return db.execute('insert into '+tableName+' values ('+ff+')',arr);
       } else {
            return false;
       }
    }
```

```
    //retrive records from table:SQL command: Select fldName1, fldName2 From
tableName Where whereStr Order By orderStr
    function displayRec(tableName, arrFldName, orderStr, whereStr) {
        //orderStr = 'Timestamp desc';
        var sfld = arrFldName.toString();
        var numfld = arrFldName.length;
        var thStr = '<th>#</th>';
        var header = '';
        var irec = 0;
        for (var i=0;i<numfld; i++){
                thStr += '<th>'+arrFldName[i]+'</th>';
        }
        if ((whereStr==undefined) || (whereStr.length ==0)) {
              header = '<b style="color: blue;">Offline mode:List all records:';
              var rs = db.execute('select '+sfld+' from '+tableName+' order by '+orderStr);
        } else {
              header = '<b style="color: blue;">Offline mode:Search['+whereStr+'] and ';
              var rs = db.execute('select '+sfld+' from '+tableName+' where '+whereStr+'
order by '+orderStr);
        }
        var stable = '<table id="tbDadaset"><tbody>';
        stable += "<tr>"+thStr+"</tr>";
        while (rs.isValidRow()) {
            irec++;
            stable += "<tr><td id='num'>"+irec+"</td>";
            for (var i = 0; i<numfld; i++){
                  stable += "<td id='"+arrFldName[i]+"'>";    //id name = arrFldName[i]
                  if (i == 0) {
                        stable += "<img src='" +rs.field(i)+ "'/></td>";
                  } else if (i == 3){
                        stable += twDate(new Date(rs.field(i)),'dt')+ "</td>";
                  } else {
                        stable += rs.field(i)+"</td>";
                  }
            }
            stable += "</tr>";
            rs.next();
```

```
        }
        stable += "</tbody></table>";
        stable = header+'<b style="color:red;">'+irec+'</b> items
found.<b><br/>'+stable;
        rs.close();
        return stable;
    }

    // Simple call flickr API to search image by tags string, upto 20 items
    function flickrGo(tagName, numPics) {
            var iStr =
"http://api.flickr.com/services/feeds/photos_public.gne?tags="+tagName;
            iStr += "&tagmode=any&format=json&jsoncallback=?";
            $.getJSON(iStr,
              function(data){
              var iPics = 0;
              $.each(data.items, function(i,item){
                 var iRand = Math.random(); //random show pictures
                 if (iRand > 0.3){
                        $("<img/>").attr("src", item.media.m).appendTo("#images");
                        if ( iPics > numPics ) return false;
                        iPics++;
                 }
              });
            });
    }

    //Distributed information retrieved by concept string
    function flickrList(tagName, numPics) {
            var iStr =
"http://api.flickr.com/services/feeds/photos_public.gne?tags="+tagName;
            iStr += "&tagmode=any&format=json&jsoncallback=?";
            //fields: Url, CreaterUserId, correlatedUserId, Metadata, Timestamp
            var sret='<table id="tbList"><tbody>';
            var header = '<b style="color: blue;">Online mode:Search['+tagName+']
and ';
            arrSearch = new Array();
            iSearch = 0;
```

```
        sret +=
"<tr><th>#</th><th>[ ]</th><th>IMG</th><th>author_id</th><th>tags</th><th>dat
e</th></tr>";
        $.getJSON(iStr,
          function(data){
          $.each(data.items, function(i,item){
            if (i>= numPics) { return false; }
            //fill into array for save later
            //fld[2] append new tagName into matadata, fld[3] date_Taken
converted into minisec format
            arrSearch[iSearch] = new Array(item.media.m,
item.author_id,"",(item.tags+','+tagName),s2minisec(item.date_taken));
            iSearch++;
            sret += '<tr>';
            sret += '<td>'+(i+1)+'</td>';
            var chStr = '<input type="checkbox" name="'+item.media.m+'"
value="check'+i+'"/>';
            sret += '<td>'+chStr+'</td>';
            //sret += '<td>'+item.media.m+'</td>';    //full URL of the image
            sret += '<td id="Url"><img src="'+item.media.m+'"/></td>';
            sret += '<td id="CreaterUserId">'+item.author_id+'</td>';
            sret += '<td id="Metadata">'+item.tags+'</td>';
            sret += '<td id="Timestamp">'+item.date_taken+'</td>';
            sret += '</tr>';
          });
          sret += '</tbody></table>';
          if (data.items.length == 0){
            sret = header + "NO data found!<br/>";
          } else {
            sret = header + data.items.length+ "items found.<br/>"+sret;
          }

          $("#images").html(sret);
        });
  }

  // Saving some importent data into local database, as the concept knowledge of
himself.
```

```
function flickrSave(tagName, numPics) {
        var iret=0;
        var sret='<table id="tbList"><tbody>';
        sret +=
"<tr><th>#</th><th>IMG</th><th>author_id</th><th>tags</th><th>date</th></tr>"
;
        $("input:checkbox").each(function(i, item){
            if (item.checked){
                iret++;
                //fo r output
                sret += '<tr>';
                sret += '<td>'+(i+1)+'</td>';
                sret += '<td id="Url"><img src="'+arrSearch[i][0]+'"/></td>';
                sret += '<td id="CreaterUserId">'+arrSearch[i][1]+'</td>';
                //sret += '<td>'+arrSearch[i][2]+'</td>';    //Empty now, as a
correlation value to each other items.
                sret += '<td id="Metadata">'+arrSearch[i][3]+'</td>';
                sret += '<td id="Timestamp">'+twDate(new
Date(arrSearch[i][4]),'dt')+'</td>';
                sret += '</tr>';
                //append this record into table 'user_concept'
                arrayIns(tableName, arrSearch[i]);
            }
        });
        sret += '</tbody></table>';
        sret = '<b style="color: red;">Save '+iret+' items<b><br/>'+sret;
        $("#images").html(sret);
}

//Main function when page has loaded completely
$(document).ready(function(){
    db_init(tableName, fieldDef);
    flickrList(sTag, nPic);
    populateElement('#iTag', 'Enter your search term here..');
    populateElement('#nPics', 'items here..');

    $("#findPic").click(function() {
        sTag = $("#iTag").val();
```

```
            nPic = parseInt($("#nPics").val());
            if (!isNaN(nPic)){
                flickrList(sTag, nPic);
            }
        });

        $("#clear").click(function() {
              $("#images").html("");
        });

        $("#Save2DB").click(function() {

              //sTag = $("#iTag").val();
              nPic = $("input:checkbox").length;
              if (!isNaN(nPic)){
                 flickrSave(sTag, nPic);
              }
        });

        $("#DisplayDB").click(function() {
              var qstr = $("#iTag").val();
              if (qstr.trim().length >0){
                   var wstr = arrFld[2]+' like "%'+qstr+'%"';
                   $("#images").html(displayRec(tableName, arrFld, arrFld[3]+' desc',
wstr));
              } else {
                   $("#images").html(displayRec(tableName, arrFld, arrFld[3]+' desc'));
              }
        });
    });
    </script>

    <style>
    #page-wrap { width: 960px; margin: 25px auto; background-color: white}
    img{ height: 100px; float: left; }
    #findPic { cursor: pointer; }
    </style>
    <style>
```

```
textarea {
        width: 850px;
        height: 480px;
}
.highlight {
      color:red;
      font-weight: bold;
      text-align: center;
}
span.highlight {
      text-align: left;
}
.nnUserCell {
      font-weight: bold;
}
.centerText {
      text-align: center;
      color:gray;
}
#tbDataset {
      margin-left: 0px;
}
#tbdataInput{
      margin-left: 0px;
}
/*    table apperiance */
tr:first-child{
      background-color: #F5F5DC;
}
tr:first-child:hover{
      background-color: #F5F5DC;
}
tr:hover{
  background-color: #E8FFEC;
  cursor:pointer;
}
td{
        border: #ccc 1px solid;
```

```
		text-align: center;
		width: 10px;
	}
	td#Url{
		width: 100px;
	}
	td#CreaterUserId{
		width: 100px;
	}
	td#Metadata{
		width: 250px;
	}
	td#Timestamp{
		width: 50px;
	}
	td:hover{
		background-color: #E8FFEC;
		border: #666 1px solid;
		width: 10px;
		cursor:pointer;
	}
	</style>
</head>
<body>
<div id="page-wrap">
  <div id="form1">
  <table><tr><td><input type="text" id="iTag"></td>
  <td>and</td><td><input type="text" id="nPics"></td>
  <td><button id="findPic">Search</button></td><td><button
id="clear">Clear</button></td>
  <td><button id="Save2DB">Save2DB</button></td><td><button
id="DisplayDB">ShowConcept</button></td>
  </tr></table>
  </div>
  <div id="images">
  </div>
</div>
</body>
```

</html>

程式碼 3.2 單概念知識擷取之程式實作原始碼

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
	<meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />
	<title>Exhaustive Recommender (EX-CR)</title>
	<link rel="stylesheet" href="tabs.css" type="text/css" media="screen,
projection"/>
	<script type="text/javascript" src="../js/jquery-1.3.2.min.js"></script>
	<script type="text/javascript" src="../js/jquery-ui-1.7.custom.min.js"></script>
	<script type="text/javascript" src="correlations.js"></script>
	<script type="text/javascript">
	/*
	 社群概念知識擷取之程式實作原始碼
	 Study field : Data mining  資料採礦
	 資料來源：利用合作團隊溝通過程儲存的資訊
	 資料儲存：由使用者決定儲存重要資訊至用戶端「社群資訊群集」
	 資料再利用：使用者可以彈性決定採用團員概念，或用戶端社群資訊群集
	             資料蒐尋單機社群資訊群集的資料，可經過相似度運算，獲
	             得高相關的概念知識，作為「分散式合作設計營造」溝通概
	             念知識，以創造共識。
	 ---------------------------------------------------------------------------------------------
*/
	function copy_clip(meintext){
	//Textarea copy to clipboard.
	//Not works on Google Chrome 09.07.20
	//This works on FF, IE
	if (window.clipboardData){
		window.clipboardData.setData("Text", meintext);
	}else if (window.netscape){
		netscape.security.PrivilegeManager.enablePrivilege('UniversalXPConnect');
		var clip =
Components.classes['@mozilla.org/widget/clipboard;1'].createInstance(Components.i
nterfaces.nsIClipboard);
		if (!clip) return;
		var trans =
```

```
Components.classes['@mozilla.org/widget/transferable;1'].createInstance(Component
s.interfaces.nsITransferable);
            if (!trans) return;
            trans.addDataFlavor('text/unicode');
            var str = new Object();
            var len = new Object();
            var str =
Components.classes["@mozilla.org/supports-string;1"].createInstance(Components.in
terfaces.nsISupportsString);
            var copytext=meintext;
            str.data=copytext;
            trans.setTransferData("text/unicode",str,copytext.length*2);
            var clipid=Components.interfaces.nsIClipboard;
            if (!clip) return false;
                  clip.setData(trans,null,clipid.kGlobalClipboard);
            }
            return false;
      }

      $(function() {
            //jquery tabs
            var $tabs = $('#tabs').tabs();
            $(".ui-tabs-panel").each(function(i){
               var totalSize = $(".ui-tabs-panel").size() - 1;
               if (i != totalSize) {
                     next = i + 2;
                     $(this).append("<a href='#' class='next-tab mover' rel='" + next +
"'>Next Page &#187;</a>");
               }
               if (i != 0) {
                     prev = i;
                     $(this).append("<a href='#' class='prev-tab mover' rel='" + prev +
"'>&#171; Prev Page</a>");
               }
            });
            $('.next-tab, .prev-tab').click(function() {
                        $tabs.tabs('select', $(this).attr("rel"));
                        document.title = $(this).attr("rel");
```

```
                return false;
            });
            //-------------jquery tabs
        });
        </script>
        <script type="text/javascript">
        $(document).ready(function(){
            var rMatrix = new Array(); // raking matrix, set as concept lattice ,
object(row) x items(col)
            var users = 15;            //set as object of FCA    20
            var items = 16;            //set as attributes of FCA    30
            var aRanking = new Array(items); // raking buffer for each users
            var aCorrle = new Array();        //correlation array of 1 user- m items
buffer
            var aCorMatrix = new Array();     //for display: correlation matrix EX-CR:
n users x n users: square matrix
            var nearNeighbors = 5;            //Wu,a, nearest 5 correlations
            var aCorMOrder = new Array();     //for caculate: correlation matrix
EX-CR: n users x nearNeighbors users: square matrix
            var aCorWeight = new Array(0.3, 0.3, 0.15, 0.15, 0.05, 0.05); //weights for
predict items recommend value
            var isVisiableCorr = true;        //is display correl value on sheet
correlMatrix, if not just display the order of correlation
            var isGraphicViz = true;          //if output the GraphicViz dot file data
-> can copy and past into Gvedit window, than draw dot graphic
            var vizColor = new Array("red","red","blue","blue","gray","gray");
//correlated color: high to low
            var vizColorcode = new
Array("#ff0000","#ff0000","#0000ff","#0000ff","#a3a3a3","#a3a3a3");
            var fRecommenderFilter = 2.9;     // a threshold of ranking value, highter
than this will be recommender
            var isRandomMode = false;
            // (I-a) init: randomlize the data pool : testing propose
            if (isRandomMode){
            for (var i= 0; i<users; i++){    // each row: users
                rMatrix[i] = new Array();
                var noRakingRatio = Math.min(Math.random(), 0.35);
                for (var j=0; j<items; j++){    //each column: items
```

```
                if (Math.random()< noRakingRatio) {
                    aRanking[j] = "x";
                } else {
                    aRanking[j] = makeRanking();
                }
                rMatrix[i][j] = aRanking[j];
            }
        }
        } else {
        //(I-b) init data: stored as javascript array import from database
            //CASE: Test data extram case, this case will dominated by user 2,
4 ,6,8 and 10
            /*
            rMatrix[0]=new Array(4, 4, 4, 4, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0);
            rMatrix[1]=new Array(4, 4, 4, 4, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0);
            rMatrix[2]=new Array(4, 4, 4, 4, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0);

            rMatrix[3]=new Array(0, 0, 0, 0, 4, 4, 4, 4, 0, 0, 0, 0, 0, 0, 0, 0);
            rMatrix[4]=new Array(0, 0, 0, 0, 4, 4, 4, 4, 0, 0, 0, 0, 0, 0, 0, 0);
            rMatrix[5]=new Array(0, 0, 0, 0, 4, 4, 4, 4, 0, 0, 0, 0, 0, 0, 0, 0);

            rMatrix[6]=new Array(0, 0, 0, 0, 0, 0, 0, 0, 4, 4, 4, 0, 0, 0, 0, 0);
            rMatrix[7]=new Array(0, 0, 0, 0, 0, 0, 0, 0, 4, 4, 4, 0, 0, 0, 0, 0);
            rMatrix[8]=new Array(0, 0, 0, 0, 0, 0, 0, 0, 4, 4, 4, 0, 0, 0, 0, 0);

            rMatrix[9]=new Array( 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 4, 4, 0, 0, 0);
            rMatrix[10]=new Array(0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 4, 4, 0, 0, 0);
            rMatrix[11]=new Array(0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 4, 4, 0, 0, 0);

            rMatrix[12]=new Array(0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 4, 4, 4);
            rMatrix[13]=new Array(0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 4, 4, 4);
            rMatrix[14]=new Array(0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 4, 4, 4);
            */
            //CASE 2-3
            rMatri0[0]=new Array(3, 2, 0, 4, 4, 2, 0, 0, 2, 0, 3, 2, 3, 2, 4, 0);
            rMatri0[1]=new Array(4, 4, 0, 2, 0, 3, 2, 3, 2, 4, 0, 4, 2, 0, 0, 0);
            rMatri0[2]=new Array(4, 4, 4, 2, 4, 2, 0, 0, 3, 0, 0, 0, 4, 0, 2, 0);
```

```
        rMatri0[3]=new Array(0, 2, 2, 3, 2, 2, 4, 4, 2, 2, 0, 0, 2, 0, 2, 0);
        rMatrix[4]=new Array(2, 0, 2, 2, 4, 4, 3, 4, 0, 0, 2, 3, 2, 3, 2, 0);
        rMatrix[5]=new Array(0, 0, 2, 0, 4, 4, 4, 3, 0, 2, 0, 0, 3, 0, 0, 2);

        rMatrix[6]=new Array(0, 0, 2, 0, 2, 0, 0, 2, 4, 4, 3, 0, 2, 0, 2, 3);
        rMatrix[7]=new Array(2, 2, 2, 0, 2, 2, 2, 0, 4, 4, 3, 2, 0, 2, 0, 2);
        rMatrix[8]=new Array(0, 2, 0, 2, 0, 2, 0, 0, 3, 3, 3, 0, 2, 0, 0, 2);

        rMatrix[9]=new Array( 0, 2, 2, 0, 3, 0, 2, 3, 2, 0, 2, 3, 4, 2, 2, 2);
        rMatrix[10]=new Array(2, 2, 2, 2, 3, 3, 0, 3, 0, 2, 0, 3, 1, 0, 2, 0);
        rMatrix[11]=new Array(0, 2, 0, 0, 2, 0, 3, 0, 2, 0, 2, 2, 4, 2, 0, 2);

        rMatrix[12]=new Array(2, 3, 3, 0, 2, 3, 3, 0, 3, 0, 2, 0, 4, 4, 4, 4);
        rMatrix[13]=new Array(0, 0, 2, 3, 3, 3, 0, 2, 0, 0, 2, 3, 3, 4, 4, 4);
        rMatrix[14]=new Array(0, 2, 3, 3, 3, 0, 2, 0, 2, 3, 3, 0, 0, 4, 2, 4);

        for (var i= 0; i<rMatrix.length; i++){
            var noRakingRatio = Math.min(Math.random(), 0.99);
            //var noRakingRatio = 0.99;
            for (var j= 0; j< rMatrix[i].length; j++){
              if (rMatrix[i][j] == 0){
                if (Math.random()< noRakingRatio) {
                    rMatrix[i][j] = "x";
                } else {
                    rMatrix[i][j] = makeRanking();
                }
              }
            }
        }
    }
    // (II) display: fill rMatrx into HTML table string
    var colStr=new
String("123456789X123456789X123456789X123456789X123456789X");
    var tableString = "<table id='tbRMatrix'>";
    tableString += "<tr><th>#</th>";
    for (var j=0; j<items; j++){    //each colomn
            tableString += "<th> I:"+colStr.charAt(j)+" </th>";
    }
```

```
            tableString += "</tr>";
            for (var i= 0; i<users; i++){   // each row
                  if (i % 2) {   //even row with light grey background-color
                      tableString += "<tr style='background-color:#d3d3d3;'>";
                  } else {
                      tableString += "<tr>";
                  }
                  tableString += "<td>U:"+(i+1)+"</td>";
                  for (var j=0; j<items; j++){   //each colomn
                        var iInt = parseInt(rMatrix[i][j]);
                        if (isFinite(iInt) && (iInt > 2)) {
                              tableString += "<td
class='highlight'>"+rMatrix[i][j]+"</td>";
                        } else {
                              tableString += "<td
style='color:#a3a3a3'>"+rMatrix[i][j]+"</td>";
                        }
                  }
                  tableString += "</tr>";
            }
            tableString += "</table>";
            $('#tabledata').html(tableString);

            //(III) Caculate rho: caculate the correlation matrix: each user(i) -to- other
users
            //init array aCorrle[users, 2], as computation buffer, NOTE: clear contents
before caculation
            for (var i=0; i<users; i++){
                  aCorrle[i] = new Array(i,0);
            }
            var vizStr="digraph G {\n";
            for (var i=0; i<users; i++){ // each user
                  //clear array aCorrle[users, 2]   and   each user to other users
                  aCorMatrix[i] = new Array(); // for display
                  aCorMOrder[i] = new Array(); // for caculate
                  for (var k=0; k<users; k++){
                        aCorrle[k][0] = k;
                        aCorrle[k][1] = -1;
```

```
                        aCorMatrix[i][k] =" ";    //each user to other users
                }
                for (var j=0; j<users; j++){          //to other users correlation
                        if (i==j) { aCorrle[j][1] = -1; }    //user self: keep coorel lowest,
skip caculating
                        else {
                              aCorrle[j][1] =pcorrelation(rMatrix[i], rMatrix[j]);
                        }
                }
                aCorrle.sort(sortCol2);      //sort index by column 2=correlaton value
                for (var k=0; k<nearNeighbors;k++){
                        // for display
                        var tStr = "<span style='color:"+vizColorcode[k]+"'>";
                        if (isVisiableCorr) {
                              tStr += (Math.round(aCorrle[k][1]*100+0.5)/100)+":";
//display correl value
                        }
                        tStr += (k+1)+"</spa>";
                        aCorMatrix[i][aCorrle[k][0]]= tStr;
                        //for caculate
                        aCorMOrder[i][k] = aCorrle[k][0];        // neighber user id
                        //for output
                        if (isGraphicViz){
                               vizStr +=
"u"+(i+1)+" -&gt; u"+(aCorrle[k][0]+1)+' [color="'+vizColor[k]+
'"]\n';
                        }
                }
        }
        if (isGraphicViz){
                vizStr += "}\n";
        }

        //(IV) display: (n x n)    square matrix user nearest neighbers
        var tableString = "<table id='tbUserMatrix'>";
        tableString += "<tr><th>[]</th>";
        for (var j=0; j<users; j++){    //each colomn
```

```
                tableString += "<th> U:"+(j+1)+" </th>";
            }
            tableString += "</tr>";
            for (var i= 0; i<users; i++){    // each row
                if (i % 2) {
                    tableString += "<tr style='background-color:#d3d3d3;'>";
                } else {
                    tableString += "<tr>";
                }
                tableString += "<td>U:"+(i+1)+"</td>";
                for (var j=0; j<users; j++){    //each colomn
                    tableString += "<td
class='nnUserCell'>"+aCorMatrix[i][j]+"</td>";
                }
                tableString += "</tr>";
            }
            tableString += "</table>";
            $('#userMatrix').html(tableString);
            if (isGraphicViz){
                $('#graphicviz').html(vizStr);
            }
            // (V) predict recommend value which items have no ranking value in the
begining, based on neightber user ranking value
            // for example: caculate user 0
            function userIrecommender(whoid){
                var aItemsRecomm = new Array();
                for (var j=0; j<items; j++){    //loop in user whoid through all items
                    if (rMatrix[whoid][j] == "x"){    //no ranking at beginning
                        var predicValue = 0;
                        var fTotWeight = 0;
                        for (var k=0; k<nearNeighbors; k++){
                            var iv = parseInt(rMatrix[aCorMOrder[whoid][k]][j]);
                            if (isFinite(iv)){
                                predicValue += iv*aCorWeight[k];    // neightber's
ranking product by nearWeight
                                fTotWeight += aCorWeight[k];
                            }
                        }
```

```
                    aItemsRecomm[j] = predicValue / fTotWeight;    //normalized
by weight
                    aItemsRecomm[j] = Math.round(aItemsRecomm[j]*10)/10;
//one digits under integer.
                } else {
                    aItemsRecomm[j] = rMatrix[whoid][j];                //keep his
own ranking data
                }
            }
            //    display them out
            var tableString = "Ranking threshold = <span
class='highlight'>"+fRecommenderFilter+"</span>";
            //display user's neightber id
            tableString += " neightber="+(aCorMOrder[whoid][0]+1);
            for (var k=1; k<nearNeighbors; k++){
                tableString += " ,"+(aCorMOrder[whoid][k]+1);
            }
            tableString += "<table id='tbItemsPredict'><tr><th>User:</th>";
            for (var j=0; j<items; j++){    //each colomn
                tableString += "<th> I"+colStr.charAt(j)+" </th>";
            }
            tableString += "</tr>";
            tableString += "<td>"+(whoid+1)+"</td>";
            for (var j=0; j<items; j++){    //each colomn
                if (aItemsRecomm[j] > fRecommenderFilter) {
                    tableString += "<td
class='highlight'>"+aItemsRecomm[j]+"</td>";
                } else {
                    tableString += "<td
class='centerText'>"+aItemsRecomm[j]+"</td>";
                }
            }
            tableString += "</tr></table>";
            $('#itemPredict').html(tableString);
        }
        userIrecommender(0); //run step V by userid = 0

        //(VI) interactive query user(i)'s recommender
```

```
                //reference from: 
http://www.quirksmode.org/dom/tests/tablesIndices.html
            $('#tbRMatrix tr td').click(function() {
                var col = this.cellIndex;
                var row = this.parentNode.rowIndex;
                var objtabs = $('#tabs').tabs();
                if (col == 0){
                    var uid = parseInt(this.innerHTML.substr(2));
                    if (isFinite(uid)) {
                        userIrecommender(uid-1);
                        objtabs.tabs('select', '3');
                    }
                }
            });
            // COPY TEXTAREA to Clipboard
            $('graphicviz').click(function() {
                copy_clip(this.value);
            });
        });

        </script>
        <style>
        textarea {
            width: 850px;
            height: 450px;
        }
        .highlight {
            color:red;
            font-weight: bold;
            text-align: center;
        }
        span.highlight {
            text-align: left;
        }
        .nnUserCell {
            font-weight: bold;
        }
        .centerText {
```

```
            text-align: center;
            color:gray;
        }
        #tbUserMatrix {
            margin-left: 0px;
        }
        /*    table apperiance */
        tr:first-child{
            background-color: #F5F5DC;
        }
        tr:first-child:hover{
            background-color: #F5F5DC;
        }
        tr:hover{
          background-color: #E8FFEC;
          cursor:pointer;
        }
        td{
              border: #ccc 1px solid;
              text-align: center;
              width: 100px;
        }
        td:hover{
          background-color: #E8FFEC;
          border: #666 1px solid;
          width: 100px;
          cursor:pointer;
        }
        </style>
</head>
<body>
<div id="page-wrap">
                <div id="tabs">
                        <ul>
                                <li><a href="#fragment-1">1)Ranking data</a></li>
                                <li><a href="#fragment-2">2)Correlation Matrix</a></li>
                                <li><a href="#fragment-3">3)Predict recommender</a></li>
                                <li><a href="#fragment-4">4)GraphicViz</a></li>
```

```
            <li><a href="#fragment-5">5)lattice graphic</a></li>
        </ul>
         <div id="fragment-1" class="ui-tabs-panel">
            <div id="tabledata"></div>
         </div>
         <div id="fragment-2" class="ui-tabs-panel ui-tabs-hide">
            <div style="text-align:center;">
            <div id="userMatrix"></div>
            </div>
         </div>
         <div id="fragment-3" class="ui-tabs-panel ui-tabs-hide">
            <p>Prediction and Recommendation.</p>
            <div id="itemPredict"></div>

         </div>
         <div id="fragment-4" class="ui-tabs-panel ui-tabs-hide">
            <table><tr><td>
            <form name="form1">
            <input style="left-margin:150px;" type="button" onclick="return
copy_clip(document.forms[0].gztext.value)" value="Copy to Clipboard">
            </td></tr><tr><td>
            <textarea id='graphicviz' name='gztext'=></textarea>
            </form>
            </td></tr></table>
         </div>
         <div id="fragment-5" class="ui-tabs-panel ui-tabs-hide">
            <div style="text-align:center;">
            <a href="case004_big.gif"><img src="case004.gif" /></a>
            </div>
         </div>

    </div>
</div>

</body>
</html>
```

附錄四

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INTEROPERABLE CO-DESIGN SYSTEM

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Abstract. Project Alliances is a new alternative to A/E/C traditional project delivery systems, especially in the commercial building sector. The interoperable model of Co-design process and systems characteristics that is required to reduce the adversarial nature of most construction projects. Interoperable Co-Design System was just used successfully to complete the Si-soft Research Center of Taiwan. This project-alliancing project was analyzed as a case study to evaluate the validity of the system. Three key paradigms of the Co-Design were reviewed and numerous examples from the management of this project were cited that support the theoretical recommendations of this model. It was concluded that the system use wild client/server network architecture embedded with peer-to-peer agent technology to provide an open, familiar and easily extended co-design system.

1. Introduction

The Architecture, Engineering and Construction (AEC) industry has a rich history of collaboration. There is an increasing trend in Taiwan to push all construction stakeholders—owners, contractors, designers, subcontractors, suppliers, and end users—to develop alternative project delivery systems that encourage higher levels of collaboration throughout the life cycle of a project The impact of misunderstanding and confrontation among construction stakeholders over the last several decades has generated management practices that inhibit industry productivity and discourage the discovery of optimal solutions to design and construction problems. Traditional design-bid-build approaches to the completion of projects have created discrimination among project team members, who have focused too narrowly on their respective contexts of involvement and have often not involved different expertise. This is in contrast to collaborative development, which improves productivity, enhances design intent, accelerates delivery time, increases quality and generally provides more value to the capital investment made by owner. These now more apparent advantages of collaboration are the main influences accelerating the integration of multiple professions into collaborative teams.

Nevertheless, allied project works face considerable hurdles before a successful or acceptable outcome can been achieved. In a large project, the project organization is highly complex and comprises a number of phases. Diverse and fragmented professional knowledge amongst participants within the project may cause misunderstanding within the design-build process and be an obstacle to communication and successful collaboration (Kalay 1999; Peng 1999). This situation can be exacerbated should the individual professionals or knowledge concerned also be geographically separated (Huang 1999).

In recognition of this, an increasing volume of research has focused upon collaborative design issues amongst multi-discipline professionals co-operating in remote environments. It argues that interoperation, based upon computer supported collaborative work (CSCW), will make the AEC industry more efficient (Chiu 1997). Integration of design ideas and development by virtual Internet technology is one of the key instruments that is helping to make collaboration amongst multiple distance disciplines more successful (Rojas and Songer 1999; Stumpf and McDonnell 2002; Valkenburg and Dorst 1998). One criticism of CSCW is that it tends to prioritize the modes and performance of delivering design data and/or graphically representing the product and seems to disregard the importance and impact of interaction among the collaborators.

This paper will briefly review three main paradigms of CSCW relative works since 1962 as well as provide a web-agent based interoperable co-design framework. It will then illustrate how the Si-soft Research Center space renew project acts as an appropriate and relevant case study of shared repository, design representation and intelligent design reasoning. Finally, some benefits/limitations of the framework and future works will be considered..

2. Three paradigms for Co-design System

The earliest study of CSCW can be traced back to the 1960s. Engelbart (1962) proposed a conceptual framework to describe how computers can help a team solve problems in efficient ways. He also outlined some of the disciplines, including design, which might benefit from technology augmentation. Steven Coons first addressed the need for a computer-aided design system that enables synchronous interaction with multiple users (Coons 1963). After these two pioneering researches, numerous experiments served to further clarify the benefits of the CSCW as applied to three main paradigms named; design information sharing repository, design geographically archive representation and intelligent design reasoning.

2.1. TEXT-BASED DESIGN INFORMATION SHARING REPOSITORY SYSTEM

The text-based design information sharing repository system mainly utilizes a common data format to exchange design information and to facilitate communication amongst the team members. Most systems have focused on delivering shareable product models and databases to publish their design works (Kim et al. 1997). Product models particularly emphasize solving issues such as data accessing rights, data concurrency and data-integrity (Eastman 1999; Sun and Lockley 1997). This development has been carried out based upon the argument that some computer programs will access all of the data without error and can be processed and interpreted by human experts with their own knowledge (Khedro et al. 1993).

However, owing to social and professional contingencies, these models could fail the CSCW system in three areas. First of all, **misunderstanding** could arise between interdisciplinary team members whom seldom derive the same understand from information without recourse to further interaction or communication (Kalay 1999; Valkenburg 1998).

Secondly, **customization** amongst participants may lead to a participant feeling that a system is demanding a particular method to be followed, in perceived conflict to his or her own preferred methodology resulting in the user rejecting the system and subsequently allowing it to fail. This is the main obstacle to the successful utilization of a co-design system.

Lastly, the increasing complexity of co-design knowledge may lead to a situation of **data overload**. All CSCW systems are intended to provide maximum information to all participants. Accordingly, data overload side effects will follow. The Internet provides a clear demonstration of the potential debilitating effect of information overload on decision-making processes. In addition, there are also a too limited number of papers that emphasize design information filtering (Haymaker et al. 2000).

2.2. VISUAL DESIGN ARCHIVES REPRESENTATION SYSTEM

Computer Aided Architectural Design (CAAD) Systems (Clayton et al. 2002; Fukai and Srinivasan 2001), construction product visualization systems (Coyne et al. 2001; Mckinney and Fischer 1998), construction process online monitoring systems (Ruffle and Richens 2001), virtual reality support design systems (Whyte et al. 2000) and design-build process simulation systems (Clayton et al. 2002; Craig and Zimring 2002; Hong et al.

2001) all focus on presentation or simulation of design knowledge in visual way.

The authors above state that the visual information contained in these systems can confidently deliver intuitive understanding of design knowledge and can be represented by hyper-graphic links to underlying design and construction information. It also can be utilized to access archived resources; support design development, analyze and resolve pre-construction conflicts and coordinate construction activities. In addition, the information is gathered and stored according to its geo-specific relationships and visually indexed by the data environment rather than through a hierarchical and abstract data structure.

However, these visually-oriented systems may involve a lot of different data formats such as CAD files (DNG, 3DS, FMZ…), Image files (BMP, JPG, PNG…), VR archives (WRL, VMO, SWF…), and Video (MPG, AVI, MOV,…). Unfortunately, without a dominating format, such multi-media information, fragmented data which does not share similar structures throughout the entire system, often increases complexity. An example would be the need to convert information to different formats for use by different professions.

2.3. AGENT-ORIENTED DESIGN SUPPORTED SYSTEM

Since 1950, design has been one of the main uses of Artificial Intelligence (AI). After that, a paradigm shift took place in the sciences and humanities and has gathered pace in the 2000's. From the 1980's onwards, user-centered and participatory design has become a widely accepted and utilized model of development. Presently, a new interesting model of AI is emerging. These models are based on new principles, such as 'situatedness', 'embodiment, emotion' and 'social interaction' (Lenart and Pasztor 2002).

Research in agent/multi-agent engineering currently runs alongside mainstream AI development reflecting changes in social paradigms. According to an agent-based engineering study, still in its early stage, there are many different notions of an agent that have been proposed. One notion of agents, which distinguish between weak and strong agency has been proposed by Wooldridge and Jennings (Wooldridge 2002). The defining characteristic of weak agency is that it provides a means to reflect on the tasks an agent needs to be able to perform automatically or semi-automatically. The ability to communicate and inter-operate with other agents and to interact with the material world often relies on an agent's ability to interact with the material world and maintain and co-update its own knowledge of the world with other agents.

The agent metaphor offers a means to model situations involving collaborative activity on a conceptual level. Some research has combined the research areas of engineering design and multi-agent systems. For example, Campbell et al. (1998) presented a theory of engineering design adapting a system of interacting software agents. They proposed the use of configuration agents to create conceptual designs, instantiation agents to fill in actual components from a design repository, fragment agents and subsystem agents to play an evaluative role and lastly, manager agents to maintain these four type of agents and the synthesis of the result. McAlinden et al. (1998) show how design agents can be integrated to facilitate information and knowledge sharing. In their research, a central product model of STEP is used and they apply the STEP standard into agent knowledge exchange language, named ACL, in order to facilitate propagation of the agent's knowledge. Their studies provide a good demonstration of an agent-based co-design system in automatic/semi-automatic collaboration in a situation of distributed computation and situatedness. This was in effect the essence of interoperation. Despite this, it would seem that the agent-based system has merely formed another new closed network environment subject to it's own inherent limitations.

3. Framework of Interoperable Co-Design System

3.1. WEB-BASED AGENT FRAMEWORK

The World Wide Web is used to an ever-greater extent for application-to-user as well as application-to-application communication. A web-based distributed computational environment provides new facilities to form a virtual organization of the A/E/C industry. Through ubiquitous Internet communication technologies such as email, ftp or net video/audio conference, team members can collaborate as a single organization virtually without geographic limitation and in spite of barriers such as working in different time zones.

In accordance with the review we described above, these technologies are too loosely structured as communication tools for our needs in terms of a reflexive inter-cooperative process. More sophisticated technology will be needed to establish a virtual environment that will support an interactive communication system for dealing with construction management problems.

As a result, in this section, we will propose an open web service framework that supports cooperative activity in the field of A/E/C. The Interoperable Co-Design (IoCD) System is a duel network service system that combines two concurrent mainstream network service paradigms, client/server and peer-to-peer networking, shown as figure 1.

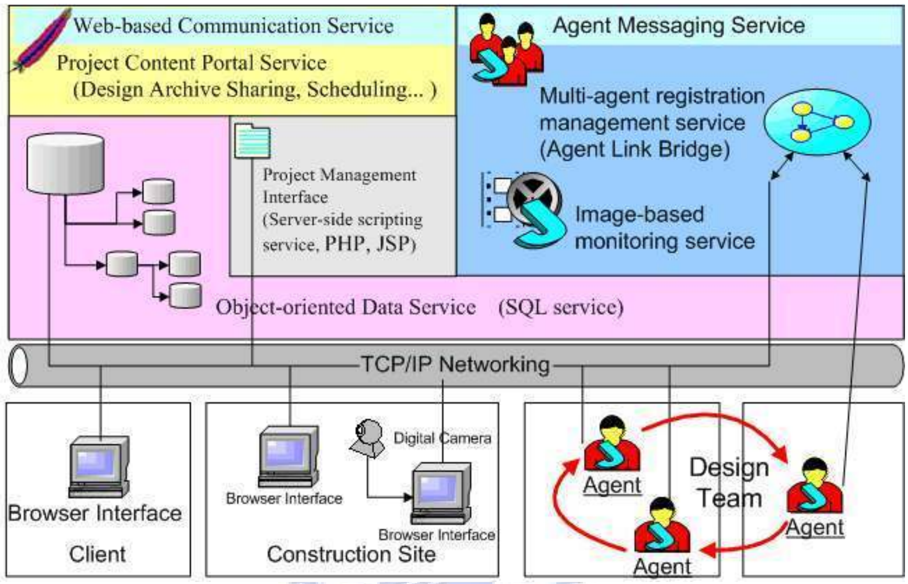

Figure 1. Duel-Network Service Framework.

3.2. IMPLEMENTATION

The system consists of two different kinds of service components. The first is a web-based communication service following the Client/Server model. It is also a dynamic Object Oriented (OO) based open-architecture portal script, written in PHP. Before this paper was submitted, five major modules were completed to support the co-design project. These are 1) a user privilege module, 2) a meeting scheduling module, 3) a group discussion module, 4) an events tracing module and 5) a design archive repository. These all provide a convenient web service interface that participants can use without installing additional software but rather, can access directly through a normal web browser.

The second is the agent messaging service, which extends from the Web-based situated communication model proposed by Shih (Shih 2003; Shih and Chang 2002). Two sub-services, including ‘Second’, which is a role-play service, provide a general script repository, a role definition repository, a model connector repository, a coordination/negotiation channel and script builder services. Last is a service, which allows full interaction with the project. In this service, the project manager can monitor the project process, update progress reported by field managers to reflect the concurrent situation of the project or use an emergent agent technology to evaluate the project performance automatically.

4. Case Study

4.1 BRIEFLY DESCRIPTION OF THE CASE.

Project name: Si-Soft research center construction renew project
Site location: HSIN-CHU Science Park, Taiwan
Site area: 80,000 m^2
Original usage of the site: CRT manufacture
Objective of Project: Change the entire site (and form of usage) from a CRT manufactory into an IC design house (office) building.
Professions involved: 1) Architect, 2) Civil Engineer, 3) Structural Engineer, 4) Interior Designer, 5) Electrical Engineer, 6) Fire control Engineer and 7) Building materials provider. (They are my team members for in the co-design process).
The main challenges in order of priority are: 1) time constraints 2) complexity: there are 7 professions, more than 18 types of work and around 250 workers working together everyday. In this case, extensive and open communication is a priority condition of participation for everyone. However, face-to-face meetings fail the job in two ways; it is time consuming and geographical barrier prevent it. In addition, the meeting itself cannot often resolve all the issues that need to be discussed. This paper is derived from the need to find a computational way to reduce the need for face-to-face discussion but still maintain communication and, at the same time, enabling the project manager to maintain control of concurrent developments on site.

4.2 PRIVIOUS WORKS PROBLEM REFLECTION

Reflections on the problems revealed in the review section (2.1 to 2.3) of this paper. There is 1) misunderstanding; 2) customization of work tasks and information; 3) data overload; 4) non-unified information formats and fragmented visual data; 5) open agent-based systems.

1) Misunderstanding: face-to-face meetings can almost deal with any kind of misunderstanding. To reiterate, there are many limitations to the method of holding meetings every few minutes. This paper describes the use of a ‘wild open’ communication system which supports ‘virtual’ meetings instead of face-to-face talks. For example, five modules have been completed, which are described in section 3.2.
2) Customization: This system is a dynamic Object Oriented based architecture portal script written in PHP. It is easy for the user to model the system in accordance with their different requirements. For example, the home module can be changed as frequently as the job to make it reflexive and efficient.
3) Data overload: We save every thing into an easily recalled database and catalog results in a reasonable way to facilitate the of re-use them.
4) Non-unified formats: Using an image-based monitoring system instead of streaming video serves as a precise example. On the server side, that we physically place the web-cams to provide a full spectrum view of the construction site. Then each web-cam is programmed to take still images and save them to the server. On the client side we provide a construction monitor agent (robot) that continuously retrieves the server image through the agent messenger service (agent link bridge). This is a physically undemanding (on the server) and robust lightweight image-based monitoring system.
   The benefits we have received from use of this system have been:

   4.1) Low cost: The web-cam server can be any P.C. with an Internet link and does not require any server side programs to be installed making it low cost and easy to operate.
   4.2) Lightweight: the client side agent program could possibly run on a cell phone acting as a computation application. This means information can be easily distributed to a parties which require it.
   4.3) Easy computation: When we need detect changes in the remote site, (construction sites can be typified by rapid progress and change), we just need to set up the start and stop date time of the image capturing program and then compute the gray scale differences of any concurrent images through their associated pixels. Counting the proportion of the image that has been changed significantly will indicate pace and progress of changes in the construction process.

4.4) intelligent agent: Following section 4.3, we add some heuristic rules into the agent knowledge base after which the agent can act as a construction risk detector.

4.5) Access privilege: Any agent communication tasks need an agent messaging service to help find the target agent addresses. The agent messenger is the gateway and also the firewall of the agent communication channel.

5) Open agent-based system: Currently, only a few research groups (Aunmba et al. 2002; Bandini et al. 2002; Campbell et al. 1998; Maes 1994) are working on various fine-grained spatial models, simulating the interaction of individual actors across different professions. These still fail to satisfy requirements since they all eventually establish a new closed system. The user has to be forced to learn to use a new tool before he or she can overcome problems associated with the new technology. In our case, the agent messaging service is embedded in the web site and not openly utilized by the user. There is no new program or interface to be learnt – the service runs invisibly behind 'traditionally' structured web pages. For details please refer to the paper proposed by Shih (Shih 2003; Shih and Chang 2002).

5. Conclusion

Through a review of previous of computer supported cooperative work and design an IoCD system framework and implementation has been proposed. This paper demonstrates a unified and integrated approach to modeling the system and uses real project experiences as proof that the IoCD system can facilitate communication amongst team members in a truly interoperable co-design process. In addition, participants can communicate through the IoCD system instead of to holding face-to-face time-consuming meetings. It boasts a customizable user interface through dynamic object-oriented technology, the efficient organization of mass data by object-oriented database management and unification of visual information formats by an agent-driven service in low-cost, lightweight, user friendly manner. It has highly intelligent capabilities and provides high levels of privileged access. Lastly, we use wild client/server network architecture embedded with peer-to-peer agent technology to provide an open, familiar and easily extended co-design system.

The IoCD system presents a new exciting challenge to the development of communication models and systems for co-operation in design –build projects. It challenges conventional paradigms that place too heavy an emphasis upon technology without considering the effects of the introduction of that technology upon it's potential users – people, from different professional backgrounds and with different experiences and prior use of technology. Potentially, the IoCD system, could be used as a communication and development model for a very wide range of applications, not just within the construction industry. Any group of professionals carrying out a project where the individuals involved are geographically dispersed can potentially co-operate far more efficiently towards a mutually acceptable outcome, providing value for investment, both in time, expertise and materials. Examples might be interior design, cultural projects such as movies and artistic events and the staging of large international events such as the Olympics and other sports events that require large infrastructure modifications or development. The simplicity of the IoCD system means that it would not require a vast technical staff to set up and operate and significantly reduce the time required to train staff in it's use. New mobile phone technology such as 3G or 4G will make the system even more mobile and reflexive. Certainly, the IoCD system has the potential to replace much redundant technology such as conferencing equipment, which have in the past have been susceptible to high costs, frequent maintenance and less than reliable performance in addition to requiring much fixed equipment that ultimately reduces it's advantage, especially when applied to multiple and especially external environments.

Acknowledgements

The heading for acknowledgements is the style of a first order heading but is unnumbered. The acknowledgements are in 9 pt, 10 pt leading.

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A WEB-BASED AGENT FRAMEWORK FOR COLLABORATIVE DESIGN-BUILD COMMUNICATION

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Abstract. The Internet connects the globe as a whole and at the same time pushes the competition increasing dramatically. Multidiscipline and distributed collaborative design-build in architecture, engineering and construction (A/E/C) companies can gain foster competitive advantage, improved designs, and more effective management of construction facilities. However collaboration can often fail, since it involves different professions who often hold different goals and also one-off organizations also build obstacles to collaboration. This paper presents a web-based agent framework to support communication, to facilitate shared understanding amongst the participants and to inspire teamwork. This paper proposes a multi-agent social interaction framework as the communication model of design-build projects. The conceptual framework emphasizes process-centric learning and the creation of group agreements within design-build collaborative activities, which help facilitate conflict migration. In addition, based upon web agent technology, this communication framework providing an intelligence distribution opportunity for the for the A/C/E industry to introduce a new and innovative paradigm of collaborative design.

1. Introduction

The increasing complexity of construction engineering projects is placing an ever-mounting burden of delivery upon architects. To meet these challenges, many companies involve a large number of professionals in design-build projects to provide a complete product or service (Luiten et al. 1998). Nevertheless, design-build projects face considerable hurdles before a successful or acceptable outcome has been achieved. In a large project, the project organization is highly complex and comprises a number of phases. The diverse and fragmented professional knowledge amongst participants within the project may cause misunderstanding within the design-build process and be an obstacle to communication and successful collaboration

(Kalay 1999; Peng 1999). This situation can be exacerbated should the individual professionals or knowledge concerned also be geographically separated (Huang 1999). In recognition of this an increasing volume of research has focused upon communication issues amongst multi-discipline professionals co-operating in a remote environment. It argues that communication based upon shared understanding integrated by virtual Internet technology is one of the key instruments that is helping to make collaboration amongst multiple disciplines more successful (Stumpf and McDonnell 2002; Valkenburg and Dorst 1998).

To this end, researchers have mostly proposed computer-based 3D models or 4D (3D model link with temporal schedule data) related information technologies and have argued that 3D computer models can successfully simplify the complexity of design knowledge. Using visualized information can help support collaborative communication and mitigate the conflict of interest amongst the relevant disciplines, generating shared understanding which then facilitates communication (Clayton et al. 2002; Fukai and Srinivasan 2001; Rischmoller and Alarcon 2002).

However, most solutions are data-centric driven rather than process-centric driven. When the 3D information is presented in static and fragmented data form, it still fails to meet integrated needs. For example, if part of the design has to be changed during the detail design phase, the visualized static 3D information cannot evaluate the impact of this change upon the whole design and its influence on the construction process. Therefore, we propose an innovative communication framework, which will integrate the information of design and construction. Stimulating interaction amongst participants is the most applicable communication technique to eliminate these obstacles. Through such engaged interactive environments where people could share information based upon the same understanding of the design problem, this framework can facilitate communication (Shih and Chang 2002; Valkenburg 1998).

This paper intends to establish a computer-based communication framework to support multi-discipline collaboration. First, we focus on agent ontology. Refined the agent model proposed by Wooldridge (2002) and constructed a genetic agent model and web-based agent co-operative system and the architecture. . Then, proposed a genetic agent model and a web-based multi-agent system architecture based on agent on case study to analyze the following three aspects: design process, project requirements, and design knowledge or design strategy for verify the validity of the communication framework. Finally a primary discussion, conclusion and future work were followed.

2. Review of Current Collaborative Design-Build Practice

The application of computing systems to A/C/E practice can be traced to at least five decades ago. There were three main paradigms in the early stages of development of architectural CAD. Initially, computers were used to assist in performance simulation and system analysis. The process of designing buildings continued to be carried out manually and utilized computer programs to generate statistics or analysis at validation stages. The results were then applied manually to the evolving design (Mitchell 1977). Secondly, the research in CAD shifted from analysis programs to computational representation of buildings. Serven Coons and Ivan Sutherland developed the first interactive 2D and 3D design tool. Their efforts simplified the input of design artifacts into analysis programs, and opened the floodgate for the development of CAD programs (Kalay 1999). Lastly, beyond the design performance analysis and visual simulation, researchers resumed their quest for more powerful design communication tools, which could represent non-geometric building information. At this stage, CAD research was strongly influenced by general information technology and as a result various types of Expert Systems were gradually introduced (Carrara et al. 1994; Coyne et al. 1990; Flemming 1994). Few of these systems survived their expectations, since the limitations of the design knowledge within the Expert System meant that it could only be used by the experts themselves (Shaviv et al. 1996).

These systems, as a design management tools, all made a great contribution to each respective paradigm. However, they seemed to fail as collaboration tools; they facilitated the exchanging of design information at the data level but crucially not the sharing of understanding amongst collaborators at the semantic level.

2.1. COLLABORATION NEEDS A SHARED UNDERSTANDING

The complexity and fragmental knowledge of the construction industry is increasing rapidly since the typical modern construction process has to involve many disciplines working as a team in a limited time frame. Team members work in separate domains and employ specialist knowledge required by construction projects. Therefore, by combining their abilities in a particular process, a collaborative arrangement is the key for team members to co-ordinate the larger objectives of the project.

At the same time, collaboration can also be a negative force, when individual action, that is in the best interest of a specific project goal, might not be suited for the goals with other collaborators(Kalay 1999). Teams may benefit from improved understanding of the relationships and issues associated with group work, and team development. In brief, teams that seek to improve their performance can do so by fostering team identity and helping different disciplines to collaborate together with shared understanding (Busseri and Palmer 2000; Valkenburg 1998).

2.2. REFLECTIVE DESIGN PROCESS FORM A SITUATED COMMUNICATION

Most complex design-build problems can be easily deconstructed into a sequence of activities, and then sub-activities. Therefore, most construction planning or simulation techniques are based on data-centric technology for purpose of product modeling the construction process. However, many independent but small groups are critical components of the construction team. Each group will join forces with other groups to accomplish a specific and relatively short-term project. And unlike product manufacture, which has a standard production system, the design-build process is variable phenomena dependent upon the reliability of resources and the stability of the working environment. As a result, operations change dramatically and rapidly along with different situations.

'Situatedness' influences the thoughts and actions of a designer (Gero 1998). In an efficient collaborative design process a form of shared understanding among participants is required. The designer must be able to "understand" their co-worker's design content. This understanding can serve as the basic concept of collaboration for the individual designer.

Excepting the above, there still are many different ways of perceiving a design problem. Reasoning from different viewpoints is a necessary part of most design processes as is illustrated by the reflective design model proposed by Schön (1983). We may use the see-moving-see cycle as an example. A designer who participates in teamwork perceives other designer's work from different viewpoints and tests whether their conclusions conflict with the current solution for the next step of the cycle, as well as, reviewing his own design and making the next stage of work. Therefore, reflective interaction among participants can form a situated communication that will provide high collaborative efficacy (Valkenburg and Dorst 1998).

2.3. MULTIAGENT SYSTEM

Research in multi-agent systems currently runs alongside mainstream AI development. However, there still are many different notions of an agent, which have been proposed. One notion of agents, which distinguish between a weak and a strong agency has been proposed by Wooldridge and Jennings (Wooldridge 2002). The characteristics of weak agency provide a means to reflect on the tasks an agent needs to be able to perform. The ability to communicate and co-operate with other agents and to interact with the material world often relies on an agent's ability to interact with the material world and on an agent's ability to acquire and maintain its own knowledge of the world and other agents.

The agent metaphor offers a means to model situations with collaborative activity on a conceptual level. Some research has combined the research areas of engineering design and multi-agent systems. For example, Campbell et al. (1998) present a theory of engineering design adapting a system of interacting software agents. They propose configuration agents to create conceptual design; instantiation agents fill in actual components from a design repository; Fragment agents and subsystem agents play an evaluation role; and lastly, manager agents maintain these four type of agents and the synthesis of the result.

McAlinden et al. (1998) show how design agents can be integrated to facilitate information and knowledge sharing. In their research, a central product model of STEP is used and they apply the STEP standard into agent knowledge exchange language, named ACL, to propagate the agent's knowledge. Their aim is to incorporate existing and legacy systems without causing delays in a design project.

In proportion to the A/E/C research areas, there has been little research that has focused on combined reflective design process with agents.

3. Web-based agent framework as a communication guide line to facilitate co-operative communication

3.1 GENERIC DESIGN AGENT MODEL

The generic design agent model illustrated was based on the horizontally layered agent architecture proposed by Wooldridge (2002). In this model the design problem provided by the client was expressed as an initial process objective and a set of initial requirements. Requirements impose conditions and restrictions on the site environment, building service functionality and perception of the design.

Figure 1 shows the composition of the processes distinguished within the component design and the types of input and output subsystem connected with environment of the web-agent system. The middle segment design process is shown to be composed of three horizontal layers: design process-remodeling layer, requirement set evaluation layer, design goal reactive layer. The design process-remodeling layer rearranges the design process by issuing information related to the current design objectives. The requirement set evaluation layer manipulates sets of requirements, on the basis of the overall design strategy, information from Requirement set, and other design object descriptions. The design goal reactive layer modifies the current design outcome by the inference results from the two design process-remodeling and design goal reactive layers.

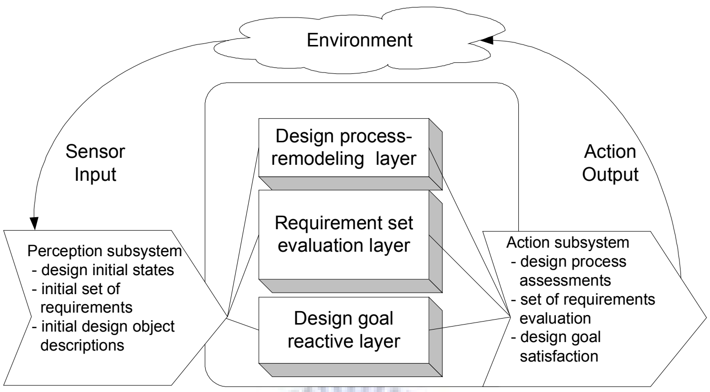

Figure 1. Genetic agent model

3.2 WEB-BASED AGENT FRAMEWORK FOR COLLABORATIVE DESIGN

A Web-based distributed computational environment provides a new possibility to form a virtual organization of the construction industry. Through basic Internet communication technologies such as email, ftp or net video/audio conference, team members can collaborate as a single organization virtually without geographic limitation and different time zone barrier. However, these technologies are all loose structured data-centric propagated approach on the Internet. In order to fulfill the needs in terms of reflective design process described above, more sophisticated technology will be needed to establish a virtual environment interactive communication system for the collaboration of problems with the distributed design.

As a result, in this section we proposed a web-based agent co-operative system, the architecture of which can been the system in Figure 2. In the construction of this system we employing use of concurrent *web-service* technology.

The system consists of three service components. The first of which is the human-computer interface service, which provides three sub-services including content portal, data and project management interface services. Secondly the design agent service provides general design problem description, definition for design situation elements, role definition. It can serve as a model connector repository, and function as a coordination/negotiation channel and general scenario builder service. The final service component is design data and the knowledge repository service. In this service, the project manager can be monitoring the project process, updating the progress by the term memory agent to reflect concurrent situation of the project. This repository will aggregate abundant design process-based knowledge ever increasing its depth and complexity further presenting itself as an increasingly valuable tool in future research.

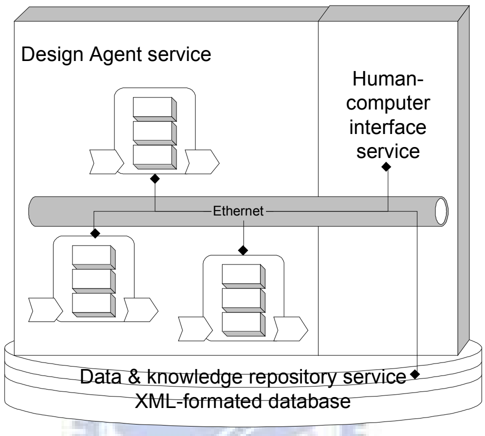

Figure 2. Web-based Multi-agent system framework

4. Case study of a design agent in a distributed collaborative design process

4.1 DESIGN INITIAL STATE

This paper was based on a parking area allocation design project in the Da-keng nature scenic area of Taiwan. The case study has been chosen because it can be used to illustrate the types of reflective reasoning required by design agents involved a distributed collaborative design process. This project entailed a distributed design process, where several participants needed to interact with each other. The design took place in the domain of nature park renew design.

The target site was allocated in an ecological recreation area (shown as figure 3). This area was a branch of the Da-Tun mountain chain. It is the biggest mountain recreation area and also is the most important ecological education zone around Taichung city (shown as figure 4, gray spot illustrate

the ecological habitat and gray line illustrate the foraging rote of wild animals). It services the central Taiwan and near to 3 million people.
The project challenge can be briefly summarized to three major points. First of all, the ecological issue: how do we to preserve the ecological balance whist also successfully allocating and integrating a park area, which will service increasing tourism at the same time. These requirements are not only proposed by the client but are legal requirements. Secondly, architectural issues: how can we make the park area fit in with the natural mountain environment whilst also developing parking functions is the major trade-off problem of architectural designers. Lastly, the construction issue: the mountain area makes it logistically difficult to reach mobilize resources. This issue can also be regarded as the major factor of the total cost.

To meet this challenge, a number of designs of different domains are needed: A project manager, a scenic architect, a biologist and a construction engineer.

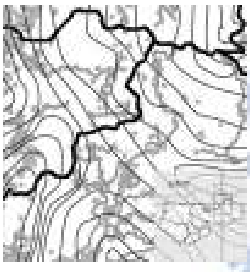

Figure3. A nature park site with contour map and main road

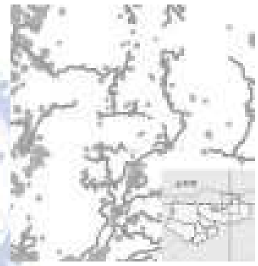

Figure4. Habitat spot and foraging route

4.2 REQUIREMENTS ACQUISITION

Once an interview was concluded with the team members, the he design project requirements were summarized as below.

- The site should be kept within 10 to 30 meters of the main road.
- As a parking lot, the slop of the land should not greater than 5%.
- The minimum area should provide not less than 100 cars and 20 buses.
- The maximum area should provide not more than 200 cars and 50 buses.
- An information and service center should be considered.

Early in the project the architect made a quick assessment and proposed two candidate designs. The dominant methodology of his profession guided the architect to scrutinize only those aspects of scrutiny that fell within his recognized area (the service of parking) rather than other areas, which were out of his professional field of expertise. He thereby failed, for example, to gain from understanding how a biologist would have perceived the problem and how he would have had to make necessary changes to his proposal..

Using the Web-based agent framework as a communication guideline a more mature result was acquired. For example:

- Biological aspects:
  - The parking lot area should not be within 20 meters of habitat spots.
  - The parking lot area should not be within 10 meters of foraging routes.
- Architectural aspects:
  - Considering the information center we need to take account of the availability of the facilities, electric power and water resources for example.
- Constructional aspects:
  - Considering the drainage, the material of the floor should be break rather than concert.

4.3 DESIGN GOAL REACTION

Based on reflective reasoning, each designer made his or her own submission to the concurrent result and prepared for the next cycle. The project manager played an important role at this stage. A final design decision needed to be made to meet the project time constraints.

5. Discussion, conclusion and future work

This paper presents the process-centric and reflective design process communication framework for design-build collaboration. The situated communication model provides an interactive approach to compose the script of human participants, which becomes a situated plan structure of the design-build project. A valid communication model can be formed through a process of collaborative composing in comparison to top-down planning/programming approaches. In addition, conflict can be mitigated after through successful coordination/negotiation processes. The script also can be a guideline when the project is operating, updating the communication model from the real case study feedback and refining the scenario to fit to the real world directly.

A case study has been presented to demonstrate the situated communication model for design-build projects. The findings of the case can be refined in relation to greater assessment feedback. From the brief description above, we can see that the agent communication model can help facilitate the collaborative design process.

In the case, we started from a description of the initial design state to reveal the primary project process models and then determine the sub-sequence of each participant. Furthermore, we identified a set of properties of the requirement through the reflective design process, in order to clarify the requirements and the dependency of the role in the project. Team members not only benefited from their own design knowledge, but also got stimulation from different viewpoints expressed through reflective communication. In summary, the situated communication model presented in this paper can mitigate communication conflicts and increase the efficiency of the collaboration.

A preliminary genetic agent model of web-based agent communication system architecture has been proposed. In this system architecture, we use the concurrent web service technology to facilitate role interaction through the Internet. A further study works will be essential for the implementation of the genetic agent model and the web-based multi-agent system.

In this study, we are not intending to propose another smart information-retrieval system for the A/E/C industry. Beyond that, we are trying to reveal a new direction for the design-build service system. This system integrates data-services, communication services and human-computer interface services as an integrated design-build management service system. As an ongoing research project, the situated communication model presented in this paper is at the core of the construction management service, a first step and fundamental to the further development of an integrated service system.

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WEB-BASED SITUATED COMMUNICATION MODEL FOR CONSTRUCTION MANAGEMENT

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Abstract. Conventionally, construction management is a data-driven management process. However, most of construction problems under the real construction situation are hard to predicate during the planning stage. For modeling such a dynamic, interactive collaborative process, we adopt a concept called "reflective learning" and "learning-by-doing" from (Schank, 1997; Schon, 1983). In addition, by using acting-role interactive model (Chang and Huang 2002) as the conceptual communication metaphor, this paper presents a situated communication model for construction management. The behavior of such communication model is discussed through a case study—slope land leveling process. Web-based implementation architecture is proposed and some implication and research results are discussed in the paper.

1. Introduction

Conventionally, construction management is a data-driven management process. The management is through the arranging resources along a time-line axis. Once the resources have been arranged, every agent will follow the schedule ideally and accomplish the assigned tasks. However, the problem is most of construction problems occurred during the real construction situation and is hard to predicate during the planning stage.

For modeling such a dynamic, interactive collaborative process, we adopt a concept called "reflective learning" and "learning-by-doing" from (Schank, 1997; Schon, 1983). The problem-solving process for the management process is similar to reflective learning—each agent reacts to the situation that is invoked by certain construction events involving many specialists. In briefly, similar to brainstorming process, you learn by reacting to what you are doing. Such process requires lots of interaction that is exactly the power of learning-by-doing mechanism.

1.1 Collaboration needs a shared understanding

The complexity and fragmental knowledge in the construction industry are increasing rapidly when the typical modern construction process has to involve many disciplines working as a team in a limited time frame. Team members work in separate domains and employ specialist knowledge required by construction projects. Therefore, by combining their abilities in a particular process, collaborative arrangement is the key for team members to conduct the larger objectives of the project.

At the same time, collaboration can also be a negative force, when individual action that is in the best interest of a specific project goal, might not suit for the goal of other collaborators (Kalay, 1999). Teams may benefit from improved understanding of the relationships and issues associated with group work, and team development. In brief, teams seeking to improve their performance by how to foster team identity and help different disciplines to collaborate together with shared understanding (Kalay, 1999; Busseri and Palmer, 2000).

1.2 Dynamic interaction needs a situated communication

Most of complex construction operations can be easily decomposed into a sequence of activities, and then sub-activities. Therefore, most of construction planning or simulation techniques are based on activity-driven technology for modeling the construction process. However, many independent but small groups frequently compose the construction team. Each group will join forces with other group to accomplish a specific and relatively short-term project. And unlike in product manufacturing have a standard production system; construction process is varied by reliability of resource and stability of working environment. As a result, operations changed dramatically and rapidly along with different situation. Construction Process Management (CPM) and other activity-based management approach still beyond its power to conduct such problem.

Therefore, dynamic interaction of construction management needs a situated communication that will provide a highly interactive mechanism.

1.3 An acting-role model for situated communication

We use an interaction metaphor called *acting role model* (ARM) (Chang and Huang 2002, Matwiejczuk & Krysia 1997) that is inspired by the role-play mechanism. Basically, a situation is defined as a stage that is the context where a play takes place. The interplaying among multi-roles frames the interactive process. In addition, the main technique of acting role communication is called *scripts* that are consisted of:

1 building scripts—to share understanding of communication knowledge;
2 interactive communication.

With such situated role-play metaphor, two major issues of construction management are identified. First, how to interactively model construction management process while each situation is changed dynamically. Second, how to mitigate the conflict, occurred during the process, to increase the efficiency of project execution using the role-play mechanism.

In order to address the situated communication among construction process, we proposed a situated communication modeling to provide a highly interactive mechanism that will create a script and its associated role-definition according to the situation invoked. Furthermore, adopt such mechanism into operational collaboration and management process.

2 A situated modeling

Acting-role model consists of Roles, Scripts and the stage where the play takes place. For communication, we adopt the concept of *controller*—the director of the play. In the context of construction management, director is similar to the project manager of a construction process. Each concept is elaborated in the following session with notion from construction management process. Needed to be mentioned here is *scripts* that propose event sequences in terms of participated roles and their definition. In addition to the role-definition, the dependency among the roles is also specified in the scripts.

2.1 A play with context

The main process is called a *play*. The context of a play describes what the play is and its own characteristics. A play with a context works as the initial background for the play to take place. In addition, context provides an immerse induction that will set up the contextual background and differentiated condition for the play. For example, for the concrete placement PC operational process, there are lots of differences between plaza and high-rise building sites. Different site will require different resources as well as different subsequence activity of the role.

2.2 A Director

Director is the main controller to manage the whole play process. The main responsibilities of Director are

1 Specifying the initial state, the goal state as well as the demands of the project
2 Creating a prototype of script including role-definitions and their dependencies
3 Decision making for the conflict resolution

It is obvious that the project manager is the director of the construction process.

2.3 Roles

The essential component of acting-role model is *roles*. Roles play the interactive model within the contextual situation of the play. Thus, each play is the interplaying process of multi-roles in asynchronous or synchronous modes. The interactive behaviors of roles are described in each role-definition. As collaborative construction management, the definition of roles is not just the classification or description of each activity, but also includes the description of useable resources as well as its performance.

The purpose of role-definition in terms of construction process is to define the required resources and constraints of each participant, which will allow appropriated evaluation and adjustment according to their context differences. Furthermore, the definition of roles should provide a shared understanding among participated roles that will avoid the lower performances or conflicts caused by the misunderstanding among participants. Therefore, role-definition should include:

1 title of work;
2 work performance;
3 required resources.

Until now, the definition of roles in construction process is very close to conventional engineering management method (CPM for example). The reason is that there is not much collaborative situation crossing different disciplines, and within a single domain, there are not many different roles in terms of their profession. Each participant should have a qualified processional knowledge and define their roles using top-down methodology.

2.4 Scripts

In a play, script tells actors know how to interact with each other and play their roles properly. We use such role-play metaphor to build up the project plan as the main structure of the operating process. Thus, We name this kind of plan as *scripts* in the acting role model. Members of the team can collaborate effectively following the script of the operating process.

In terms of construction operating process that involves many specialists, a valid script needs lots of expertise. Therefore, instead of top-down planning, we propose an interactive communication approach to compose the project plan.

Scripting includes two phrases. First phrase is collaborative composing the script. And second phrase is playing by applying the script to the situation provided.

2.4.1 Collaborative compose script

First stage of the scripting is composing the script. Roles propose their detail properties to reveal activities, resource and relationship with others. And then, all of the team members can share a fully understanding of the project goal and every activities in a situated context. In the end, a valid script is composed via the reflective communication process.

In the real world project, there always are conflicts during the collaboration. A user-friendly communication interface can motivate further interact among roles. An asynchronized environment, such as Web-based communication environment, has the advantage to facilitate user communication in synchronies or asynchronies way.

2.4.2 Playing

Second stage of the scripting is applying the script to evaluate the feasibility and then, refining the script by operation feedback from real world.

More than just script validation, applying the script through the Internet can reinforce the horsepower of the project monitoring. Interaction between script and operating process of the real world not only has a power tool to facilitate the project management but also can obtain a refined script to reflect the real situation, which will be the treasure of the script repository for next project.

3 A Case study—slope land leveling process

The case study described in this paper is slope land leveling process. A strait forward model is required. Acting-role model mentioned above can provide a situated communication link into the real world problem.

In this section, we will outline a primary script of play to reveal a land leveling operation sequence in the beginning. Base on this predetermined script; team member can have an overall picture of the project. Then, after discussion by demand request and supply, participators can propose more detail definition and dependencies of roles to clarify the order of the activities. Since the script is updated through the collaboration among team dynamically, conflict between activities can be identified and mitigated through negotiation and communication immediately. As a result, a more valid script of the operating process could be acquired through the building-scripts process. And last, applying this script to simulate the operating process to reflect the situation of the dynamic world is demonstrated

3.1 Primary script

Project: Slope Land Leveling Operation Project
Initial state (Entry condition): Slope land
Goal state (Results): Land leveling with a design height

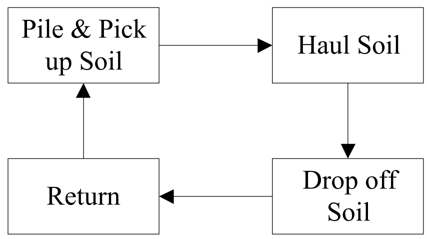

Figure 1. Initial activity model for earthmoving

Demand: Ground level is equal to design height
Script: Slope Land Leveling
Track: Slope Land
Props: Soil moving

Director:

P-Project manager proposed a primary activities diagram as an overall process model (see Figure 1). This primary diagram provides a quick insight for land leveling process that needs to pile, lift and haul the soil to level the land.

In addition, the sequence of activity, obviously, is a close loop process. Each activity on the close loop will direct influence the following activity.

Roles:

Base on the primary activity diagram above, three roles are found, which accomplish the major activities of the land-leveling project. There are:

1. B-Bulldozer
2. S-Shovel
3. T-Truck

3.2 Remodel script

In the remodel phrase, detail script is built by interplaying among the members of team. They share the primary script as the basic understanding and supply their own process knowledge back to other roles. After communicating reflectively and familiar with each other by discussion, a valid script is emerging.

However, in the real world, conflict has not necessary to be solved smoothly. Director will play as a controller when team members fall in endless discussion. Therefore, director will make the key decision to terminate the endless loops and move on the next step of the process.

Project: Slope Land Leveling Operation Project
Initial state (Entry condition): Slope land
Goal state (Results): Land leveling with a design height

Demand: Ground level is equal to design height
Script: Slope Land Leveling
Track: Slope Land
Props: Soil moving

Director:
Project manager is the main controller of the play.

Roles definition:
There are three roles definition proposed by participators.

First, a bulldozer to be responsible for two major activities that are pushes and piles the soil (see Fig 2).

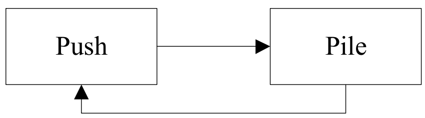

Figure 2. Bulldozer role script

Second, a shovel is in charge of three activities including shovel, pile, lift and drop soil into truck for long distance portage (see Fig 3).

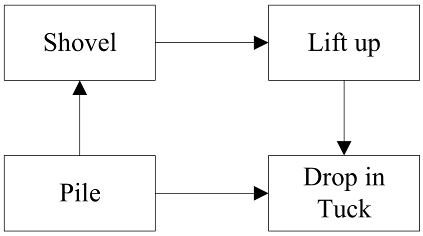

Figure 3. Shovel role script

Last, a truck is the major transportation resource of the land leveling process (see Fig 4). Haul and dump is the major activities of truck role.

Rules of roles dependency:

Rule 1: If Bulldozer is absent then Shovel will instead of Bulldozer.
Rule 2: If Truck absent then project suspended.

Scene 1. Entering:

With a demand arose from client. Project manager created a new stage for a new play

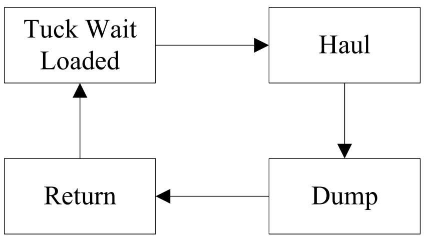

Figure 4. Truck role script

In this paper we proposed a web-based context integrated system to create a virtual stage. Through the web technology not only facilitate to build a communication forum to support collaborative construction management but also provide a distributed computational environment to form a virtual organization for specific project without geographic limitation. The architecture of the web-based context integrated system will be described in section 4.

General script repository (GSR) is a database for historical script of construction process. Director can build a new play and set up a primary script upon demand in an easy way by retrieved and inherited from similar project that was saved in the GSR

Once the primary script was build. Subcontractors can login to the virtual stage as a role to bring up their role definition more detail and refine the script as mentioned above (see Fig 2, 3, 4 and 5.).

In virtual stage each role can express his knowledge and specific requirement to help other role to find out the difference of each other. For example, bulldozer will under poor performance when geologic material is hard rock. In such situation the shovel may hook on stone breaking header to break out the rock. Besides, a new resource, rock crusher, could be a considerable alternative.

In the end, a valid script can be created by the reflective communication. Figure 5 reveal a possible script to identify the major activities sequence and their relationship

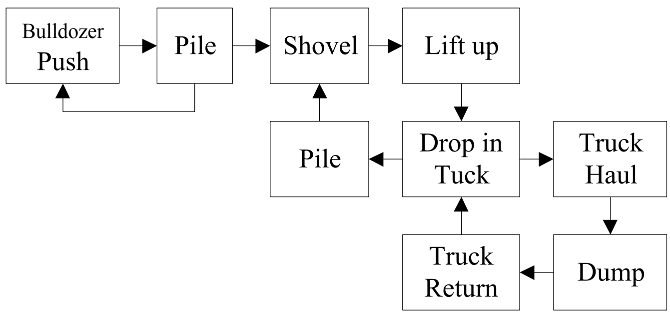

Figure 5. Slope land leveling activity model

Scene 2. Playing:

Now we can use the script to simulate the land leveling process and discuss some situation that can met in real world.

Play 1:

When we consider the land is hard rock as the example mentioned above. And role shovel may propose a possible solution as Figure 6. This proposal satisfies the rule one proposed by director in the role definition section.

Play 2:

When the role truck was unavailable. The whole process will stop as rule two mentioned. In this circumstance, director should be reminded automatically and made the decision to suspend the project or invited another role truck to participate in the project.

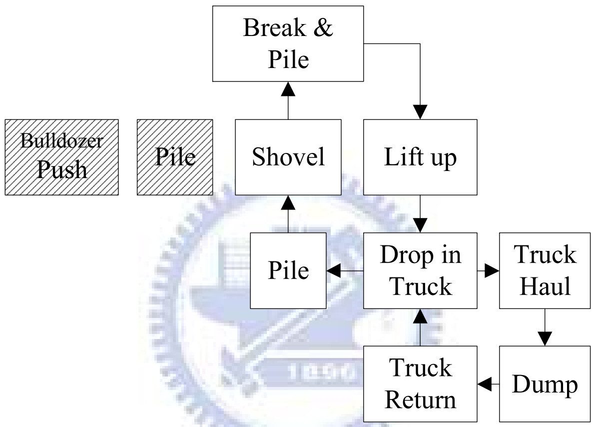

Figure 6. Hard rock land leveling activity model

4 A Web-based system architecture

Web-based distributed computational environment provides a new possibility to form a virtual organization of the construction industry. Through the basic Internet communication technologies such as email, ftp or net video/audio conference, team members can collaborate as a single organization virtually without geographic limitation and different time zone barrier. However, these technologies are all loose structure communication approach on the Internet for our needs in terms of reflective communication process described above. More sophisticated technology will be needed to establish such a virtual stage for a role-play interactive communication system for construction management problem.

As a result, in this section we proposed a preliminary web-based communication system and the architecture of the system showed as Figure 7. In the system, we are using the concurrent *web-service* technology to construct such a system.

The system is consisted of three service components. First is communication service, which provide three sub-services including content portal, data and project management interface service. Second is role-play service, which provide general script repository, role definition repository, model connector repository, and coordination/negotiation channel and script builder services. Last is a service to playing the project. In this service, project manager can be monitoring the project process, updating the progress by field manager to reflect concurrent situation of the project or using an emergent agent technology to evaluate the project performance automatically.

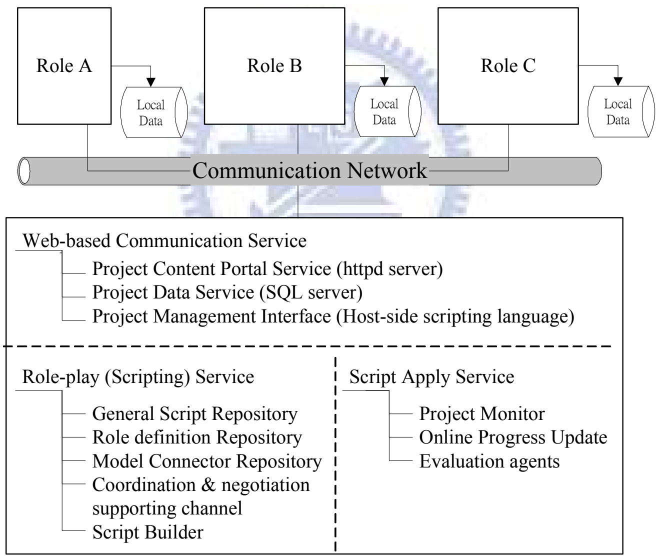

Figure 7. A proposed web-based system architecture for collaborative construction management

The interface of the client will be a thin client. Participators can reach the system and manipulate the full function of the system through a general web browser.

In this system, we are not intended to propose another smart information-retrieving system. Beyond that, we are trying to reveal a new direction for construction management service system. This system integrates data-service, communication scripting service and script applying service as an integrated construction management service system. As an ongoing research project, the situated communication model presented in this paper is the major core of the management service, which are the first step and the fundamental of the integrated service system.

5 Conclusion

This paper presents the situated communication model for construction management. This situated communication model provides an interactive approach to compose the script, which is a situated plan structure of the construction project. A valid script could be formed through a collaborative composing process compared to the top-down planning approach. In addition, conflict can be mitigated after a well coordination/negotiation process. The script also can be a guideline when the project is operating. In the end, updating the script from the field process feedback can refine the script to fit to the real world directly.

A case study has been presented to demonstrate the situated communication model for construction management. In the case, for the description of activities, we start from a well-know approach, activity-based diagram (ABD) to reveal the primary project process model, and then sub-sequence of each role. Furthermore, we identify many properties of the roles through this process, in order to clarify the definition and the dependency of the role in the script. Team members not only can insight the overall structure by the ABD of the project and ABD of the roles, but also can get the details from description of script and the contextual description produced from reflective communication. In summary, the situated communication model presented in this paper can mitigate the communication conflicts and increase the efficiency of the collaboration.

A preliminary web-based communication system architecture has been proposed. In this system architecture, we use the concurrent web-service technology to facilitate roles' interaction through the Internet. A further study over system behaviors will be essential for the implementation.

In this study, we are not intended to propose another smart information-retrieving system for construction industry. Beyond that, we are trying to reveal a new direction for construction management service system. This system integrates data-service, communication scripting service and script applying service as an integrated construction management service system. As an ongoing research project, the situated communication model presented in this paper is the major core of the construction management service, which are the first step and the fundamental of the integrated service system.

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