A Maintenance Management System (MMS)

Kenny CHAN

Master PM, PGDip., MRICS, MHKIS, MCIOB, MCIArb., AAIQS, AHKIArb., RPS, CFM(USA), PFM(HK), CFM(Japan), MBIFM, MHKICM

Program Leader, Div. of Bldg. Sci. & Tech., City University of Hong Kong, Council Member, Building Surveying Division, HKIS, Member, Property & Facility Management Committee, HKIS

Maintenance, similar with all other functions, should be goal-oriented. The following demonstrates one approach to establish goals and objectives for a Maintenance Management Program (MMP).

General maintenance goals could be deduced from:

- BS 3811 (1984) - *Glossary of Maintenance Management Terms in Terotechnology* defines 'maintenance' as the combination of all technical and associated administrative action intended to retain an item in, or restore it to a state in which it can perform, its required function.
- BS 8210 (1986) - *Guide to Building Maintenance Management* describes 'building maintenance' as work other than daily and routine cleaning, necessary to maintain the performance of the building fabric and its services.

Specific maintenance objectives could then:

- Establish an effective defects reporting and rectification system
- Promptly respond and repair discrepancies in the facilities
- Develop a system of regular scheduled maintenance actions to avoid premature failures
- Perform proper housekeeping and cleaning for building fabric/services to render an acceptable environment
- Undertake major repairs or replacements having fully considered life cycle costs and value for money
- Proactively look for improvement works to reduce total maintenance and operating costs, if capital fund permits
- Operate the facility utilities economically in an optimal way, yet with reliable performance
- Maintain a proper just-in-time stock control system for spare parts for timely maintenance
- Schedule all planned works, with allowance in staffing and resources for contingency items
- Perform project management roles for all maintenance
- Upkeep a record system for all modified works
- Devise a faster contra charge system at agreed cost centres, after each rectification
- Conduct training programmes to improve performance
- To minimize risks/disturbance to customers
- Benchmarking your organization, your services and yourselves

It is unrealistic to adopt one MMS equally applicable to all organizations; no two building maintenance establishments would be organized identically. However, a classic management model will encompass planning, organizing, staffing, directing, controlling, and evaluating. The next steps forward required are checklists for good maintenance management, with automated facility management (such as computer-assisted facility management or CAFM). Priority should be set on systematizing maintenance items, whether automated or manual. The database for an enterprise holding over a million square feet would be better automated for efficient management.

The following feedback loops should exist:

- Planning, programming, staffing, execution
- Work standards, achievable deliverables
- Facility condition assessment & audit, coping with annual funding
- Overall budget, accounting, management information system (MIS)
- Benchmarks, customer satisfaction survey

Facility Managers should implement policies and procedures to monitor each of the above regularly, adhering to the enterprise's strategic plan.

The following are details of an effective MMP, barely corresponding to the classic management model.

Planning and Programming

A comprehensive MMS commences with the fundamental data, plans, policies, procedures, and standards to set proper priorities, describe the facilities and their condition, define the work, establish standards, and organize the work into a plan that is both responsive and workable. (Under-funding in past years may cause the database to be obsolete).

The inventory of facilities describes the category of facility, states its condition (whether by ongoing inspection or a specific condition assessment), and comment on any deficiency. New elements, whether capital additions or correction of mistakes, are entered at least annually.

The annual departmental MM work plan contains major MM projects with priority order, a lump sum each to fund preventive maintenance, routine service orders and contingency items. A prioritized list of under-funded requirements should also be prepared.

MMP is planned and funded annually; it should also be operated with a mid-term plan that sets priorities on major and cyclical items.

Budgeting

Each enterprise should identify its requirements in its own unique way and organizational culture (such as bottom up or top down). Often, not all factors may be fully considered e.g. what would be the potential impact/maintenance upon toilet usage when the university canteen is reluctantly accessible by the public? If funds are available beyond the critical requirements, they are rank-ordered by priorities established in a mid-year plan. Alteration and minor construction of capital nature should not be mixed with the pre-defined MM funds without prior approval.

When the budget is prepared, Facility Managers perform analysis on unit cost comparisons, replacement values, comparisons with budget of current year and trend analysis. If the accumulated requirements exceed the funding guidance, impacts of the funding constraint by category should be submitted.

A proper cost accounting and MIS system should produce current cost data to assess requirements for preventive maintenance, minor repair, service orders, and emergency items.

Some smaller companies would tend to track the unit cost of general maintenance and service orders. Some larger organizations would track total costs by activity code, with emphasis on critical trends, projecting an overall view on all facilities.

The effects of the capital budget on a MM budget and common features are:

- Additions to the capital inventory add to the base for MMS
- Decisions based on life-cycle costing, rather than merely capital costs, have positive major downstream effects on future MM budgets
- Designing to maintain is a fundamental concept in all design policies organizing an MMP at national or international level (usually a staffing issue) or at local level (usually a staffing and a line management function) may be very different
- A Facility Manager should be undoubtedly in charge of a MMS, from policy through evaluation
- MMP is placed where it is not subject to competition for new capital funds
- A concisely defined channel for gathering, categorizing, and executing MMP to be adopted, ensuring coordination with operations, alterations, and capital construction

Organizing

Staffing for good MMP varies significantly according to the size of each company; however the following may be worth noting:

- MMP staff should be equally technically competent as the capital program staff, and they will review critically on all capital projects
- If the building inventory is of small portfolio, MMP staff may be limited to reduce overhead costs
- MMP is properly staffed to inspect for deficiencies and works done
- Training is organized to improve management and technical skills
- A proactive MMP may generate better leadership qualities

There should be an appropriate balance of works through outsourced contracts and direct staffing. Tasks related to policy, standards, budgeting, work plan development, quality assurance and evaluation would be better retained in-house, unless external audit by a third party is required.

Directing Staff

The function of directing is almost synonymous with implementing. There should be an appropriate level of job design, specification, documentation and staff's ability to respond rapidly to crisis.

MM control devices include policy, budget, standards, procedures, work plan, approval levels and MIS. The Facility Manager, given whatever level of resources and parameters, should balance control of budget/expenses, likely potential risks, revised priorities, and possible windfalls. A real-time management information system would help.

With rising benchmark requirements, Facility Managers should assess a MMP per the following factors:

- Whether the right methods and skills are adopted
- Which critical facilities are achieved
- Total backlog or against a target percentage of the replacement value
- Whether priorities are fully met
- Overall comparison of activities, category, building and proportion of works completed
- Unnecessary leakage of MM funds
- Periodic budget comparison with previous year/month

Demand for benchmarking has been accelerated by rising quality management trend focusing on efficiency and effectiveness. Benchmarking process consists of identifying particular aspects, measuring its performance, establishing similar companies for benchmarking, comparing the department's performance against competitors, and figuring out whose best practices to follow. Benchmark Report was published by International Facility Management Association triennially. A benchmarking model known as Strategic Assessment Model was developed, which also focused on assessing MMS. This model includes at least fifteen benchmarks by which colleges and universities can assess MMP with each other, highlighting recommended acceptance standards as illustrated below.

Some typical benchmarks for maintenance:

1. Benchmark for Efficiency

- Work time for each work order
- Cost per work order, classified by category, for ease of comparison
- Expended costs compared with previous record, or a measure against capital
- Works order that completed on time and how long required
- Overall maintenance funds as a percentage of the facility's capital budget

2. Benchmark for Effectiveness

- Measurements for customers' satisfaction
- Number/percentage of positive comments received, tabulated by category
- Backlog of deferred maintenance
- Hours worked/idled, checked against working hours available
- Ratio of preventive, routine and unplanned maintenance hours/output
- Statistics of plants, equipments and components failures
- Works orders finished by time period (number per month/year), by category

Would your organization's MMS be adequately reflecting the increasing demand for quality facility management services in view of the inevitable benchmarking process throughout the industry?

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Behind the Scenes of Shopping Centres - *Waste Management*

Alan LO
MRICS, MHKIS, RPS(GP)

Nowadays, shopping centres become increasingly important to our daily lives; we shop, dine, entertain or work in shopping centres. Shopping centres are no longer mere commercial developments but places for social gatherings and community's functions as well.

As at the end of year 2001, the total area of shopping centres in Hong Kong accounted for more than 28 million square feet and some popular ones are Pacific Place in Admiralty, Harbour City in Tsimshatsui, Festival Walk in Kowloon Tong and New Town Plaza in Shatin.

Popular shopping centres with a well-balanced trademix attract millions of visitors per month and visitors can easily spend a whole day there. Given the large number of visitors and the long duration of visits, a large centre generates a huge amount of waste every day; therefore good waste management is as important as other standard property management tasks like cleaning, security, repair and maintenance, etc.

Typical examples of waste are food waste from restaurants, sewage waste from washrooms, exhaust gas from kitchens, carton boxes from supermarkets, garbage from visitors, etc. We will focus on solid waste in this article.

In year 2001, the weight of commercial waste disposed of at landfills increased by 3.1% from the previous year's level; and the most unfortunate is that the 3 existing landfills in Hong Kong are estimated to be filled up within the next 10 to 15 years but no new landfill sites are available yet. This may seem just a concern for the Government but owners and managers of shopping centres have not stayed aloof as the launch of a landfill charge in the near future is expected.

The objectives of waste management were traditionally (a) reduce waste in terms of both volume and weight, (b) reuse or recycle of as much waste as possible and (c) minimise the negative impact of waste disposed on the environment.

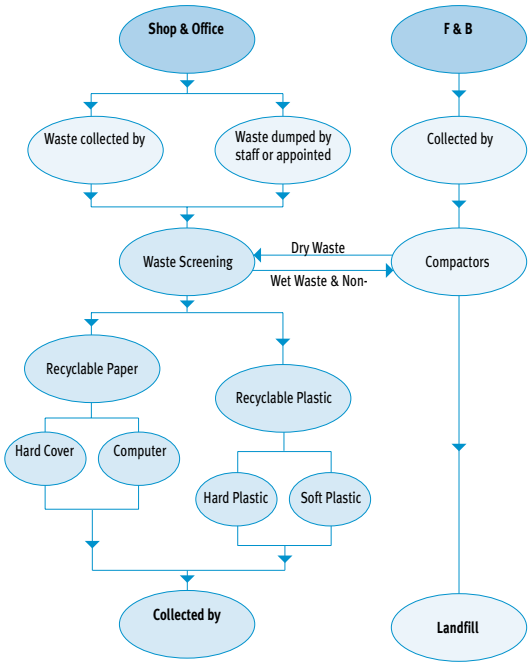
However, there are now more positive values of waste management. Waste processing helps improve the efficiency and effectiveness of handling waste; e.g. lessened weight and volume of waste can reduce transportation cost.

With the increasing environmental awareness in the society, a shopping centre with good environmental management practice will project a better image and attract more customers; this is more apparent in Europe and North America.

Moreover, owners and managers of major shopping centres are usually blue chip companies, which are well aware of their social responsibilities. To enhance their corporate image, they are also willing to allocate resources in environmental management to achieve international standards like ISO 9000 or ISO 14000.

Having said all the merits of waste management above, the question now is how a waste management system is actually run behind the scenes. The flow chart below showing the solid waste management process of a major shopping centre in Kowloon will give you a clearer idea.

Let us follow the journey of a carton box disposed



by a supermarket - the empty box will first be collected by a cleaning contractor from the supermarket to the refuse room where the manual screening process will pick out the recyclable carton box for a recycle agent to collect. In case it is a bucket of wet food waste from a restaurant - the cleaning contractor will collect the waste from the restaurant and pour the waste from the bucket into a compactor (which is a large machine functioning like a blender and dehydrator to reduce the volume, water content and weight of the wet waste) in the refuse room and the compacted waste will then be disposed of at the landfill.

To make a long story short, the waste management process can be briefly described in a simple sequence: (1) source, (2) collection, (3) screening, (4) volume/weight reduction and finally (5) collection by recycle agents or disposal at a landfill.

The whole process is really as simple as it is shown but the result is significant. With the full operation of the waste management process kicked off in mid 2001, the waste landfilled in 2002 was already reduced by 13.3% and 32% weight of the total waste was recycled.

What was most encouraging was that the centre's manager does not need to pay an extra penny for the additional manpower responsible for the manual waste screening process. This is because the income generated from the selling of recyclable materials such as carton boxes, plastic bottles, and aluminum cans, etc. has already covered the extra labour cost.

Notwithstanding the significant results achieved, there are still a substantial amount of recyclable materials going to the landfill owing to cross-contamination; e.g. once a piece of recyclable paper is contaminated by an oily lunch box, it is no longer recyclable.

Therefore, when you visit your favourite shopping centre next time, try to appreciate the workers running the waste management process behind the scenes and be considerate by making good use of the waste separation/recycling bins, if available.

Interview with Ian Wong, *General Manager (Property and Land) of Urban Renewal Authority (URA)*

The Urban Renewal Authority (URA) was established in May 2001 to regenerate the run-down parts of Hong Kong through a combination of redevelopment, revitalisation and rehabilitation. It also strives to preserve Hong Kong's culture and heritage, and buildings with historical value while redeveloping old districts.

Mr Wong, a general practice surveyor and head of the valuation department, is responsible for formulating URA's policies on acquisition, re-housing and cash compensation, analysing project viability, and assessing acquisition offers.

1. What is the role of the URA?

The URA was established to speed up urban renewal in Hong Kong. For redevelopment projects, we aim at completing the acquisition and clearance process within 24 months from the first date of making an offer. In our Wan Chai project H16, the exercise was completed in a period of 17 months only. Since early 2002, we have commenced acquisition for 9 projects, covering more than 900 property interests.

2. So, what are the difficulties in urban renewal and how do you overcome them?

There are a number of challenges, particularly when we are talking about buying other people's home. This includes agreement on purchase offers and reducing the social impact. With the 7-valuer system in place and the sound support of professional advice provided by our fellow surveyors, we have smoothened the acquisition process. However, there are always difficult cases to resolve. This will require patience and understanding from both sides. On the social front, we have commissioned locally based Social Service Teams to assist people affected by our projects, especially groups with special needs like the elderly. We have also arranged with major banks special loan/mortgage facilities for use by the owners affected. Our approach is people-oriented.

3. How do you find your work in URA?

My work provides me with good opportunities to obtain exposure, experience challenges and achievements. I have met with people from different walks of life, from big developers to small property owners and tenants. Meetings at the Legislative Council and District Council are often. I also attended TV forums and phone-in radio programs. Achievements came when I was able to purchase all affected property interests without the need of resumption and when a project was completed.

4. Had the URA slowed down the pace of urban renewal in recent years of unfavorable market conditions ?

Quite to the contrary, the pace of urban renewal has not slowed down at all. With the approval of the Financial Secretary, we started implementation of 3 "Early Launch Projects" even before the commencement of the first year programme. So far, we have started acquisition for 9 projects and gazetted one project under the URA Ordinance. We will launch another 5 projects by the end of this financial year. In addition, we have also entered into a strategic partnership with the Housing Society to implement 7 more projects in the next 5 years.

5. In calculating the Home Purchase Allowance (HPA), URA has opted for advice from seven surveying firms, instead of two as in the past. Can you tell us more about this?

The URA offers an owner-occupier of domestic property the market value (valued on vacant possession basis) of his property plus an ex-gratia allowance, namely Home Purchase Allowance (HPA), for purchase of the property. The HPA is the difference between the value of a notional flat, which we define as a 7-year-old flat in a comparable quality building in the locality, and the open market value of the property being acquired. Opinions on the value of the notional flat can be quite different. In order to build up a wider base of reference and hence a fair assessment, we engaged seven valuers to provide valuation advice on the unit rate of a notional flat. The following weighting mechanism will apply to the valuations obtained:

Unit Rate in Ascending Order	Percentage Weighting
Lowest	0%
Second Lowest	10%
Third Lowest	20%
Median	40%
Third Highest	20%
Second Highest	10%
Highest	0%

This is an administrative measure with a view to expedite acquisition of domestic units. It is one of the means to improve the previous practice. Should fellow members have any suggestions, please feel free to give me a call at 2588 2222.

6. Will the URA review its compensation policies if it keeps on losing money in the projects?

The policy generally follows the one passed by the Finance Committee of the Legislative Council. Based on this policy, we have to pay some 2.5 to 3.2 times the market value of acquired properties of 35-45 years old. Some members of the general public opine that the Home Purchase Allowance is too generous. In addition, this will also affect the viability of a project. We will bear this in mind as well as the need to balance the interest of the general public and that of the stakeholders of urban renewal. We welcome discussions and suggestions.

7. How do you see the future development of urban renewal in Hong Kong?

At present, there are about 9,300 private buildings in the Metro Area which are 30 years' old and above. This number will continue to rise and the demand for urban renewal will increase correspondingly. We are taking a holistic approach by applying what we call the 4 Rs, viz. Redevelopment, pReservation, Rehabilitation, and Revitalisation. As mentioned earlier, we have already started acquisition for 9 redevelopment projects. Some of the buildings with architectural interests will be preserved. By rehabilitation, the URA will assist and encourage property owners in carrying out voluntary maintenance of their property. This has a positive impact to the surveying profession because rehabilitation requires support from building surveyors. Revitalisation is a coordinated approach of improving urban fabric in conjunction with the other 3Rs, such as upgrading of pavement, road works, open space as well as organising street events. It aims at stimulating business activities by introducing livelihood to an urban area. After all, urban renewal requires a fine balance between costs and benefits. This would require innovation and dedication to accomplish.

Emily Ling with Ian Wong

Interim results for registered area defects in the New Territories

Dr Conrad TANG
BScEng(Surv), MEng, PhD, MHKIS, RPS(LS)
Assistant Professor, Department of Land Surveying and Geo-Informatics,
Hong Kong Polytechnic University

Steve LAM
Department of Land Surveying and Geo-Informatics,
Hong Kong Polytechnic University

Alice CHENG
Department of Land Surveying and Geo-Informatics,
Hong Kong Polytechnic University

Introduction

A comparison of four Demarcation District sheets (DD sheets) and their respective registered areas using digitization method has given a pilot study on the estimation of the number of problematic lots in the New Territories (NT) [Tang, 2003]. In general, a quarter of the Old Schedule Lots have defects in the registered area. This project of the Department of Land Surveying and Geo-Informatics of the Hong Kong Polytechnic University ("PolyU") further extends the investigation area to 21 sheets of DD covering all 9 NT land administration districts. The primary aim is to quantify the total number of lots for which discrepancy exists between the registered area and the original graphic boundary record. Several aspects of boundary discrepancies are investigated and the results are to provide a better picture on the error analysis of the long-used basic land boundary records in Hong Kong.

Information Acquired

In this project, SMO (Surveying and Mapping Office) and the Hong Kong Land Registry kindly supplied copies of the required plans and document. There were six 1:3960 DD sheets and fifteen 1:1980 DD sheets selected from nine NT District Survey Offices (Table 1); and the corresponding Schedules.

District	DD Nos.	Plan Scale
Tsuen Wan	356	1:1980
Kwai Tsing	455	1:1980
Yuen Long	107, 119, 125, 129	1:3960
Tuen Mun	137	1:3960
	385	1:1980
North	45, 63, 75	1:1980
Tai Po	12	1:3960
	28, 203	1:1980
Shatin	174, 191	1:1980
Sai Kung	217, 227, 233	1:1980
Islands	3 Lamma Island (Sheet 2), 305 Lantau	1:1980

Procedure

To generate accurate figures on individual lot area discrepancy, a raster-vector conversion software namely Geoway and a graphical software were used. Microstation was applied to compute the areas efficiently based on the digitized DD sheets images provided. A comparison of sample lots from twenty-one DD sheets and their respective registered areas had been worked out. For those differences exceeding 20 m2 (half of one hundredth of an acre) in two different scaled DD sheets were classified as registered area defect, because it was numerically wrong to have the registered area stated in that discrete number.

It was initially planned to scan the full page of a DD sheet and it was soon realized that not too many whole DD sheets were clearly usable for scanning and automatic polygon generation. Areas of intact and clear images were selected from various DDs. It would be more useful if the selected lots were existing lots in current land records. That means they could be used to compare with the current land boundary records kept in the Cadastral Information System in SMO.

Initial Findings

In Table 2, a total of 1,942 lots (212 house lots & 1707 agricultural lots) within these DD sheets were digitized and analyzed. The coverage ratio of the selected lots varied from 1 in 45 to one-half on a DD sheet. The ratio of the found registered area defects ranged from 19% to 76% in a DD (Table 2). And, the overall ratio of the registered area defects was 42% (819 lots out of 1942 lots in Table 2).

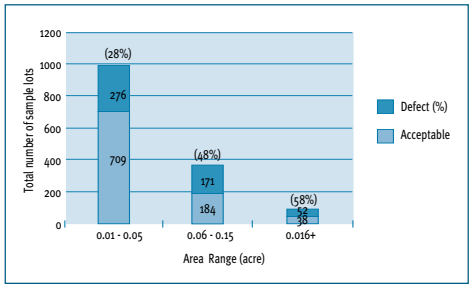


Figure 1 - Registered area defects in 1:1980 DD sheets

Over two-thirds of the lots belonged to the small area group (0.01 to 0.05 acre). Although those larger area lots (0.06 to 0.15 and plus acre) seemed to have higher ratios of registered area defects, it was well expected as a large graphic area tended to more easily have error in area estimation precise to a half of 0.01 acre (Figure 1). DD203 was found to have the largest number of the said defects, whereas DD3 had the least as shown in Table 3.

As expected, the scales had effects on the derived area. As referred to in Table 3, the overall percentage of registered area defects in 1:1980 DD sheets (35%) was lower than that in 1:3960 (62%). With these defects (Figure 3), there were more lots (1,194 lots) occupying area larger than registered than the lots occupying less area than registered (716 lots).

Preliminary Analysis

This test result of one-third of lots in the 1,980 DD sheets and two-thirds of lots in the 3,960

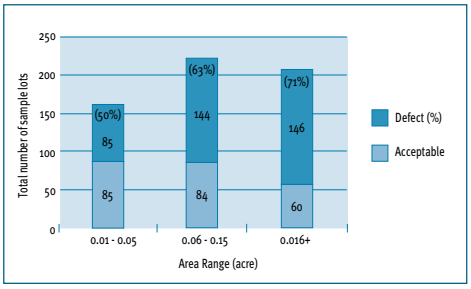


Figure 2 - Registered area defects in 1:3960 scaled DD sheets

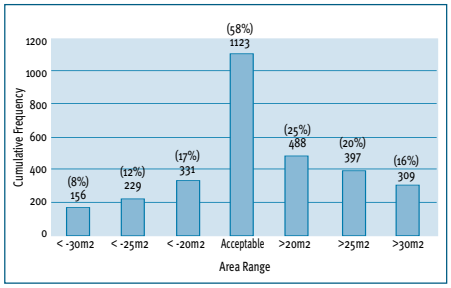


Figure 3 - Magnitude of area defects (Overall)

DD sheets showing registered area defects indicated that the magnitude of errors of area estimation by the graphic method adopted in 1905 was far too significant. It was confirmed that a large scale DD (1:1980) yielded better accuracy than a small scale DD (1:3960). The larger the area - the more the chance exceeded the tested norm which was 20 m2 here. It was interesting to find out that the exceeding and the deficient defects in area were roughly equal, although the exceeding side (graphic area larger than the registered) showed constantly larger numbers.

The influence of scale is well known and the Government has adopted a reasonable yard stick to measure the area re-definition on the Old Schedule Lots by adding a 5 to 10% graphic error to the basic 20 m2 (SMO, 1998). The registered area is defective when there is a mismatch between the graphic area (possible actual occupation) exceeding 20 m2, and certainly it is problematic in area when the mismatch exceeded the SMO definition.

We are working on the analysis of these errors. Another significant source of error is the wrong recording of rent in the Schedule, and a wrong rent would affect the integrity of title even if the graphic area matches the registered area well. To compare this result with the existing Lot Index Plan will give another meaningful indication to the boundary problems. The work is now being carried out.

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Table 2 - Statistics

District	DD Nos.	Sample Data Size				Registered Area Defect		
		Cover Ratio[1]	House (Qty)	Agri. (Qty)	Total (Qty)	House (Qty,%)[2]	Agri (Qty,%)[3]	Total (Qty,%)[4]
IS	DD3 Lamma	1 / 11	0	138	138	0 (0%)	26 (19%)	26 (19%)
IS	DD305 Lantau	1 / 15	112	35	147	29 (26%)	13 (37%)	42 (29%)
KT	DD455	1 / 4	0	63	63	0 (0%)	27 (43%)	27 (43%)
DN	DD45	1 / 10	0	123	123	0 (0%)	55 (45%)	55 (45%)
DN	DD63	1 / 5	45	39	84	7 (16%)	16 (41%)	23 (27%)
DN	DD75	1 / 10	0	115	115	0 (0%)	48 (42%)	48 (42%)
SK	DD217	1 / 13	0	75	75	0 (0%)	23 (31%)	23 (31%)
SK	DD227	1 / 8	0	60	60	0 (0%)	27 (45%)	27 (45%)
SK	DD233	1 / 2	0	105	105	0 (0%)	43 (41%)	43 (41%)
ST	DD174	1 / 9	0	108	108	0 (0%)	26 (24%)	26 (24%)
ST	DD191	1 / 6	17	99	116	8 (47%)	28 (28%)	36 (31%)
TM	DD137	1 / 6	0	110	110	0 (0%)	68 (62%)	68 (62%)
TM	DD385	1 / 4	26	59	85	11 (42%)	17 (29%)	28 (33%)
TP	DD12	1 / 6	0	44	67	0 (0%)	40 (60%)	40 (60%)
TP	DD28	1 / 12	0	58	58	0 (0%)	23 (40%)	23 (40%)
TP	DD203	1 / 7	2	69	71	0 (0%)	41 (58%)	41 (58%)
TW	DD356	1 / 4	9	73	82	2 (22%)	31 (42%)	33 (40%)
YL	DD107	1 / 20	1	91	92	1 (100%)	37 (41%)	38 (41%)
YL	DD119	1 / 19	0	112	112	0 (0%)	73 (65%)	73 (65%)
YL	DD125	1 / 34	0	58	58	0 (0%)	44 (76%)	44 (76%)
YL	DD129	1 / 45	0	73	73	0 (0%)	55 (75%)	55 (75%)
Total			**212**	**1707**	**1942**			**819 (42%)**

1 Cover Ratio: Numbers of samples/ Total numbers of lot in the Schedule.
2 House (%): Total numbers of problematic house lots / Total numbers of house samples in this sheet x 100%.
3 Agri. (%): Total numbers of problem agricultural lots/ Total numbers of agricultural samples in this sheet x 100%.
4 Total (%): Total numbers of problem lots/ Total samples in this sheet x 100%.

Table 3 - Percentage comparison for two different scales of DD sheets

1:1,980 scaled DD sheets				1:3,960 scaled DD sheets			
District	DD Nos.	Samples (Qty)	Area defected lots (Qty,%)	District	DD Nos.	Samples (Qty)	Area defected lots (Qty,%)
IS	DD3 Lamma	138	26 (19%)	TM	DD137	110	68 (62%)
IS	DD305 Lantau	147	42 (29%)	TP	DD12	67	40 (60%)
KT	DD455	63	27 (43%)	YL	DD107	92	38 (41%)
DN	DD45	123	55 (45%)	YL	DD119	112	73 (65%)
DN	DD63	84	23 (27%)	YL	DD125	58	44 (76%)
DN	DD75	115	48 (42%)	YL	DD129	73	55 (75%)
SK	DD217	75	23 (31%)				
SK	DD227	60	27 (45%)				
SK	DD233	105	43 (41%)				
ST	DD174	108	26 (24%)				
ST	DD191	116	36 (31%)				
TM	DD385	85	28 (33%)				
TP	DD28	58	23 (40%)				
TP	DD203	71	41 (58%)				
TW	DD356	82	33 (40%)				
Total		**1430**	**501 (35%)**			**512**	**318 (62%)**

Towards a Spatial Data Infrastructure (SDI) for Hong Kong

Victor NG Tak Wai
Land Surveyor, District Survey Office/ North

Introduction

Every person depends upon spatial data or so called geographic information to support their daily activities. The range of spatial data used is very diverse ranging from "coarse" data about the geographic location of a country on the earth, to "fine" data concerning the identification of a lamppost. It is estimated that up to 80% of all data have some spatial or geographically related characteristics (Kacmar et al., 1995).

Geographic information is "*information about objects or phenomena that are associated with a location relative to the surface of the Earth*" (AGI, 1999). A geographic information system (GIS) is "*a powerful set of tools for collecting, storing, retrieving, at will, transforming and displaying spatial data from the real world*" (Burrough, 1986, p. 6). Since almost every human activity has a spatial component, GIS is useful to nearly every discipline. The adoption and use of GIS technology has significantly increased demands of spatial data (Masser, 1998). While the spatial data has become widely available, people need a way to share the data to exchange or provide access to information among each other. An obvious example is that development planning of a city is dependent on relevant spatial information from various organisations such as the Planning Department, Census Department, Transport Department and Lands Department. Spatial data has the potential to impact widely on society, due to its ability to represent a host of important characteristics spatially and thus provide support in areas as diverse as town planning, oil exploration, environmental monitoring, crime protection, marketing decision and investment analysis. Sharing of spatial data can improve the ability of the spatial data users to make informed choices.

Masser (1998) points out that most operational applications of GIS depend on the availability of spatial data collected by government agencies in some ways. Governments have made major investments in collecting spatial data and these data have become national resources that are fundamental to good decision-making (AUSLIG, 2000).

Given these circumstances, many governments in the world are starting to re-examine their geographic information strategies in order to facilitate the use and integration of spatial data. Spatial data infrastructure initiatives are currently underway in many countries of the world. Among them, the most highly publicised initiative is the programme to establish a National Spatial Data Infrastructure (NSDI) in the United States to coordinate geographic data acquisition and access (Masser, 1998).

In Hong Kong, the government is committed to enhancing and promoting Hong Kong's information infrastructure and services so as to make Hong Kong a leading digital city in the globally connected world of the 21st century (ITBB, 1998). In parallel, Hong Kong is going to develop shared spatial data and broader applications of GIS within society (HKSAR, 1999). As such, the development of an SDI in Hong Kong is inevitable in order to facilitate spatial data sharing and dissemination.

Significance of the SDI

Masser (1998) identifies three key elements of spatial information strategies including the need for overall coordination, the identification of core spatial databases and the significance of metadata services. Metadata is defined as "*data about data and usage aspects of it*" (AGI, 1999).

Governments and private sector agencies in many nations are facing the problem that their needs for accurate digital spatial data exceed their capacity to create and maintain the data. At the same time, these nations are also focusing on efficiency and accountability in the use of public resources. As spatial data are the basic building block of searching and analysing those public resources, this partly explains the rapid global spread of the concept of the SDI that encourages data sharing within and among organisations (Tosta, 1997a).

Masser (1999) propounds that geographic information can assist decision-making, improve economic growth, social development and environment management. He also points out that government agencies are not only the main external providers of geographic information for most operational applications of GIS but they also exert a crucial influence on national developments. In the United States, the Mapping Science Committee (MSC) (1995) believes that government plays a leading and facilitating role in coordinating the development of spatial data and making those data available for public use and exchange.

Due to its traditional role in the collection, maintenance, and dissemination of geographic information, a government should play an important role in promoting and facilitating the use of geographic information by developing an effective and efficient geographic information strategy. A government has the responsibility to develop an SDI to achieve better use of geographic information (Onsrud *et al.*, 1998; Lopez, 1998).

Because of the differences in political, institutional, technological, geographical and human behavioural factors, it can be understood that responsibilities, authorities and approaches to geographic information as well as the SDI may vary greatly among different countries and regions. Masser (1999) presents in his report the findings of a preliminary study of international experiences of the development of the SDIs. There is a great deal of diversity in terms of status, scope, access, approach to implementation and resources among studied countries.

Benefits of the SDI

The tangible indicators of an SDI are effective links between data from different sources, widespread use of SDI-compliant data and their adopted standards, and guidelines for data quality. The economy of the tangible aspect of an SDI can be in terms of the time savings in data collection, creation and maintenance.

There may also be intangible indications of the success of an SDI such as, raising awareness of geospatial data beyond the current user communities and greater collaboration resulting in commercial success.

However, the impact on the economy of the intangible aspect is difficult to measure. The economic advantages through the use of an SDI, such as a company choosing the best location for their outlet or government departments more effectively battling epidemic, cannot always readily be quantified.

Nanson and Rhind (1998) opine that the implementation of an SDI assists development at all levels with potential benefits for all in the form of new commercial services and better government.

The benefits of the establishment of an SDI are observed as follows:

- Reduce duplication of effort

  An SDI can reduce the potential for waste and duplication of effort by coordinating the development, use, sharing, and dissemination of spatial data. Through the use of an SDI, an organisation is not required to prepare the data itself if the required data are readily available in the SDI. Independent preparation of the same data by different organisations can be avoided. In this connection, the cost of data collection and creation can be reduced.

- Save costs

  With the implementation of an SDI, spatial data produced by one organisation or political jurisdiction can be compatible with similar data

produced by other organisations or jurisdictions in agreed standards and specifications. When organisations share the data, less or no effort is required to convert the data into the required specifications. This will achieve cost effectiveness and save costs in data acquisition.

- Improve resources allocation

An SDI provides efficient algorithms for capable incorporation of different types of spatial data, effective search of huge spatial datasets, and versatile representations of goals and constraints in order to facilitate scheduling and resource allocation.

- Gain economic growth

An SDI can reduce and avoid unnecessary data collection, uneconomic data handling methods and erroneous decision-making caused by lack of information. It can facilitate economic competitiveness and cultural enrichment by the wider exploitation of available geographic information.

- Enable access to timely and accurate spatial data

The purpose of an SDI is to provide a framework to exploit geographic information by the public and enable business growth through viable, comprehensive, demand-led and relatively easy data access. An SDI also facilitates ready access to government spatial data that will encourage more extensive use of a valuable public resource for the benefit of the community.

- Improve efficiency

An SDI improves efficiency in data collection, processing and distribution. It also promotes the use of spatial data and the exploitation of the potential offered by spatial data and related technologies for greater efficiency and effectiveness.

- Improve data standardisation

Lack of consistency between different spatial datasets will result in lack of compatibility among different applications. This will lead to duplication of effort in data acquisition and difficulties in accessing important datasets. An SDI enforces the formulation of data standards and the creation of the metadata to improve data standardisation.

Needs for an SDI in Hong Kong

In Hong Kong, geographic information and GIS have also been increasingly employed in recent years by the Government of the Hong Kong Special Administrative Region (hereafter referred to as the Hong Kong government) and the private sectors to support their daily operations. In order to provide societal GIS, it is required to establish an SDI to minimise duplication of effort in collecting the expensive digital data and facilitating data sharing and dissemination. As a first step, the Land Information Centre (LIC) of the Lands Department of the Hong Kong government completed a prototype metadata system in early 1998 for the LIC's digital map data (Leung, 1998). The prototype metadata system is proposed to be a clearinghouse for an individual who wishes to know about spatial data in the Hong Kong government. At present, the prototype contains only three sets of the metadata including the basic mapping system of the LIC, the cadastral information system of the LIC, and the water mains record plan data of the Water Supplies Department. The purpose of the clearinghouse is yet to be realised. The establishment of the prototype metadata system is initiated by the Lands Department for trial only. The Hong Kong government has not yet formulated its spatial data strategy nor proposed productive metadata services. Actually, there is neither a well-structured organisation nor a well-established framework to coordinate the development of an SDI in Hong Kong.

Future Directions

Promoting economic growth is one of the most important goals under the agenda of the Hong Kong government policy address. The Hong Kong government is reviewing its finance investment in information production, dissemination and archiving. This has led to the recent consultancy study on alignment of planning, lands and public works data for devising the interdepartmental data administration policy of the Hong Kong government.

Currently, the GIS market in Hong Kong is still in its embryo stage. Most of the active GIS users are within the Hong Kong government. In order to establish a rigid institutional framework and to collaborate partnership, the spatial data stakeholders, providers and users among public sector, private sectors, and academia should be involved.

The Hong Kong government should recognise the increasing demand of spatial information in a coordinated manner, which requires the establishment of a SDI for Hong Kong. Policy is the most important factor in implementing the SDI. The government should take lead to formulate the appropriate policy and legal framework in setting up the SDI. In this connection, the Hong Kong government should address the policy implications and mission opportunities of establishing an SDI as follows:

a) Establish legal framework - issues such as liability, confidentiality, information privacy and costing must be explicitly addressed in order to align with the government policy and the social interests. The establishment of the SDI should recognise the existing state of copyright laws, pricing policies, etc.

b) Facilitate electronic access - newly developed electronic access channels such as Internet, Intranet and Extranet are cost-effective means of disseminating digital datasets. The distributed network infrastructure should be built up and evolved to cater for the SDI.

c) Invite participation - institutional partnerships provide a unique opportunity for institutions to share government spatial data development cost and benefits. It will be increasingly important for agencies from various parties to work cooperatively in sharing resources and technical expertise to set up the SDI in data production, management, and dissemination. The SDI may require participation of commercial activities.

d) Promote open access - copyright and other forms of intellectual property rights that may limit the re-dissemination of spatial data should be imposed as minimum as possible provided that the government's responsibility to protect information privacy can be complied with. The information policy should promote equity use of information regardless of rich and poor.

The final goal is that the participants in the field of spatial data are working together in the same direction, allowing solutions to emerge, enabling the widest possible diffusion of technologies. The SDI should be embedded within and formed part of the National Information Infrastructure (NII) to provide the vital services and capabilities required for the information society. The SDI should work for the benefit of the community, rather than simply becoming a technically imposed solution. It should not only cater for individual GIS but for a collaborative GIS network. This can improve and help expand applications to serve Hong Kong's people better.

Constructive Acceleration - Acceptance by the UK Courts

John B MOLLOY

LLB(Hons), BSc(Hons), FHKIS, FRICS, FInstCES, MCIArb, MAE, RPS(QS)

Managing Director, James R Knowles (Hong Kong) Limited

In an article some eighteen months ago I looked at constructive acceleration and questioned whether it was a valid claim.

'Constructive acceleration' is acceleration that is undertaken by a contractor of his own volition, i.e. without either an instruction from the Contract Administrator, or an agreement with the Employer (depending upon whether the contract provides for acceleration or not). The term originated in the United States Court of Claims where there is doctrine of constructive acceleration relating to situations where an instruction to accelerate is implied from the actions of the Employer or the Contract Administrator.

Such a situation commonly occurs in Hong Kong where the Contract Administrator does not assess the extension of time that the Contractor is entitled to at the time of the delay, but waits until the end of the project and then assesses the extension of time that the Contractor actually needs.

When the Contract Administrator adopts such an approach it puts the Contractor in a very difficult position. Consider the following example. A Contractor suffers a delay for which he considers himself entitled to an extension of time of eight weeks. He serves his notice, submits his particulars, but the Contract Administrator enters into arguments about the principle and detail of the extension of time claimed. What is the Contractor to do, particularly when late completion carries very large liquidated damages with it?

It is a bold Contractor who decides that notwithstanding the high level of liquidated damages he will finish six weeks late because he is entirely confident that he is going to get the eight-week extension of time he is entitled to, even if it means going to arbitration to enforce his rights. However, nor will a Contractor generally accelerate to complete on time because the costs will be too high and in any event why should he if he believes himself entitled to an extension of time.

More likely the Contractor will accelerate (constructive acceleration) albeit partially to reduce his potential risk to liquidated damages whilst still pushing the Engineer for any extension of time. In such a scenario the Contractor will accelerate, finish one month late and the Contract Administrator will begrudgingly grant him the one-month extension of time that he needs.

Where such happens the question that arises is whether the Contractor can claim back the costs that it has incurred in acceleration, particularly if the Contractor can show that it was entitled to the full extension of time originally claimed?

Claims on this basis are common in the United States, but in Hong Kong (and generally under English legal systems) there is no doctrine of constructive acceleration and the leading textbooks have traditionally suggested that such a claim in not valid. For example:

Mr I.N. Duncan Wallace, in Hudson's Building and Engineering Contracts states:

> *"...in those cases where an A/E has been shown to have wrongly rejected applications for extensions of time and called for completion to time a claim to have deliberately accelerated progress as a result of a typical owner's breach will usually be unlikely to satisfy the remoteness requirements of either branch of the Hadley v Baxendale rule..."*

and in Building Contract Claims by Powell-Smith & Sims the authors state:

> *"Where the architect wrongfully fails to make an extension of time, either at all or of sufficient length, the contractor's clear remedy under the contract is arbitration ... if he increases his resources, that is not a direct result of the architect's breach, but of the contractor's decision."*

However notwithstanding these negative comments, in my last article I drew attention to two cases that did provide some support for claims for constructive acceleration. These were the Singaporean case of ***Aoki v Lippoland (Singapore) Pte Ltd (1995) 2 SLR 609***, and the Australian case of ***Perini Corporation v Commonwealth of Australia (1969) 12 BLR 82***.

However the problem with these two cases is that they were decided with specific regard to their facts, and so their universal application was doubtful. In particular, the Singapore case relied upon the contract provision that the Contract Administrator must act within a set period of time, and in the Perini case the facts were quite extreme in that case as the Contract Administrator had actually refused to grant extensions of time in certain circumstances where an extension was clearly due.

So the validity of such claims in the United Kingdom and Hong Kong was, to say the least, very doubtful.

However, contractors will be very pleased to hear that claims for constructive acceleration have now been given judicial support in the United Kingdom in the recent case of ***Motherwell Bridge Construction Ltd (t/a Motherwell Bridge Storage Tanks) v Micafil Vakuumtechnik and another (CILL November 2002)***

The facts of the case are relatively straightforward. Micafil awarded two sub-contracts to Motherwell Bridge for the construction of an autoclave (a strong, pressurized, steam-heated vessel, for laboratory experiments, sterilization, or cooking). The sub-contracts were on FIDIC terms.

Delays occurred to the progress of the works. Motherwell Bridge claimed that these delays were the responsibility of Micafil and requested an extension of time of three weeks. In their letter claiming entitlement to an extension of time Motherwell Bridge also commented that the delay could be extinguished by working overtime. The letter read as follows:

> *"Motherwell Bridge proposes accelerating the original contract programme by increasing labour and plant resources and additional working shift patterns in order to absorb the additional works resulting in the increase in weight of the autoclave. Should this not be acceptable we would require an extension to autoclave "ready for reception test" until (week 47)".*

No extension of time was forthcoming and Motherwell Bridge duly commenced night working from 19 June 1998 to 11 September 1998 in order to try to keep the work up to schedule. In simple terms they carried out constructive acceleration.

In this action Motherwell Bridge, inter alia, claimed for reimbursement of the costs of this constructive acceleration. It was their position that the costs of the constructive acceleration had been incurred in attempting to comply with Micafil's implied wish for the contract to be kept to time and against the background of Micafil's refusal to grant appropriate extensions of time.

In his judgment His Honour Judge Toulmin QC found that Motherwell Bridge were entitled to the costs that they had incurred in constructive acceleration. He said that he was satisfied that the costs were incurred by Motherwell Bridge in an attempt to recover time lost in completing the work in circumstances where they were subject to significant penalties for delay if they failed to complete the work on time, and that he accepted that acceleration costs should be awarded where a party has been denied an extension of time which he was entitled to.

This judgment will be of great interest to contractors as it gives judicial support to claims for constructive acceleration. It should also be a warning to Contract Administrators that should they fail to assess and grant extensions of time for delays in a timely manner that the Employer may be faced with a valid claim from the Contractor for constructive acceleration.

Concurrent Delays - A Practical Approach - *Part 3*

This is the third and final part of the article on concurrent delays - a practical approach.

Examples

A few examples of delay analysis are provided below.

Example 1

The contractor planned to commence pre-drilling for bored piles on day 8. It did not start until day 25, i.e. a culpable delay of 17 days. The contractor, however, brought additional pre-drilling and bored piling plant to site and the re-run programme and the contractor's subsequent performance showed that the 17 days of culpable delay was extinguished due to the provision of extra resources.

The contractor was, therefore, not responsible for delay to completion as the culpable and non-compensable delay caused by the late start of pre-drilling was extinguished.

This is a common scenario as experienced contractors will look to extinguish the delaying effects of a culpable event as it is usually less expensive than the alternative of liquidated damages, prolongation costs and sub-contractors' claims.

Example 2

The contractor excavated trial holes as planned, commencing on day 1, and immediately found uncharted utilities which clashed with the proposed permanent works design of a reinforced concrete culvert. The contractor had planned to commence excavation for the culvert on day 8, but could not do so. Instead, the contract administrator instructed diversion of the uncharted utilities, which took 120 days.

Excavation for the culvert commenced 120 days later than programmed and delayed completion by a similar period. The contractor claimed additional time and money for 120 days.

Adjacent to the culvert was a retaining wall, the excavation for which was planned to commence on day 22. The retaining wall was in a non-critical string of activities with 50 days float. The contractor delayed the start of the retaining wall by 100 days as it took benefit of the delay caused by the diversion of the uncharted utilities to defer expenditure on the retaining wall. The contract administrator, however, maintained that the retaining wall deferment constituted a culpable delay and no additional payment should be made during the 100 days of the 120 days prolongation caused by the diversion of the uncharted utilities due to alleged culpable delay on the retaining wall.

In example 2, the dominant delay was that caused by the diversion of the uncharted utilities and that was the first delaying event to occur. It was an excusable and a compensable event. It created further float in the string of activities including the retaining wall which float subsumed the effects of the retaining wall deferment which did not cause delay to completion. Therefore, as the contractor could utilize this float, it should have been reimbursed prolongation costs for all of the 120 days.

Example 3

Take example 2, but the retaining wall excavation was due to start on day 1 but was not started until day 15 and then took 15 days longer (a total delay of 29 days). Excavation for the culvert was planned to start on day 8 but the utility diversions delayed this by 120 days, which caused a similar delay to completion.

The contractor claimed reimbursement of prolongation costs for 120 days but the contract administrator maintained that the retaining wall deferment was a culpable delay and payment was only due for 91 days (120 - 29 days).

In example 3, the dominant delay commenced on day 8 when uncharted utilities were found and the culvert excavation could not commence as the utilities had to be diverted. On day 8, the dominant delay became the diversion of the uncharted utilities and the contractor should have been reimbursed prolongation costs for all of the 120 days as the effects of the retaining wall deferment were subsumed by float and did not affect the date of completion.

Example 4

The contractor's programme had two critical paths both with zero float:-

Path 1

- construct the structure;
- install the permanent lifts;
- remove the temporary hoists;
- curtain walling infill;
- FSD and BD inspections;
- finish fitting-out.

Path 2

- appoint the curtain walling nominated sub-contractor;
- design development, submissions and approvals;
- procurement, fabrication, delivery;
- erect curtain walling;
- curtain walling infills;
- FSD and BD inspections;
- finish fitting-out.

The contract administrator was late in nominating the curtain walling sub-contractor and then introduced variations which prolonged design development, fabrication and delayed delivery.

The nomination should have been on day 15 but was not made until day 50. The installation should have commenced on day 150 but the first delivery was not until day 200. Installation actually commenced on day 201 and delayed completion by 51 days. The delays were caused by excusable and compensable events.

Meanwhile, construction of the reinforced concrete frame took longer than planned due to a culpable delay of 20 days in the period from days 30 to 60 as the contractor took longer to set up its climbing formwork system than it had planned. After that, construction of the frame progressed as planned.

The contractor claimed reimbursement of 51 days' prolongation costs but the contract administrator maintained that payment was only due for 31 days (51 - 20 days).

In example 4, the delay in nominating the curtain walling sub-contractor, which commenced on day 15, generated float in the other strings of activities, including critical path 1, which was put into float. The contractor was entitled to utilize this float and should have been reimbursed prolongation costs for 51 days.

Example 5

Take example 4 and reverse the events such that the culpable structural delay commenced on day 15 and the compensable nomination delay commenced on day 30. The structural delay created float in the curtain walling string of activities (critical path 2) until that string of activities again became critical.

The contractor would only be entitled to reimbursement of 36 (51 - 15) days prolongation costs, being the prolongation caused by the excusable and compensable curtain walling string of activities over the culpable structural delays which started first and were not extinguished.

The difference in philosophy between examples 3 and 5 is that the retaining wall deferment in example 3 did not affect the critical path.

Example 6

This example applies to a private development and not a Government project.

The contractor's tender programme for construction of pile caps, a basement and ground floor slab showed the contractor taking possession of site on day 1 and commencing construction of pile caps on day 22. After construction of the pile caps, the remaining concrete works used 60N concrete for which the contractor had to provide samples, carry out tests and obtain approval before 60N concrete could be used. The first 60N concrete pour was due on day 50.

The contract was awarded and the tender programme became the first construction programme.

The Authorised Person did not obtain the Building Authority's (BD) approval of the pile cap design to allow the contractor to construct the pile caps as planned. A revised design for the basement slab, walls, columns and ground floor slab was also submitted to BD for approval.

BD's approval of the pile caps was obtained on day 55 and notified to the contractor on day 58. BD's consent to proceed with pile cap construction was notified to the contractor on day 78. BD's approval of the revised substructure design was obtained on day 80 and consent on day 95. Both were notified to the contractor on day 95.

The delays to the construction of pile caps was, therefore, as follows:-

Pile caps	-	actual start	-	day 79
	-	planned start	-	day 22
	-	difference		57 days
	-	less advance works		5 days
	-	actual delay		52 days

The contractor could not pour concrete for any of the substructure after receipt of BD's consent on day 98, as it had not obtained approval of the 60N concrete mix. Formwork and reinforcement were fixed for the basement slab and completed on day 110 but the contract administrator would not allow the 60N concrete to be poured. However, on day 120 the contractor did pour 60N concrete at its own risk. Thereafter, progress was as planned. The delay to the basement works was as follows:-

Substructure	-	actual first pour	-	day 120
	-	planned first pour	-	day 50
	-	difference		70 days
	-	less advance work		15 days
	-	actual delay		55 days

The contractor claimed prolongation costs for 52 days. The contract administrator maintained that the failure to obtain approval for the 60N concrete mix was a culpable delay and, as this amounted to 55 days, it was dominant and no prolongation cost were reimbursable and 3 days of liquidated damages was payable (an extension of time of 52 days had been granted for the excusable delay to the start of pile cap construction).

The contractor ought to have been reimbursed prolongation costs for 52 days as the delay in obtaining BD's approval and consent for the pile caps caused the first and critical compensable delay which generated float in the other strings of activities. BD's approval and consent for the substructure was notified to the contractor 45 days after the contractor had intended to start substructure work. Normally, the Authorised Person notifies the contractor when BD's approval is obtained so that the contractor could proceed with preparatory work but, in this case, that did not happen and the contractor was denied the opportunity for early preparation. It was after day 110 that the delay in obtaining approval for the 60N concrete mix could have had any delaying effect. After the contractor had completed preparation works on day 110, the absence of approval caused delay to completion until the contractor poured the concrete at its own risk on day 120.

The contract administrator could have assessed the effects of the late BD approvals and consents for the pile caps and ought to have awarded extensions of time before BD's approval and consent for the substructure was obtained. This action would have enabled the contractor to reprogramme and take advantage of float created in non-critical strings of activities.

Conclusions

Case law in the USA and the UK can be used as a guide to what should happen in Hong Kong.

Whether it is the contractor or the employer who seeks damages for delay, when there are allegations of culpable delay used to offset the delaying effects of excusable and compensable events, a detailed delay analysis is necessary if the parties do not reach an amicable agreement.

When dealing with time under GCC Clause 63, the scheme of things should be for the contract administrator to establish when, given the delaying effects of excusable events, the contractor was likely to complete the works without it having to take delay recovery measures. This obligation should not be left until completion of the work but should be ongoing throughout the project.

When dealing with financial claims under GCC Clause 57, the contract administrator should consider not only the delaying effects of excusable and compensable events but also the delaying effects of non-compensable events. He should also consider if the delaying effects of compensable and non-compensable events were of equal efficacy.

Where a contractor re-arranged its programme to take advantage of float created on non-critical strings of activities by the delaying effects of excusable and compensable events on the critical path, then the use of such float should not be classified as culpable or non-compensable delay. In the USA, this is termed, a "pacing delay".

When assessing financial claims, the contract administrator should determine the dominant cause(s) of delay at any one time in the contract. The cause(s) must be dominant, not just in terms of the delay it caused, but also the efficacy.

When faced with a notice of delay, many contract administrators respond by examining a contractor's performance on other work in order to seek out concurrent delays caused by culpable events so that the contract administrator can diffuse a contractor's claim. This undoubtedly results in extensions of time not being granted on time (or at all) as the contract administrator often waits to see if a culpable event caused delay after the delaying effects of an excusable event were clearly apparent. In reality, this cannot be concurrent culpable and excusable delays. The delaying effects of the earlier excusable event created float in other non-critical strings of activities and the effects of the later pacing delay never became a culpable delay as it was subsumed by float.

Comments by a contract administrator such as the contractor was not waiting for the information as it did not have idle resources, or it had not erected the tower crane, or it had not delivered the materials, indicates a basic ignorance of how contracting works, i.e. the contractor would not spend money on procuring resources, or erecting the tower crane, or delivering materials when the information to proceed with construction work was not available.

Practically, in the event of delays, the worst thing that a contractor can do is not to issue notice(s) of delay on time. When the contractor begins to incur additional cost, as it certainly will do on a delayed and disrupted contract, commercial realities have to be faced and, if there were excusable and compensable delaying events, then a contractor will make claims. It is to be hoped that, in these circumstances, adequate records were maintained so that the post mortem delay analysis can arrive at the correct diagnosis. Ill will and poor records often result in a dispute.

For further information, please contact *bera@netvigator.com*