Cost Effective Survey Technology for Developing Countries – The Development of a FIG Survey Specification

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SUMMARY

This paper outlines the continuing work of FIG Working Group 5.4 toward the goal of producing a FIG publication by the 2006 FIG Congress in Munich. A review of the previous papers from the FIG Working Week in 2004 is first summarised. The detailed outline for the new proposed FIG Survey Specification is then discussed. The overall document structure and the detailed chapters and section headings for each part are presented for general discussion. Finally the remaining work plan for Working Group 5.4 during the remainder of 2005 and through-out 2006 is reviewed.

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1. INTRODUCTION

This paper follows on from the two detailed discussion papers presented at the 2004 FIG Working Week in Athens[1,2]. The first of these two papers discussed some of the current technology that can be used for cost effective surveying and mapping in developing countries. Satellite, aerial and other imagery types were discussed with GPS and data processing methods. According to the required mapping or spatial data infrastructure (SDI) product, selection of imagery type and GPS method were explained, with the appropriate use of archive material and classical survey techniques where appropriate.

In the second paper, the cost implications of revising existing mapping and the specification of new mapping to fit an SDI were first outlined. The likely demands on funding and the critical importance of cost effective use of funds was then discussed. The relationship between the donors, recipients ('clients') and practitioners ('contractors') was considered with the possibilities of harmonisation of small projects and possible alternative cost recovery methods were all discussed at length. The conclusions of both papers were as follows:

- in general, a standardised procedure and flow line should be adopted for the consideration, specification and execution of mapping projects when using cost effective survey technology and techniques for developing countries
- funding issues and the need to combine smaller projects and pool resources is critical to the most cost effective method of working
- a new mapping specification to specifically address all the issues is required.

Since the publication of those papers, during the past year, some of the FIG WG 5.4 members have been working on survey projects in developing countries. They have now had first hand experience in the needs and realities of putting a survey project in place, running it, managing the practitioner / recipient relationship and producing an agreed set of spatial data deliverables for the SDI.

From this experience it is clearly becoming the case that perhaps the key driver to cost effective use of appropriate survey technology and techniques is the development of a new and appropriate survey specification. This needs to be an up-to-date publication covering the wealth of new techniques and technologies. It needs to outline and discuss best practice guidelines for use of the methods and techniques. It also needs to allow a project team to generate a technical survey specification to be part of an overall tender document for a given project.

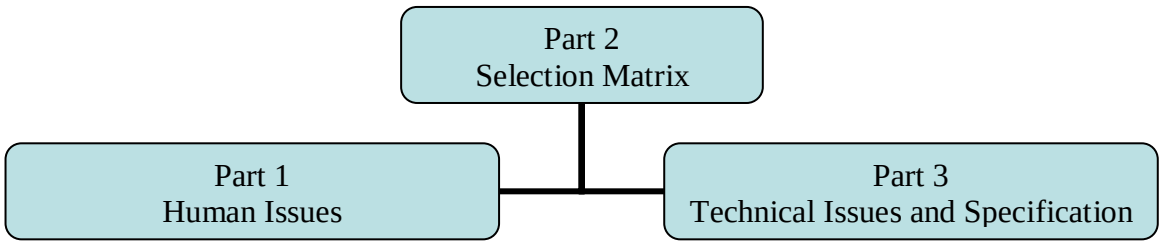
Underpinning this, it also needs to introduce to a project team the issues relating to funding and cost recovery. It must highlight the developments of global spatial data infrastructure

(GSDI) and how to ensure that best possible cost effectiveness can be obtained by ensuring the specified products and immediate needs of one project are attained with a view to possible future needs. A useful method of assisting a team to consider the most appropriate survey technology and techniques should also be included.

Once a particular project is specified appropriately, the process of practitioner selection through competitive tender will further ensure cost effectiveness. However, the important mantra "buy cheap, pay big" must be avoided as the cheapest price may not be the most cost effective. Therefore, in order to achieve the best possible results and value for money it is also proposed that an initial pre-qualification questionnaire is also part of the process of practitioner selection.

2. PROPOSED DOCUMENT STRUCTURE

The proposed structure for the new FIG survey specification document will be in three sections. Part 1, will be a general discussion of the human or 'soft' issues, where funding, cost efficiency/recovery, sustainability, SDIs and other subjects are fully detailed to ensure a project team are fully aware. Part 3 will be a full discussion of the technical or 'hard' issues and will include a series of actual specification clauses to allow the production of a formal specification for any given project. Part 2 will be a 'bridging section' to link Parts 1 and 3 together and will allow the recipients to input various requirements and obtain a listing of suitable technologies and techniques for a given project. The structure is shown diagrammatically below:



Another key idea for this publication is to overcome the historic problem of documents becoming rapidly dated. The idea is to publish in the standard FIG publication format, a hard copy document that will cover the issues which will not date rapidly. Thus, most of Part 1 of the document can be in this hard copy format. The other parts of the document will be a version controlled web-based publication. This is ideal for areas where the inevitable march of technology continues to offer new survey methods and techniques.

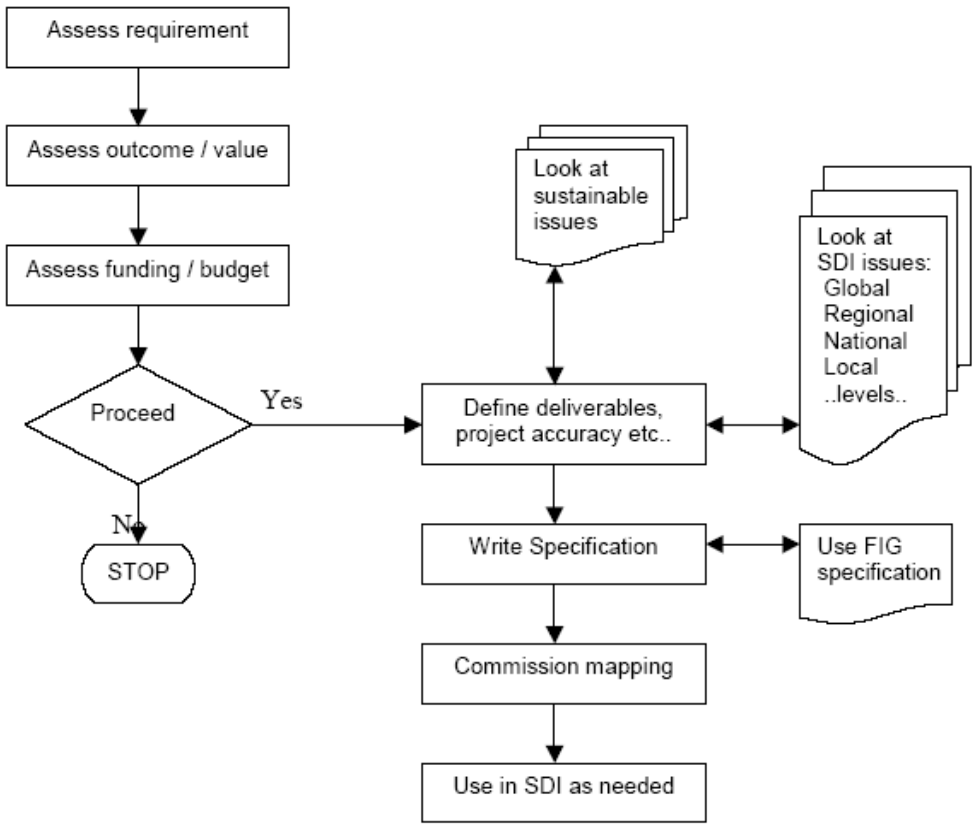
This format will allow the rapid update of specification clauses and guidelines on the use of new technology. It will ensure that new imagery satellites being planned and launched can be included once the technology has been proven. Similarly, future upgrades to the GPS system

and the introduction of Galileo can also be included. Thus, most of Part 3 can be in this web-based format. Part 2 can also be written to operate as a type of computer program and is obviously better in a web-based format.

3. SDI AND OTHER GENERAL ISSUES

Part 1 of the document must give clear guidelines on the general items outlined above. A more complete discussion of the issues is now widely available[3] and can be used as the basis for the preparation of best practice guidelines. One of the main elements which effects the whole document is the structure of the SDI in place where the project and mapping is required. The interoperability of the SDI is critical to ensure that a set of spatial data products and digital mapping can not only be used for the original purpose, but can also be archived and stored in a format that will allow other project and development teams to use them in the future.

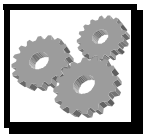
Standardisation of the process flow line is also important and needs to be included in the guidelines. The flow line proposed[1] is as follows:



A possible structure for Part 1 of the document written as best practice guidelines with a tabular structure giving the guideline followed by a summary explanation could be:

Chapter 1 – When to Use This Document
Chapter 2 – Consideration of SDI
Chapter 3 – Funding and Aid
Chapter 4 – Land Administration and Policy
Chapter 5 – Sustainability
Chapter 6 – Project Groupings
Chapter 7 – Project Management

For part 2 of the document the project team should be able to select the various requirements for the end product from a variety of standardised inputs. After "processing", an output of the most cost effective survey technology and techniques that should be considered would then be produced. For example, for a project where the update of a traditional cadastre is required the following inputs/outputs may be generated:

Input – set the project requirements		
Accuracy required	± 0.2m	☒
	± 0.4m	☑
	± 1.0m	☒
	± 2.0m	☒
	± 5.0m	☒
Output format	DTM	☒
	Vector Mapping	☑
	Raster	☒
Imagery type (optional)	Aerial Photography	☐
	Satellite	☐
CLICK TO  **PROCESS**		
Output – cost effective technology and techniques to consider		
Mapping Scale	1:2,000	
Imagery	1:8,000 Vertical Aerial Photography	
Control Measurements	Level 4 GPS[1]	

The above are just a few of the general items that could be input/output. The list could be expanded further to ensure project teams with little or no detailed knowledge of survey technologies and techniques could research their project extensively before engaging a team of experts to assist in the preparation of a formal specification.

4. SPECIFICATION OF TECHNOLOGY AND TECHNIQUES

The writing of a good survey specification is an art. The aim of any survey specification should be to set out the criteria required for the performance of the survey and to set tolerances necessary to achieve the final results required. It is most important that the specification is not a document that tells a pratitioner how to perform the survey.

A well written specification should allow the pratitioner ample scope to state his preferred methods, field procedures, equipment and reporting, all within the criteria set out. It cannot be stressed too strongly that a poorly written specification may cause a pratitioner to misinterpret the important aspects of the survey project. This can lead to over or under quotation and poor overall survey design. This will become evident in a wide range of competative bid prices being submitted; causing difficulty in the selection of a suitable pratitioner and obtaining value for money. The provision of a good survey specification is therefore essential.

It is critical that the framework used to generate the specification is of the highest quality to ensure a project is completed in the most cost effective way. Historically, most survey specifications[4] have been written to follow the general technical process of a survey; that is, following the general form:

- project information
- project control and geodetic information
- imagery specification
- detail capture
- contours and spot heights
- additional information to be shown
- presentation of final mapping
- digital data
- delivery schedule.

For this new FIG survey specification it is proposed that this traditional format is radically updated. The project deliverables; i.e. the digital data, mapping products and other required items together with the timescale required for their delivery are the most important and therefore should be considered and specified at the outset. The proposed new structure for Part 3 of the document is as follows:

- project information
- specification of final mapping, digital and archive data
- delivery schedule
- project control and geodetic information
- imagery specification
- detail capture specification

As the new specification framework will be web-based, the clauses relating to each element that will make up the final specification for a project can be selected as “building blocks”.

Therefore for any particular project the specification clauses can selected as appropriate and constructed into a final document. For example, in the cadastre update project, outlined in section 3 above, as satellite imagery is not applicable for the project, these clauses can be left out of the final specification. This is further reasoning for the use of a web-based format. It is also important at this stage to engage an independent expert, who is a professional surveyor. They can then work with the recipients team to ensure the survey specification is written and produced to the highest quality.

5. REMAINING COST EFFECTIVE ISSUES

With the proposed structure of the new FIG survey specification outlined it is worth reflecting on the working groups mission statement. This has been drawn from the text of the keynote address given by Dr. Anna Tibaijuka to the XXII FIG Congress in Washington DC, 2002.

> "To identify more cost effective ways to improve the availability and accessibility of tools of land information. To suggest these methods to aid more effective planning, development and management of the environment. Also to develop innovation, adaptation and resourcefulness in simplifying these tools to fit the local situation."

Even if the recipients project team has the best possible understanding of all the issues and a well specified survey, there are still obstacles which may prevent the most cost effective use of a donors funding. There are three areas to consider:

1. Projects must be coordinated and grouped within regions. The more recipients that come together to pool resources and harmonise their requirements, the more cost effective any one project will become. For example, imagery captured for a cadastre project could be slightly over specified to allow future engineering projects to utilise the same raw data. This coordination would save the engineering team the cost of re-flying the entire area for their road construction project.
2. Ensuring practitioners can work to the required level of quality is vital. A pre-qualification questionnaire should be completed by those wishing to competitively tender for projects. This will ensure that the lowest bid of a particular project is not the cheapest and poorest quality. Practitioners should also have a good track record of completing similar projects. There may also be training requirements to balance the correct sustainable solution for some projects.
3. Competitive tender is the best method of ensuring value for money. However, it may be worth considering, if there is an unacceptable spread in the bid prices, that the entire bidding cycle is rejected. A revised specification could then be re-issued as clearly the original was misinterpreted by the practitioners. A suitable contract also needs to be developed in conjunction with this FIG survey specification. This could be a task for another FIG working group over the coming work period.

6. THE NEXT STEPS REQUIRED

Comment on this paper is now welcomed from as many sources as possible, particularly delegates from FIG Commissions 3, 5 and 7. Review and comment from proposed users of the specification, such as UN-HABITAT and other agencies is also required. Once the structure has been discussed and finalised, a working party from the WG 5.4 members will then be formed. This will allow delegation of responsibility for writing the various sections of both the hard-copy and web-based parts of the document, later in 2005.

Work here in Egypt will be to initially discuss and to begin to flesh-out the content of the specification, looking at what relevant specification clauses can be drawn from the international stage, as many different documents exist.

As technology develops, it guarantees that the web-based part of the specification will require regular update. A working group dedicated to this task needs to be planned into the work plan for Commission 5. It can be a rolling task and will need to be included in every Commission Chairs' planning for the foreseeable future.

7. CONCLUSIONS

To move forward with the activity planned for FIG Working Group 5.4 and to try and achieve the mission statement, by FIG Congress in Munich 2006, much work has to be done. It is now time for the working group members to put in the effort required to get the new FIG Survey Specification prepared. With comments and input from the wider FIG and UN communities, the provision of cost effective survey technology and techniques can soon become a reality. However, without coordinated effort and real energy from the other working group members the reality may fade as the sun sets on this four year working period.

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BIOGRAPHICAL NOTES

Dan SCHNURR is a Chartered Land Surveyor and works as a Senior Project Manager at Simmons Aerofilms Limited. He has worked deep in the commercial reality of surveying and mapping projects for over 15 years and was lead author for the RICS publication "*Guidelines for the use of GPS in Survey and Mapping*." He is broadly experienced in land surveying and mapping throughout the world having worked in Europe, the Middle East, Australia, West Indies, United States and South East Asia. He is a corresponding member of the RICS Mapping and Positioning Practice Panel and is the UK delegate to FIG Commission 5. Within this role, he is also Chair of FIG Working Group 5.4: Cost Effective Surveying Technology and Techniques for Developing Countries.

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