CHAPTER 4

DATA ANALYSIS

4.1 Introduction

The phenomenographic analysis produced a set of qualitatively different categories of description. This analysis aimed to discover not only how people understand, think and learn about specific phenomena and concepts, but also their conceptualisation of the geomatics' industry phenomenon.

The narrative of the interviewees' experience was grouped on the basis of similarities and the groups delimited by their differences. The categories, defined in terms of core meaning, were formed from these groups. These categories represent the different conceptions held by the group of people of the geomatics' industry, and their relative organisation is the most significant outcome of the research and represented the results of the analysis. The relationships amongst them are represented graphically in an outcome space that is characterised by hierarchical linkages.

The following analysis demonstrated the interrelated and hierarchical relationships between the conceptions of a professional which would form the foundation for an Australian curriculum structure necessary to develop the essential qualities of a professional for the 21st Century.

4.2 Data manipulation and analysis.

The process involved the interviewees' transcripts being analysed to ascertain the main similarities and differences in their experience of the phenomenon. It identified the most distinctive characteristics and structurally significant differences in the experiences of the phenomenon. Although the categories of description originate from contextual understanding, they were de-contextualised. Hence, the planned data analysis process proceeded by :

(i) a selection process based on criteria of relevance, delimiting and interpreting the phenomenon in terms arrived at from the interview;
(ii) an iterative interpretation between the original interview context and the pool of meaning context which allowed a step by step differentiation within the pool of meaning regardless of the origins of the meanings; and
(iii) broadly compare the outcomes with current curricula principles.

The immediate observable outcomes validity and reliability depend on:

(i) the essential differences between categories being observable; and
(ii) verifying appropriateness of categories though their internal logic.

To control this situation, the transcripts were reduced to a series of descriptors delineating all statements and dialogue 'chunks' considered possibly useful [a total of 237 attribute

descriptors were isolated] and their location within a particular interview transcript [eg. 4/15 is paragraph or block 4, line 15] (refer to Appendix 3). This identified the variety of differences and similarities of the attributes defining the future geomatican. These were then grouped into like areas for comparison, in order to isolate the significant statements and sources of variation. While this technique went some way towards isolating the conceptions, it proved too mechanistic and analytical to maintain the essence of the interviewees' utterances and for identifying the most distinctive characteristics and structural differences that clarify the defining of the phenomenon. However, this technique has provided a referencing system that enables all useful information related to a conception, or its' clarification, to be located quickly. Combining this reference system with the process of manual forward and backward comparisons process revealed the eventual development of the conceptions and the locations of supporting quotes.

4.3 Conceptions Development

The following four conceptions have been identified by the Australian geomatics' industry stakeholders as being essential qualities, for the 21st Century, of a person (geomatican) beginning in his/her professional field of geomatics'.

CONCEPTION 1. Geomaticans provide solutions for problems which can utilise spatially located geographic data.

CONCEPTION 2. Geomaticans provide spatially located geographic data.

CONCEPTION 3. Geomaticans provide a particular spatially located geographic data specialist technical service.

CONCEPTION 4. Geomaticans provide and manage geomatics' activities and engage in project management.

4.3.1 CONCEPTION 1. Geomaticans provide solutions for problems which can utilise spatially located geographic data.

This conception focuses on geomaticans providing solutions to problems arising from the application of any form of geographic data or their support systems. In addition to professional knowledge competency, the professional is expected to have a broad discipline knowledge and an understanding of social and other professions' needs. A well developed level of initiative, innovative and lateral thinking and analytical skills are also required initially to identify and quantify all aspects of a problem in its context. These same skills are applied in defining the solution based on a technically competent output that also provides spatial reality to the solution and connectivity in its context. These professional qualities provide the structure and processes necessary for management skills and specific paraprofessional technical skills to be applied and ensure the best solution is

CODE	NO.	PARTICIPANT
MCS	1	Manager - Corporate sector
PSP	2	Principal - smaller surveying practice
MLG	3	Manager - Local Government Authority
MSG(A)	4	Manager - State Government Authority/ 'Authority' executive.
MAG(A)	5	Manager - Australian Government Authority/ 'Authority' executive.
PSP	6	Principal - smaller mapping practice
PSP	7	Principal - smaller mapping practice
PSP(A)	8	Principal - smaller surveying and mapping practice/ 'Authority' executive.
ACA	9	Academic
ACA	10	Academic
ACA	11	Academic
MSG(A)	12	Manager - State Government Authority/ 'Authority' executive.
MSG(A)	13	Manager - State Government Authority/ 'Authority' executive.
PLP(A)	14	Principal - larger surveying and mapping practice/ 'Authority' executive.
MLG(A)	15	Manager - Local Government Authority/ 'Authority' executive.
CON(A)	16	Consultant services/ 'Authority' executive.
MSG	17	Manager - State Government Authority
MSG(A)	18	Manager - State Government Authority/ 'Authority' executive.
PSP	19	Principal - smaller surveying and mapping practice
ACA	20	Academic
ACA	21	Academic
MSG	22	Manager - State Government Authority
PSP	23	Principal - smaller surveying and mapping practice
PLP	24	Principal - larger surveying and mapping practice.
ELP(A)	25	Larger surveying and mapping practice/ 'Authority' executive.
PLP(A)	26	Principal - larger surveying and mapping practice/ 'Authority' executive.
CSG	27	Consultant - State Government Authority
ACA	28	Academic
MSG	29	Manager - State Government Authority
MBS	30	Manager - Industry bureau service
PLP(A)	31	Principal - larger surveying and mapping practice/ 'Authority' executive.
MAG	32	Manager - Australian Government Authority
MSG(A)	33	Manager - State Government Authority/ 'Authority' executive.
MSG(A)	34	Manager - State Government Authority/ 'Authority' executive.
MAG(A)	35	Manager - Australian Government Authority/ 'Authority' executive.
PSP	36	Principal - smaller surveying and mapping practice
PLP(A)	37	Principal - larger surveying and mapping practice/ 'Authority' executive.

NOTE: The following groupings were used in the Table: Surveying (all); mapping (mapping, GIS, photogrammetry) and Authority executive (Board, statutory body or professional body).

(A): Authority/executive position
ACA: Academic
CON: Consultant
CSG: Consultant - State Government
ELP: Employee - large private firm
MAG: Manager - Australian Government
MBS: Manager - bureau services
MCS: Manager - corporate sector
MLG: Manager - Local Government
MSG: Manager - State Government
PLP: Principal - large private firm
PSP: Principal - small private firm
RES: Researcher

Table 4.1 Research population identification coding.

reached. The definition of the 'single discipline' geomatican is embodied in this ability which requires a wide breadth of professional and social knowledge.

Three sub-conceptions, in relation to the utilisation of spatially located geographic data, have been identified. These are the abilities to: identify a problem or need; determine a solution; and provide advice. The processes of detecting a problem and providing a spatially located geographic data solution are interrelated, whether the professional is acting pro-actively or reactively to a given situation. These sub-conceptions are described in the following sections.

(a) Geomaticans will be able to detect a situation requiring a solution using an application of geomatics.

The problem or a situation that could use spatially located geographic data may be presented to the geomatican. Alternatively, an existing function or process may be in existence but previously unidentified as being able to benefit from a geomatics' application. In both situations the professional should be able to determine if there is a unique problem or whether the application of a simple established procedure, or some established standard facility or product, exists to deal with the situation. Whether this unique or significant problem exists within or outside the geomatics' field, or crosses both spheres, the professional is expected to identify and comprehend all the problem's facets by drawing on a breadth of discipline-specific and wider general knowledge.

Both geomatics' managers and academics expect the professional geomatics' graduate to be able to identify and categorise a problem. In particular, they expect the beginning professional to use a high intellectual operations level and a broad knowledge to concentrate on diagnosing unique or difficult problems. Tasks requiring the application of standard practices are considered the domain of the paraprofessional. The following statement reflects this situation:

> **MSG-29.** *Have this skill to actually work out whether they've got a significant issue on their hands or not.*

> **ACA-21.** *With solving unusual problems? I think that the skills involved in that are firstly identifying the problem. Firstly identifying that there is a problem, you get a lot of data and you find out there is a problem of some sort; so the first challenge is problem definition.*

The problem should be identified in its context and not solely as a technical issue within just a part of the geomatics' discipline. **MSG-29** highlights the need for a solution commensurate with the clients' domain, which may have no need of precise accuracies or fine details. Both **MSG-29 and PSP-23** extend this by emphasising the need to provide the clients with what they want in a form that addresses their concerns about affects of the solution, viz. it is about communication and understanding the client and their domain:

MSG-29. *There has been a overemphasis on accuracy. Surveyors are millimetre mad. ... Well, there's something wrong with the system that doesn't allow the client to determine what accuracy he or she wants. .... I think that's right, the professions are going to have to become far more attuned to the client*

PSP-23. *It's part of the professional attitude, it's part of the thing that an ordinary person will really go into depths on things that really concern them, but not bother very much about those things that concern other people.*

An understanding of the client's needs and the consequences of any diagnosis will provide the contextually correct and applicable problem parameters. The qualities for this include attention to detail and perceiving the connectivity between the issues. Rather than being reactive and providing a specific technical solution, the geomatics' manager requires the professional to use his/her initiative to search for and identify problems, and proffer solutions within any sphere where the application of geographic spatial data can be of benefit:

MSG(A)-4. *I mean, being lateral thinking is probably, in my view, trying to see opportunities and bringing solutions which didn't seem to be linked.*

MAG-32. *I don't think we have enough pro-active people in the profession.*

MSG(A)-34. *Jobs are not standard. Understanding what a client needs and finding the answer, that's what it is about.*

(RES.) ***What do you mean by pro-active? In what sense?***

MAG-32. *Well people who can make things happen ... The majority of people, like right now in surveying, wait for things to happen rather than take a much more pro-active business approach and attempt to influence the way things are happening in such a way that, well it not only benefits them individually but also benefits the community. So what I'm saying is I think, for whatever reason, we tend to be a profession of followers rather than a profession of leaders.*

Being pro-active and working within a wide sphere of interest is seen as necessary to reverse the perceived trend of the geomatics' professional's diminishing professional status (becoming a specialised technician) and loss of discipline spheres of operation. Hence, the geomatics' professional requires a broad social and technical knowledge base and should possess people skills, innovativeness and lateral thinking to identify and understand problems in a unique way over a wide spectrum of situations. The manager of a geomatics' bureau service categorises the profession as needing and respecting the wider view and having social responsibility, not simply performing technical duties or being a master of a technology tool. These global attributes

contribute to the detection and isolation of unusual or seemingly unconnected problems, providing opportunities and role consolidation for the professional:

(RES.) ***What is it the professional has to offer me over and above the paraprofessional that I've got to pay extra for; what special skills does the professional have?***

MBS-30. *The capacity to think laterally. And the capacity I think (for better terminology) to be able to see the project and not just the technical exercise. I mean, producing a subdivision, as you already rightly identified in our earlier discussion, has all sorts of social impacts; could have all sorts of social impacts. An understanding that a GIS is a wondrous tool, but again the impact of some of the analytical processes and how to go about those sorts of things, how to be able to handle some of the more controversial results coming out of the analysis, as a whole understanding in terms of land as an underpinning factor for the community at an economic base line, are issues that I expect from a professional that I would not expect necessarily from a paraprofessional.*

(RES.) ***So that's analytical ability and social responsibility?***

MBS-30. *Yeah, I mean, that to me is basically the difference between a professional and a non professional.*

Beginning professional geomaticans should apply skills and breadth of knowledge in identifying and determining all the contextual parameters of a problem with relation to the application of spatially located geographic data and supporting systems. In addition to the full geomatics' knowledge, the professional requires good communication skills and an understanding of society in general, as these are parameters established around the client's needs but within limits imposed by society and geomatics' practices. Initiative and highly developed lateral thinking, analytical and innovative abilities are also necessary attributes in performing at this professional level in addition to the expected inherent social responsibilities.

(b) Geomaticans are able to utilise the entire geomatics' knowledge spectrum in determining a solution.

The beginning professional is expected to be able to use geomatics' technical knowledge and an understanding of the problem and its context to develop a solution. The professional skills level is beyond more technical performance, and includes understanding the processes, consequences and usefulness of what geomatics' attributes he/she need to reach a solution. Hence, the professional's qualities rest with innovative thinking, conceptualisation and global thinking abilities rather than with performing standard technical tasks.

The expectation is that the beginning professionals have gained some technical

competence. However, the main emphasis addressed by the following comments refer to technical processes, limitations and outcomes, a broad knowledge of their impact on other professional areas and achieving the best solution. Good communication and interpersonal abilities are required to communicate the solution, as is an awareness of societal needs, so that the client oriented geomatics' solution is also compatible with societal expectations. The following government manager also emphasises the need for the professional to maintain discipline and societal knowledge currency and, to some extent, anticipate future needs:

(RES.) ***So, if part of that would be innovativeness, are there any other qualities like innovativeness, which need to be enhanced or taught, that that person is going to need?***

MSG-17. *It's a hard one to define but it is the ability to detect unique solutions. What I see happening so often in our society, in the various professions, is using all the solutions of the past.*

(RES.) ***Will he need any abilities to do that? Any special abilities?***

MSG-17. *I think there's a negotiation ability, more than they've ever had to have before. I guess there's a, some sort of ability to understand other points of view: because I think I mentioned the environment, as people live longer, shorter working hours and all that sort of gunk. Looking at that block of land in isolation, won't be a winner economically, because people will be looking what recreational pursuits are in the general area as well. So that you know they'll have to be looking at maybe only developing that bit and making that bit recreational and getting the same economic return, because it's a whole community establishment rather than a dozen housing blocks of sort. And so it is certainly the understanding of our new social systems; and it's an understanding and an empathy that competing forces in our society.*

As with problem identification, problem solving requires that knowledge of geomatics' and associated disciplines combines with lateral thinking abilities in identifying the technically and socially best alternative solution. With a knowledge spanning the entire geomatics' discipline and investigative skills (such as problem solving and research methodologies), the geomatican can explore all possible alternative solutions and have confidence that his/her final choice is the best solution:

(RES.) ***Are there any other attributes or anything to enhance the solving of problems: any abilities?***

ACA-21. They *need to know their technical discipline well. They need to have sufficient knowledge of associated disciplines as they may impinge on it. They need to be comfortable with the scientific methods as the method of solving*

complex problems and they need to have solved problems within their tertiary training to have confidence in their ability to do this. ..... They certainly get that if they go to honours, but they may not get that in their undergraduate studies and I think they should, not to do research but to solve unusual problems. ..... Having defined the problem then it's - so that's an inductive phase; and then it's a question of defining the parameters of the problem what's causing that problem, so it's sort of a bit like a deductive phase so as to come up with a solution.

A knowledge of associated disciplines (such as law and economics) that impinge on the solution choice is necessary to establish the validity and reinforce this decision. It also enables the geomatican to ensure contextualisation and functionality of the solution or the ability to seek appropriate clarification of details affecting the solution's application. A pure geomatics' technical solution is only suitable if it is rendered applicable in the solution's application context and fulfils client desired outcomes:

(RES.) ***Once they have a solution to that particular problem, do they need to have the abilities to go further than that?***

ACA-21. *There may well be more than one solution and, usually there is, so the best solution is some mix of technical and economic and maybe legalistical aspects. So they need to have an appreciation of, sufficient appreciation of, economics. That's why earlier I said they need some knowledge of economics. So that they can decide on the best solution and how to implement it, and it may be a simple problem or it may be very complex, they have to know enough on how to implement the solution that they wish to employ. They may in fact have sufficient information to implement; they may find in fact the problem involves elements outside of their Bailey Record jurisdiction or whatever, but they have to know, I think they need to know, where to go to solve that problem. In fact thinking off the top off my head, if they find they are doing a survey of a property and they find the cadastral boundary is totally wrong or something they can't necessarily solve, then they should recognise they have to go back to the owner and they may well have to go back into the Department. What they do need to know is how to progress towards a solution, whether they can solve it themselves or not, if they can - how to do it, if they can't solve it themselves, i.e. beyond their jurisdiction, who to direct that problem to.*

(RES.) ***They need to be innovative?***

ACA-21. *Yes, I think so.*

The following comments from an academic, a corporate sector manager and a government manager reveal a second variation on the importance of the ability to perceive multiple employment of data or systems in providing a solution. Whether the application of data is as a single entity or combined with other data or systems, multiple

data utility is necessary for maintaining business viability and professional market position. These industry groups also believe that the professional must utilise various (or a combination of) data forms and gathering, storage and output systems to provide the best solution, not just to provide individual data sets as a service industry. The best solution for commercial and professional survival also requires attributes of current technical and societal knowledge and lateral and innovative thinking abilities for providing the best outcome, value added opportunity and multiple data and systems utility:

MCS-1. *...they have got to have not just an idea of, if we do it this way or if we press these button we get this, but to understand how that has come up through the computer, how it is all put together, so that they can come up with different applications, difference scenarios.*

The attributes of the professional are best employed where there is commitment that the solution of a problem will be contextually relevant. This commitment is demonstrated through detailed analysis and evaluation and endeavouring to apply innovative ideas to ascertain to best solution for that situation:

(RES.) ***So it's not technical or very intelligent people you're looking to employ, you're looking to employ some other sort of specific person? What are those attributes that you think make up the ideal person?***

MAG-32. *Well I think it goes back to what I said earlier. I expect commitment; I expect a bit of vision; I expect ideas, innovation, thinking about what you're doing rather than just doing it. Those sorts of things.*

ACA-21. *What I mean by that is I believe that more and more we are going to have to go to sustainable practices instead of growth practices and we have to more and more adopt practices that are in sympathy with the whole environment.*

Part of the contextual commitment is achieving an outcome that satisfies the commercial needs of both the client and the professional. Geomatics' data utility enables multiple data usage, reduces the cost to clients and increases the geomatican's market place competitiveness, productivity, market share and profit. The need for commercial viability, and a change from traditional methods and separate geomatics' specialities, is increasingly evident:

CSG-27 *Professional delivery of services is considered to be a personalised service. Commercial is a very fundamental delivery of service (you give something in return for money). I perceive a lessening of professional service out there and in the surveying profession now.*

Business viability in geomatics' requires innovative contextualised applications and multiple data utilisation across a broad spectrum of opportunities. These opportunities include the original application, adding to an established data base, deriving an unsolicited marketable product, or application for any purpose which can be shown to benefit from the application of spatial data. The requirements for a broadly based knowledge and lateral thinking are in addition to, and should underpin, discipline technical knowledge:

MLG(A)-15 *... start thinking around the surveying problem in the context of the operation that you're trying to do.*

PLP(A)-14 *You need to understand the sort of modern equipment that you're working with and you need to understand how that then applies to satisfying clients' needs. Too many surveyors have a good technical background but only know how to measure millimetres as a result of it. I think the secret is if your technical background is right, you can see applications into a wide number of areas that may not even necessarily be directly related to surveying. So, the first thing is you've got to have a good technical background, you've got to be coherent.*

MSG-22. *Well initially, most times you don't have data and then you say what do I want to use it for. Most times you get data because you want to use to solve a problem. So it's the other way around. Product determination and innovation is a fairly specific area. Sure that's the area that creates a competitive edge in a lot of cases, but I don't know that there is a fairly specific area of introducing into any degree the process creativity, innovation, you know all of those sorts of things. So I don't think that a professional would need in his normal undergraduate degree the focusing on innovative ways to create a product and market and all those sorts of things. What he has to do is be aware why he's using it, and look at the gambit of activities that he does and try and say well, I've used this information for this activity, but hang on it also has applications in this activity that I'm doing. So it's rather than saying OK I've got this spread of information, now what'll I do with it? It's using it but then whilst you're using it, think of ways that you know, for utility of information, because it's costly, right, so you should try to make maximum use of it, so you know, how can I apply it in a different way.*

This 'manager' requires application, initiative and innovative thinking, but has difficulty reconciling the need to be taught or that the abilities can be enhanced through specific learning techniques. He also identifies the need to maximise links between academia and industry to try to achieve these desirable attributes.

The wide variety of geomatics' operations experienced by government, bureau services and academia lead these personnel to assume that paraprofessionals will perform the technical practices. Decisions and advice on what practices, or combination of

practices, are required to solve unusual or unique problems is largely the domain of the professional. A substantial part of providing the best and acceptable solution is to be able to communicate with clients and those in the geomatics' profession, necessitating a broad knowledge base and interpersonal skills. A solution must consider all possible consequences and ensure the geomatics' solution is an integrated part of the structure it fits into. This linkage, or spatial connectivity, is required to have practical structural attributes in addition to being applied with vision to its usefulness and to the applicability or consequential affects on society at large. This requires a contextualised breadth of knowledge and understanding and analytical and evaluative abilities to synthesise an appropriate outcome:

MBS-30. *A non professional will do the job. A professional in doing the job understands the broader implications and how it could impact on, if you like, associated, but not obvious, other groupings or other factors. ..... People are looking, not for specialists services, they're looking for outputs which are specialised and looking to deal with people who have a broader range of vision than what I'd say your suburban surveyor would offer them or would want to offer them at the present stage.*

ACA-28. .... *straight out competency, ... describes skills and services to people ...*

(RES.) ***What are these qualities required by a professional in the 21st Century?***

ACA-21. ... *technical competence to me includes not only competence at doing the work but solving the problems related to their work and conducting the scientific method so as to solve unusual or less usual problems.*

MLG(A)-15 *Have a fairly deep idea of the processes and what your product is going to be used for.*

The present working environment expectations will also apply to the emerging and future technical and societal situations. The past emphasis on data capture will largely acquiesce to data maintenance collection, a function within the performance capabilities of paraprofessionals. Societal demands for spatially connected information will require professionals to be innovative and concentrate on, and communicate about, the applications of data. The professional geomatican will also require the capacity to interpret social and technical developments so that he/she may manage the data, the development of supporting systems and solution transferability:

MSG(A)-4 ... *but in 2002 there'll be data capture, but it'll be small; manipulation will be great and analytical applications will be tremendous. ..... See, the thing is that I am not really excited about the movement of tectonic plates. I'm not excited about the tremendous resolution of microns in the sense*

of errors. I am interested in meeting social and economic needs of a growing nation. ..... We know it because spatial information brings reality to that economic base. So I want people to have an understanding of how the land and its administration and deployments fits into the economic base of the nation. ..... an understanding of spatial connectivity, basic computer skills, literacy, but trying to create a reasonable foundation for all of the applications which will flow on. I find that there is still a belief in some of our leaders' heads that we're in the mapping business. This is a big surprise to me because I thought we were in the information application business, ... they have to understand what are the best systems to be acquired and maintained to underpin those applications. Because I mean the capture of data is just a temporal thing which we're going through and that'll be all over, fundamentally, in about, let's say five or six years, and then it's the use of the data that we have to look forward. So as long as these people have an understanding of the ranges of data to which would lead towards applications, which they don't have to know about; but so long as they could have an understanding of the support systems and the capabilities of hardware and a fairly good understanding of what sort of software systems. ..... So if I had to describe this person that we produce who can now read and write and he has an understanding of economics and he has an understanding I suppose of computers; somehow or other we have to shoot into his brain system a spatial head. Now if there's one value that I'd find in the surveying and the mapping world, is most of them have got a spatial head, they can relate things and that's what brings reality to the whole business of mortgages. Up till the time that you know where the land is or the stream and which parcel it goes by, it's all a bit of a shares and bonds scene. But once you turn it into spatial reality, then there's a connectivity between all these things.

The breadth of knowledge and analytical, synthesis and evaluation cognitive abilities, required by the professional to solve unique problems, are seen to be inherent abilities enhanced by specific learning. This was summarised and expressed by both private (**PLP(A)-37** and **PLP(A)-14**) and government sector (**MSG-29**) professionals and represented in the following quotation:

PLP(A)-14. *I think we have an expectation of people coming out of establishments that probably they are trained more than they're educated, that shouldn't be so.*

Another state government manager and a state government consultant expressed similar views for the needs of current and emerging technical and societal environments. The beginning professional is required to consider the problem in its wider context to evaluate and analyse the needs and consequences before arriving at the best solution or planning approach:

CSG-27. *private firms - you've got to be flexible and you've got to be, you've got to think of creative solutions all the time. You question things, because*

everything's changing so fast. Have a questioning attitude, .. with education - get such a broad base so it gives you so many opportunities .. and confidence in your ability to be able to do a job.

MSG(A)-18. *The practical training for the measurement area I think will drop back and what we are going to have in the 21st Century is the technician doing a lot of the formal measurement, the field work as such. The professional will be taking the bigger picture view of the world and getting involved in the strategic planning and the planning detail, and if you are talking about cadastral surveying, even leaving the actual peg bashing more to technicians.*

A beginning professional requires an ability to select a combination of appropriate practices and processes from within the entire geomatics' domain to proffer the best solution, using spatially located geographic data, and not just to provide the source data. Multiple utility and value added usefulness of the data for business and society benefits should also be a consideration, but secondary to the clients' requirements. The underlining abilities are those of being able to analyse, conceptualise and evaluate to ascertain the limitations, outcomes, usefulness and impact of the solution in professional, commercial and societal terms. To achieve this the graduate requires a knowledge across the whole spectrum of the geomatics' discipline, in addition to an understanding of societal needs and trends, and the context into which the solution is to be integrated.

(c) Geomaticans will provide advice on utilising geomatics' principles and processes.

The professional's role of providing advice on technical issues and supervising and performing technical tasks, is a secondary role to providing a more global technical and processes conceptual advice to clients. To achieve this the geomatican requires knowledge and understanding of the concepts and processes of all facets of the geomatics' discipline. A wider knowledge of associated professional practices (such as engineering, law, etc.) is also required so that he/she can advise on all the processes, at a non-specialist technical level, and affectively communicate with the client about geomatics' limitations and possibilities of the whole issue within its context:

ACA-28. *Competency in advice that is provided. ... but also the breadth of his knowledge, you know I think the age of highly specialised niche type surveying is probably gone. People expect much more than technical competency. So to be able to give sound, reasoned advise over the whole range of topics, not just narrowly over some technical issues. .... I know it all sounds pretty vague, but he is going to be an all rounded person ...*

PLP-24. *So I think in a way professions are dying and that the extension of this multi-disciplinary concept is that there's a person who works in business and what he really is, is he's an adviser on property law, land law, the technical aspects of getting things measured physically in the ground and represented*

diagrammatically, or in a computer.

In a situation where this advice from a geomatican cannot satisfy the needs of a client, it is expected that the geomatican would either be part of a team of professionals collectively providing complete advice or, from his/her breadth of knowledge, know where to seek the required specialised assistance or to direct the client to the appropriate person:

PLP-24. *In order to do that he may be working in a business where there are other people who have other such titles as computer operator, engineer, lawyer, accountant, or all these people may join and form this business and they actually offer this service. i.e. we'll tell somebody whether this thing is feasible to go ahead with, i.e. a development.*

Generally, the geomatican should be able to provide advice on the total issue based on the breadth of geomatics and understanding of the connectivities with related discipline areas (eg. civil engineering, urban and regional planning, etc.). Integrated with this is an understanding of: business needs and processes; the economic and environmental issues; and social preferences:

MSG-17. *...if I can go back to this global person, it's someone who goes in there and says yes that parcel is capable of development. And these are the things that are required. Rather than getting getting someone in to just do an environmentally impact and the engineers to do something else and so on and so on.*

PSP(A)-8. *They're talking about that (techniques) instead of talking about the process. ... So the client comes to you and he says, I have this piece of land and you tell him what the problems are in subdividing. Now, unless you know the process and if you can link the process to the actual field work that goes to it ... the rest is simple because you can apply, you can then see other ways you can apply, but if you're just taught the basic system, forgetting about the process, it just never hangs together.*

CON(A)-16. *... a professional surveyor is an adviser rather than a peg basher. He gives advice to his client as well as going to put pegs in the ground. And that's going to start bringing up things like business acumen, knowledge of the environment and the economy of Australia. Another thing is if you're dealing with cadastral and the land development areas, you should be able to advise the client when to go with the development and when not to and things like that. And you need to look at the statistics of what people want to buy and all that sort of jazz so that you can help him design the layout and that sort of thing, all of which have got nothing to with technical measuring, and that's all the advisory stuff.*

PLP(A)-31. ... *advises as to how to deal with land, you know the subdivision of land or the development of land in fact.*

The professional geomatics' graduate is required to not only dispense advice on geomatics' technical capabilities and processes, but also contextualised basic advice over a wide range of impacting social issues. Whether as an individual or part of a multidisciplinary team, the beginning geomatics' professional requires an understanding of other disciplines and society in general so that the advice is appropriately applied in context. If required, the advice can be integrated with other professional advice, or the client directed to more appropriate assistance. Again a broad knowledge base, analytical, evaluative and communication skills play a significant role in a graduate's working environment and the ability to provide the best advice.

4.3.2 Summary of conception 1.

This conception focuses on the professional's primary role of providing a client oriented solution to a problem by employing the application of any form, or combination, of geographic data or their support systems. All three sub-conceptions deal with the utilisation of spatially located geographic data to identify a problem or need, determine a solution and to provide advice. The processes of detecting a problem and providing a spatially located geographic data solution are interrelated, with providing advice on the solution a logical conclusion of those processes. The beginning professional geomatican is expected to apply geomatics' discipline-specific skills and wider general knowledge in identifying problems and providing advice, or providing the best solution to the problem. By selecting a combination of appropriate practices and processes from within the geomatics' domain, the professional is able to address the contextual parameters of a problem.

A solution is expected to be based on a technically competent output with spatial reality and connectivity in its context. This contextualised advice must be compatible, and capable of integration, with other professional advice and needs. The solution is also expected to provide the structure and processes to which management skills and specific paraprofessional technical skills can be applied to ensure the best solution is achieved. Evaluating the opportunities arising out of the solution for value added products and data utility for business economics and the benefits to society, is also a professional's responsibility.

The underlining attributes to ascertain the limitations, outcomes, usefulness and impact of the advice or solution are those of good communication skills; initiative; highly developed lateral thinking; analytical and innovative abilities; and the ability to conceptualise, synthesise and evaluate. The graduate not only requires a knowledge across the whole spectrum of the geomatics' discipline, but also an understanding of societal needs and trends, and the context into which the solution is to be integrated. Hence, the overriding conception derives from the 'single discipline' geomatics' approach which facilitates this essential quality for the beginning professional.

4.3.3 CONCEPTION 2. Geomaticans provide spatially located geographic data to support an enterprise.

This conception focuses on providing spatially located geographic data for direct application into an information media or into land development and management. In addition to a competent professional conceptual knowledge and understanding of the methodology and techniques across the spectrum of geomatics', the professional is expected to have a broad general knowledge and understanding of the processes of related disciplines and society's structure. The technical work will be performed by paraprofessionals, permitting the professional to function on a project supervision level organising, evaluating, analysing and synthesising information. In addition, a well developed level of initiative and innovative skills is required to provide contextualised spatial reality and connectivity as part of a project processes. The 'single discipline' geomatics' concept is embodied in the practice mode and the various descriptions of this beginning professional, viz. generalist, physical geographer and resource manager.

Two sub-conceptions within this conception, those of gathering and presenting, are interdependent but are seen as separate activities with their own professional domain. A third sub-conception, providing spatially thematised geographic data, consists of the combined processes of the gathering and presenting sub-conceptions. The latter illustrates the trends of larger private and government organisations and the concept of geomatics. These sub-conceptions are described in the following sections.

(a) Geomaticans gather spatially located geographic data for client specified needs.

Despite automation and other technological advances, this sub-conception considers the beginning professional's role as providing specific data in response to a need for geographically located information to support a client's enterprise or undertaking. Hence, the geomatican is reactive to client needs and gathers geographic information for specific tasks or, alternatively, physically locating that information to support some enterprise. The main purpose is to gather information for others to use and apply.

Geomaticans have traditionally measured geographic phenomena to provide their spatial connectivity and identification. Employees in government and private practice perceive this to still be the role of graduate professionals. It is the geomatican's expertise in visualising geographic data environments, spatial connectivity and contextual usefulness that maintains this role and provides the client with appropriate and useful data:

ELM(A)-25. *Well surveyors generally are data gatherers ...*

***P*UP(A)-8.** *We are experts in data gathering spatial information. No one, I believe, can conceive as well as the surveyor can with spatial information.*

MAG-32. ... *he's very strongly client orientated in terms of meeting his client's demands. You give the client something which he perceives is of added value to his business*

However, acquiring that data is becoming widely accepted as largely a paraprofessional technical level activity. Recent technological advances and automation allows vast quantities of data to be rapidly collected and processed with minimal skills and decision making. The traditional specialist technical practices in the land professions will be paraprofessional support roles. Hence, fewer professionals are required to perform just those tasks for providing data in a form for the client to analyse and use. The professional's role will be concerned with the analysis and interpretation of data, comprehending its usefulness and best use before organising its' application and storage:

MLG-3. *I see the surveyor's role will put all the data together, into say land information systems.*

ACA-28. *So in terms of both the skills of the numbers that are going to be required to do data collection is likely to decrease.*

MSG(A)-12. *I mentioned the surveyor as data gatherer, and I really don't see the professions as such hanging in there much longer. Surveyors, cartographers. I see the demise on what they're presently understood to be. There's always a need for that type of skill but not necessarily attached to a profession. A surveyor in the eyes of most people has an identity problem: it has been the cadastral surveyor, but when you look at the true meaning of the surveyor it's much broader than that. Cartography is the same. Cartography in the true sense of the word is much broader than making some maps; and if you look at the broader definition for those people, there would be a role, but the professional cartographers and surveyors may not be there.*

MSG-29. *Yes, I think there's the automation issue so that we need fewer valuers out there.*

PSP-19. *I think there is a need (for graduates) to go that way because the profession needs to regain ground, and it's not going to do it by land or cadastral surveying because it's just not very demanding, it's just peg bashing, and that's what I feel many survey technicians are out there doing anyway. In most survey practices they are. ... In terms of paraprofessional and professional, it probably would be the demolition of the number of professionals you would need , but I think the line is very thin anyway.*

The professional in this conception is not perceived as having a significant business, leadership or managerial role, but is an individual 'cog' within a system. The perception is that there is a minor, but necessary and fundamental, technical contracted service

involving spatially located geographic data gathering or measurement setting-out for a client. This view of the entire industry is articulated by a government consultant and managers at different levels of government:

> **MLG(A)-15.** *I think my own perception is that surveyors do have a perception of being subservient to other people. ... are a service industry.*

> **MAG-32.** ... *we are a service industry.*

> **CSG-27.** *private firms - Yeah professional delivery of services is considered to be a personalised service. Commercial is a very fundamental delivery of service* (you give something in return for money) ... *I perceive a lessening of professional service out there and in the surveying profession now.*

In this conception the practice of the geomatican is to gather, supply or set-out geographic position information to satisfy instructions received from a client. It is considered a specialist service and the core role of the geomatics' professional. However, technological advances and automated processes are changing this to a paraprofessional level of practice, requiring the professional to advance to another operational capacity, such as analysing and interpreting data for application, to remain a professional entity. The current professional practices are being increasingly delegated to the paraprofessional, reducing the need for the professional in the data gathering capacity.

(b) Geomaticans prepare spatially thematic geographic information for clients.

This sub-conception focuses on presenting analysed and integrated geographic spatial and textual data to create a general information medium or thematised information for client contextualisation application, generally in support of management. Generally working alone, the beginning professional will access, understand and amalgamate the geographic data forms appropriate to the task requested by a client: a value-added application service.

Whereas the first sub-conception, that of providing data, considered the professional's role as one of data acquisition, this sub-conception considers the professional's role as dealing (sorting, manipulating and amalgamating) with stored data to form thematised information for products or storage for multi-user access:

> **MLG-3.** ... *and your cartographer's pull that information out to produce your maps.*

> **PSP-6.** *I think it's changed really from measurement because the of change in technology and communication, it's really gone from measurement to management. How you supply the data, what's available, the format of data is in and what the client requires. So therefore the format you're outputting.*

That's really what it is. Taking the data in, which may require measurement or the information may be available and then just management into the technical format that the client wants.

The analysis and integration of geographic data sets are elements of the role of the technically practising professional. The management and marketing aspects are generally not this professional's concern as they are singularly dealing with data as a specific service to a clients request. Both academics and government managers conceptualise that the professional's function is to employ his/her understanding of the spatial connectivity of land data to provide a geographic data interpreting, analysing and synthesising service:

MSG-22. *There's one that is the professional that's dealing with the information and analysing it etcetera.*

ACA-20. *Geographic information analysis depends less on the large groups and more on the individual.*

MSG-22. *So if that person, if that's his role, is to simply manage that, develop it up etcetera, the interactive skills, the marketing skills etcetera, aren't necessary.*

To control and provide a specialised service for contextualised spatial information to the diversity of geographic data user clients, the professional will require a conceptual understanding of all geomatics' data acquisition methodologies and technologies in addition to data integration and representation techniques. Good communication skills are also required for dealing with the different clients:

ACA-20. ... *fundamental education...they have the ability to understand and comprehend the process of the acquisition of information and the manipulation of the data, but it's going to be unlikely that there'll be few of the groups out there doing the processing themselves.*

This breadth of knowledge of the functions of geomatics' land-related disciplines, and a good knowledge of the *modus operandi* of other non-geomatics' users of geomatics' information, will enable the professional to supply useful, individually tailored, integrated, analysed and synthesised information from an established multi-faceted information environment:

MSG-22. *the traditional cartographic skills need to be much broader, much more into interpretation of land .... information, spatial and textural: analysis and manipulation of that information in either a GIS environment or something of that nature. Clearly the traditional cartographic skills, in terms of the depth of detail are not necessarily what's going to be required. Land information clearly, in terms of providing integrated land information, affects valuers, affects*

surveyors, affects you know just about every professional base that deals with land.... And the analysis of that information. So you know that is a growing area and it's certainly that is going to leave the true professionals, those that stay behind and just simply look at valuation or look at things in isolations, time's going to pass them by. So it needs a fairly major shift in emphasis and focus.

In satisfying client requirements, the beginning professional will have less manual technical training and be more broadly educated in digital technologies' methodology and techniques. He/she will have a wider knowledge of information applications in other disciplines and society in general. Hence, the professional will be client oriented but mindful of limitations imposed by his/her discipline and society. A general knowledge of society needs, good communication skills, lateral thinking abilities and innovative skills, will still be essential attributes if the professional is to provide the best, and correct product that satisfies individual client requirements:

ACA-28. *Again the traditional cartographic mapping calculation functions: they will obviously go towards the digital end of the spectrum in terms of the methods for data collection and data storage, but more importantly the application to which those data are going to be placed are going to be much wider than traditionally. So technically the people looking after those data sets will need to have a much greater awareness of how that data is going to be used; they are going to have to be much more driven by what their clients want, rather than traditionally where it is driven by technique and lifestyle products.*

This conception of the beginning professional deals with an individual integrating, analysing and synthesising geographic data sets to create thematised and contextualised information for a client. This role requires skills, knowledge and training in digital technologies' methodology and techniques such as: electronic data collection and storage field survey systems; GPS and photogrammetry; electronic scanning systems; and computer and related output environments. Additional attributes required to deal adequately with client needs include good communication and lateral thinking abilities, innovative skills and a general knowledge of the clients' environment. As an employee, the beginning professional will have minimal contact with the management and marketing facets of the business, but will be required to liaise with others and organise and manipulate information to achieve the best outcome for the business and the client.

(c) Geomaticans provide spatially thematised geographic information for clients.

In this sub-conception, the professional is a generalist with a holistic perspective and involvement within the entire geomatics' practices of collecting, manipulating and applying spatially located geographic information. A full and complete range of geomatics' services or end products must be realisable in order to retain: an acceptable professional status, service and influence within society; the best geographic information related advice; the best solution determination; and appropriate application management. The total and global approach to the collection, manipulation and

application of spatial data to all aspects of environmental and social planning and management is the operational goal of the future professional. This will necessitate less technical training and education in more concepts and processes in all facets of geomatics, placing the onus for technical work with the paraprofessional group. In addition to professional competence and general social knowledge, this person must have developed skills in lateral and innovative thinking and the ability to adapt and adopt new technological uses to this expertise. Essential supporting skills consist of environmental knowledge, understanding and interpreting laws and the legal processes, social issues and consequences, communications and personnel management.

Future geomaticans will expand the repertoire of their professional and business practices, offering a full range of geomatics' expertise and services. This is the perception of managers in all levels of government and a large firm employee, all of whom have experienced multidisciplinary organisations. They consider that the geomatics' industry is comprised largely of specialist practices. These practices are continuing in the traditional data collection and setting-out capacity without fully utilising the range of modern technolcgical advantages in digital data; collection forms; integration; storage and communications, to expand the breadth of services a professional should be capable of providing:

MLG-3. *Its a very narrow field (cadastral), getting narrower, it has got to widen out to.*

MSG-22. *a relatively small scale operation where the professional is in fact the interface then yes, that professional needs all of those skills.*

ELM(A)-25 . *Well surveyors generally are data gatherers ... It seems to be an easy transition from gathering data to be able to put it into a format where people can use it.*

MSG-29. *I think you'll find that the scope of professional services offered will broaden. I think you'll find that the scope of business from the true professionals will broaden.*

MAG-32. *... you'll find that the scope of professional services will broaden.*

MBS-30. *I'm a believer that it* (the surveying profession) *should broaden, spend a fair bit of time broadening itself out again, which is why I'd be talking about people who, as well as having surveying experience, would have town and regional planning, all of those sorts of broad skills. People are looking, not for specialists services, they're looking for outputs which are specialised and looking to deal with people who have a broader range of vision than what I'd say your suburban surveyor would offer them or would want to offer them at the present stage.*

PLP(A)-26. *Yeah, facilities management; asset management; information systems; land information systems; land administration; integration of data: hopefully they, all those things will be able to be provided by surveyors; particularly spatial data; integration of spatial data.*

A lateral expansion in services and increased involvement in the higher planning and design operational levels must occur to maintain professional status and to continue functioning at a professional level. This is achieved through influencing a developmental or operational environment from an analysis and evaluation involvement rather than simply the supply of geographic technical data:

ACA-20. *The engineering and mining areas, particularly in the function of road type, I think there should be more emphasis placed on the skills in that area so that in the area of design, particularly road design, we could be involved in the functional area, could be an area surveyors should be able to then become more professional ...*

PLP(A)-26. *My view would be that generalists need to have an overview of what's involved in the design, so there'll be some similarity that would stream off into a wider range of subjects. For an example the surveyor he would need to have more idea of planning input, finance, marketing, engineering. We used to to a lot of civil sort of works previously but that's dropped away. Enough to be able to know how he would need to perform his task as a generalist in conceptualising a development, just using that as one example. So I would see that trend emerging. So that's the organisational field.*

More than this service expansion is required to retain status and function as a professional. The beginning professional will need a geomatics' approach to enable a full and useful interpretation, analysis and manipulation of spatial data in line with the technology induced data collection, manipulation and dissemination changing practices of the profession. The professional will not only have skills in data collection and application management, but also a knowledge of the concepts in the different facets in geomatics' ; a pedestrian knowledge of related disciplines; and a general knowledge of the wider society. He/she will then be able to adapt and adopt new geomatics' data collection, storage and dissemination technologies into wider applications within related professional areas, and secure an improved professional advisory and managerial interest:

PSP(A)-8. *You may move more into spatial information, managing spatial information. You may be a collector and a manager.*

MAG-32. *I think you'll find that the paraprofessional or the people that have no qualifications they will stick to a narrow area of knowledge which they probably do quite well: because they'll stick so narrow. .... they'll be able to continue doing it this way because that's the way we've always done it but the*

true professional will be the one that will be inquiring and saying well just because we did that last one that way, is there a better way, here's the emerging area of knowledge, so I think you'll find that the professions in fact will start to overlap.

ACA-11. *In other words, rather than simply be the technicians who actually put data together and print data out, they would be looking at a larger picture.*

PSP(A)-8. *To me we collect information; we can manage it well and we should advise people on how to deal with public commodities at random.*

The beginning professional geomatican will have a breadth of knowledge covering the entire geomatics' profession and including environmental and social knowledge. The following five views of managers from government, private firms and a bureau service postulate this move to generalisation. Utilising all the above knowledge resources towards achieving a best solution, it is necessary to advance the profession's changing emphasis of arranging the provision of spatially located geographic data for land management. This development, together with leaving most of the technical work to paraprofessionals, is conceptualised as progress from the current technical specialist professional towards the true generalist or geomatics' professional:

PLP(A)-26. *In my area, which is surveying, I would see that there would be at least partly a move away from specialisation to more generalisation.*

MAG-32. *the way the future's going it's obviously, land information and spatial data for ... land management. And having surveyors be more influential in land or decisions relating to land management. So you know you can appreciate, you understand the land.*

MSG-22. .. *it's moving away from specialisation. These skills to be able to communicate, to be able to negotiate, to be able to prioritise and to assign resources and manage resources etcetera. I doubt that we can necessarily afford to give everybody that level of expertise* (just a core of people), *so we really are going to be much more generalists ...*

Acquiring and providing spatial data for land development and in support of broader land management issues, is the main thrust of private enterprise. The government sector is more concerned with government land administration and management. Hence, the government sector sees the emerging professional as requiring a broad, if shallow, general knowledge of geomatics' and land-related matters, and a global perspective of geomatics' applications. This will ensure that the professional's application of spatial information management will encompass all the political, social, legal and administrative processes of land development, land use and social implications:

MAG-32. *Well I think that's what you're after, you're after everyone to have that veneer of knowledge right across all those.*

MBS-29. *Now there'll always be room for the Grand Poobar of knowledge in the Real Property Act and, but he's not the person who's going to influence. So I guess in a nutshell it's more about the generalist rather than the specialist. What'll need to make sure is that people do not sit within their traditional schools, that surveyors and valuers and those sorts of people become much closer. Within the Lands Department - amalgamating.*

PLP(A)-26. *My view would be that generalists need to have an overview of what's involved in the design so there'll be some similarity that would stream off into a wider range of subjects. For an example the surveyor he would need to have more idea of planning input, finance, marketing, engineering. Enough to be able to know how he would need to perform his task as a generalist in conceptualising a development, just using that as one example.*

MSG-29. *I guess what all professionals need is some sort of base skills over which you cast some areas of knowledge. So one of the base skills would be project management. Then there is probably some people skills: you're going to need some people communication type skills. So I guess base skills probably come into areas such as communication. So irrespective of whether you're going to be a land professional or whether you're going to be a lawyer, or whatever you're going to be, we're probably interested in those areas of base skill. I think there is also an area of forward thinking. .... actually look for new innovative ways of applying those things and ways of just streamlining what we currently do. I think they're probably the three core areas of skills that you'd want. Over which you cast an area of knowledge. So the area that I'm particularly interested is the area of the land professional. So the land professional would, over that, want a knowledge of surveying, valuing, and in the broader sense, land administration.*

While the current perception sees a need for only a few highly trained specialists, those that generally practise in only one aspect of geomatics' are regarded as paraprofessionals. Expert technical support (the specialist) is required, but for addressing the needs of wider social and developmental issues in their totality, the generalist is increasingly in demand:

MAG-32. *But having had that veneer of knowledge, there's room for experts. The world is tending towards generalists, we can see that now. However there'll always be room in the world for the specialists. So what you want is to have these core skills which we overlay areas of knowledge. Some people will be happy with a relatively thick overlay and not have any area of particular specialists, they're the true generalists.*

MBS-29. *The old Lands Department actually had two quite strong camps. There were clerks and they had a lot of detailed knowledge on the sorts of things I'm talking about. And then there were the valuers. They concentrated very much on the technical issues. In reality if you said to me now which were the true professionals, I'd probably have to say the clerks, the valuers were the technicians.*

Academics support this holistic philosophy but perceive the industry developing into a two streams (refer to sub-conceptions 2(a) in 4.3.3(a) and 2(b) in 4.3.3(b)) where the professional practices in all aspects of that respective stream, i.e. is a generalist or multidisciplinary professional in that respective stream. The narrower first stream concentrates on data measurement, while the second primarily provides spatially located geographic information to support planning and management enterprises. However, the multi-disciplinary nature and expansion in the presentation stream (sub-conception 2(b) in 4.3.3(b)) and increased paraprofessional role in the data gathering stream, reinforces the trend towards a paraprofessional person and a single stream professional:

ACA-11. *I see that it* (cartography/GIS) *as being a much more multi-disciplinary kind of programme than surveying. On the other hand in cartography or GIS or whatever, we have a big opportunity to have a very broad based course in spatial sciences. I mean you have got thematic cartography, computer cartography, environment management, remote sensing, land information systems, geographic information systems, planning, you have the whole range of courses there without going into the in depth measurement skills like geodesy, gravity, GPS and so on.*

To utilise modern technology and accommodate societal needs for spatially linked data sets, government geomatics' managers are moving increasingly towards the geomatics' or general practitioner concept. This 'multi-skilling' has better utilised human and physical resources through: the flexible deployment of resources to accommodate needs; multiple task completion by the single professional to reduce time, duplication, and co-ordination; and global understanding of task related problems. Combining the professional strands has created a single understanding and system for spatial data handling, removing difficulties and problems that are experienced with linking data sets between expertise areas. Such an environment is technically and economically sound and provides better service to clients and society in general:

MSG-17. *One of our catch cries is the multi-skilled process so that, we talked earlier about a surveyor going out and doing survey checks. You know most systems get developed then they talk about linking data sets. Rather than seeing them as 'a system' where there's no need to link data sets because it's one whole system.*

MSG-17. *... I've charged him from the task of creating the land professional for the Department of Lands; we're going to start it here very shortly. I've had*

some multi-skilling underway, mainly organising the valuers to start with the development area, which is essentially developing crown land for sale and all that sort of jazz. I've instructed (a name) that when he goes out to do the survey, do the valuations as well so I won't have to send valuers. I've got three cartographers trained up, virtually trained up in the typo process.

These government enterprises already have employees who function in this geomatics or multidisciplinary way and who see changes needed for beginning professionals. The need is for a broader knowledge spanning all the land professions, an inquiring mind and the professional willingness and communication skills to initiate developments. The beginning professional can then work as a professional, not as a technical specialist, helping meaningful change that takes account of the wider context:

MAG-32. *But if we're serious about the land professionals have something to offer, and I think they do, then the only way you're going to be in a position to be able influence things is by getting on that front edge. Now you're going to get on the front edge by this broader knowledge with these underlying skills. You're not going to get on that front edge and be able to influence society by having a detailed knowledge of the Real Property Act. Because the reality of the Real Property Act can be changed. And that's why you need someone who is inquiring and say let's change the Real Property Act.*

The professional should also be able to assess when paraprofessional technical assistance or non-geomatics' expertise is required. This is possible with a broad knowledge which includes professional geographic data collection and presentation methodology, legal and social issues knowledge and a sound environmental knowledge:

MSG(A)-12. *I would class myself as very much the multi disciplinary type of person from a background point of view. ... a person who wants to take that multi disciplinary approach, then I guess I am looking at what you call a land professional, I call it more a resource professional. So to me we have a resource, earth, which I guess to ensure perpetuity we've got to put in place certain strategies to make sure it continues to be a resource without decline. So it's very much what you call a development approach. So if someone wants to enter that field, to me they've got to have good skills in the measuring side, the data gathering. You can call it surveying if you wish. The analysis side, the geographers, and I guess to a large extent, possibly the cartographers would fit in that, as opposed to being the surveying side. The legislative people, the people who have to understand what legislation exists, what the legal aspects that presently impact the community. Call it the land act, call it the environmental side. The people who know about trees, flora and fauna or that aspect. What I guess I'm saying is to me, the qualities you need are good, sound operation knowledge of what exists. You'd have to have expertise in those areas, and also able to know when you are out of your depth and need*

specialist skills. If you've got a surveying problem which is not your field, you need to know when you need to go to the expert who knows how to do that at the most cost efficient manner.

Academics conceptualise that a professional performance plane requires a comprehensive knowledge of the availability, limitations, advantages and disadvantages of all the techniques and methodologies in the geomatics' discipline. A broad understanding of, or the capacity to understand, the task's context is also required to deal with that task as an integral part of the whole and the anticipated desired consequences:

ACA-10 . *I think they have to be able to think of the project as a whole. They have to realise what the goals of the project are and they have to understand what methods are available. ... they have to be aware of the equipment, they have to understand the limitations, the pros and cons, the different processes of equipment around, and then given that, they are to achieve a required accuracy, it is up to them to choose the combination of equipment of methods that will satisfy.*

Technological advances enable the professional to explore multiple combinations of data capture, interpretation, analysis and combinations for display or in support of management. Hence, the beginning professionals need an understanding of all geomatics' technologies and methodologies. In addition, they need a general knowledge of the context, or the ability to comprehend and adapt solutions to that context, in which the task is undertaken:

ACA-21. *I think that the challenges in our profession is in the collection. It has always been in the collection and display of information and where it is we have tended to focus on topographic data and cadastral data, I think we have solved a reasonable number of those problems. There may be some parts that haven't been solved, and certainly at the engineering level there are always challenges, Each engineering problem is different but I think a lot of the challenges for us, in my opinion, are in bringing in other information from other disciplines and integrating them with the information we get and information from other sources in a way that is appropriate for resource managers to use. .... I think the integration, the propagation of error through the analysis, extraction of information through remote sensed images and field survey techniques and the integration of different information and presentation and that information for managers. I would have seen those directions as being the directions for our profession in the future and very much being a geographer in a sense; a physical geographer in a sense.*

Academics, in reviewing industry trends, conceptualise this integration of data forms and the derivation of a product, or end solution, for a particular context, as an increasingly desirable business practice. To gain or retain clients and have an

economically viable business, the professional needs to offer a complete 'one-stop' service and, ultimately, an immediately usable solution:

> **ACA-10.** *Measurement Science is still one side of it, but increasingly we see it is also spatial information management* (by the professional surveyor), *you don't just get the data and hand it over, increasingly that has to be managed and has to put into other systems, like GIS. It has to be integrated with remote sensing or something.*

In a traditional sense, geomatics is a multi-disciplinary industry that will, to some degree, with some individuals specialising, remain so as it progresses towards a single multifaceted structure. New graduates may be required to function in any one or a number of geomatics' facets. In addition, a more dynamic work environment has placed geomaticans into situations not previously a professional practice expectation (e.g. GIS use and needs, marketing, etc.). From the academics' interpretation of the needs of the profession, education in geomatics is increasingly considering all facets of the profession and their integration, and moving away from the narrower streaming emphases. This addresses the beginning professional's choice of the diverse employment opportunities; choice of the automation and technological advances that have increased access, opportunity and ease of utilising the facilities of each geomatics' facets; and the need to offer clients a total service:

> **ACA-10.** *The areas that geomatics' is concerned with, certainly Measurement Science, what people would call traditional surveying, representation, analysis, management, retrieval and display of spatial data .... mapping sciences. But increasingly it includes land management, geographic information systems, remote sensing, geology, photogrammetry and surveying.*

> **ACA-10.** *Ok, we believe our students still need to know the equipment, you see we are trying to cater for all sorts of markets.*

> **ACA-10.** *... there are people in all sorts of areas at the moment they never expected to be in...*

> **ACA-11.** *I think the number one priority will have to be in terms of training professionals is to have people who are multi-skilled or have the ability to diverge into a different range of opportunities.*

To facilitate a broader general education within profession-specific education, there is the need to reduce the technical training aspects for professionals and concentrate more on techniques, methodologies, contextualising outcomes and interpersonal skills knowledge: a concentration on applications skills, opportunities and management of providing spatial geographic information. Hence, the education program should contain a greater emphasis on interpersonal skills, society and knowledge about other disciplines where opportunities exist for geomatics' applications:

ACA-28. *Obviously communication and people skills, and this is all for the reason he is going to have to have a broader education that traditionally, you can argue that traditionally the surveying course where emphasised the techniques of surveying for data gathering, rather than how the data can be used and the various groups are going to be using it. At least at the educational level the students are going to have to be opened up to that, and together with that, as I said, the necessary communication and people skills.*

Academics continue to see the high level of technical competence moving from the traditional professional to the paraprofessional: professional education continues in its endeavour to favour a greater understanding knowledge over a broader based knowledge. To effectively devise and apply a useful and best solution, and not simply supply a result, the professional will need to understand the function and output of a system or method, analyse output and be capable of being innovative in the application of that system or its output:

ACA-21. *My view is that the professional person will not be as competent at operating technical machines as a technical person who should be there supporting them.*

MSG-22. ... *an appreciation of the concepts of using a particular software environment, of using the information, knowing where you can get it. As long as you get one that has representative functionality* (of equipment and software), *as long as they understand the way one of them works, they can then start applying that to others quite readily.*

(RES.). ***Would they have any particular skills, these new students, that the older surveyors wouldn't have had?***

ACA-11. *I think they would certainly have a lot more breadth of training. You know, having a broader appreciation of maths and physics, geography, if you like, management and so on. I mean the surveyor who has come through the article system and working as an apprentice with the cadastral surveying would have a very narrow vision of what surveying and what the possibilities of surveying are. So I think therefore the students that come through this system now will have a much broader education rather than the narrow training focus.*

MSG-22. *Now, there has to be an increased emphasis upon the technology ... understand the use of a package .. and the analysis of that information.*

PLP(A)-14. *I'd have to say everyone can get a result but not everyone knows why they got the result.*

PLP-37. ... *professionals are less technically capable, but they understand*

more and can see opportunities.

To function proficiently and professionally at applying and managing systems and spatial data, the emerging professional must receive less technical training and a wider professional and general education. The emphasis of this education will be on enhancing skills and knowledge in lateral and innovative applications of geomatics' services. Only then can the professional truly amalgamate data to achieve contextually the best and most useful outcome, i.e understand the whole contextualised spatial concept suitable to the professional, the client and society:

ACA-28. *In terms of the technical ones, understanding of his field, and the field will have to be much wider than traditionally, the emphasis from the measurement type, of Measurement Science away from the data gathering, towards the data management aspects; and then the application of the data to other areas. So in general we are looking for a much more rounder person than we have had in the past, both in general terms and in his professional knowledge and professional skills. So the focus is away from the narrow land based survey tasks for data and towards management and application of the data.*

MSG(A)-4. *an understanding of GPS and geodetic networks which bring rigour to the landscape; and then we move onto the cadastral layers which are all about mortgages and ownership and that sort of thing. And then shooting off then we have all of the natural resource layers which we used to call in, in the main all the different layers on a topo map. But we add to that now the natural resources, the geological layers and so on. But then it leads further then because you've got your cadastral base, you've got your topo base as we used to refer to it, but then you start moving into your social and your economic. So if you haven't got a reasonable understanding of how the world spatially sits.*

MSG(A)-34. *A knowledge breadth enables you to see where everything sits and how it fits together. So, if you have to sacrifice some technical competency ...*

Personal skills and personnel management should be emphasised to engender and develop a team holistic perspective and involvement in developing and applying spatial information. The value of the wide knowledge base of the professional is in managing the individual support services in the process of developing the amalgamated and best contextualised solution. Coupled with this is the need for the beginning professional to have a greater understanding of the interpretation of laws and the processes which provide a more dynamic and influential professional approach to his/her deliberations:

PLP(A)-14. *So somehow or other they need to learn a bit more dependence on each other. We've got a management structure in place that makes all the other bits and pieces rely on the other bits and pieces. There's not enough emphasis given to legislation, the whole world is, you know all of our world is*

going to be conditioned by new types of legislation in the next years. ... as professional people have to interpret that legislation we need to really make sure we understand what it's saying. And you know we work a lot with the law, I think just about every bloody act known to man, somehow surveyors get involved in it. Surveyors have always looked after the environment, ... but I see very little emphasis on environmental issues in future education. I don't want every surveyor to become a Greenie because by the very job we do working for developers that's probably not going to be profitable, but we can have a very key role to play in it even if it's at getting sensible policies on information gathering.

CSG-27. *it doesn't matter whether you're one or two centimetres out on the water course boundary. So, (a) he's got to be able to read an Act and understand it, and then (b), I think he's got to have an understanding of the judicial system and what they look for in, in all these things.*

In this sub-conception the beginning geomatics' professional utilises the methods and techniques of geomatics in a total approach, ie. the collection, manipulation, synthesising and contextual application of spatially located geographic information. By utilising the paraprofessional's technical output and other expert advice when required, the geomatican is able to apply interpretive, analytical, evaluative and synthesis skills to provide a client with appropriate thematised output. To achieve this the professional attributes include: a good conceptual knowledge and understanding of geomatics; a general knowledge of the environment; laws and legal processes; societal needs; and spatial data uses. Specific abilities for lateral and innovative thinking and good communication skills are also required in facilitating the application of the information. This conception is derived from the conceptualisations of those in all levels of government involved in geomatics, academics and the larger private practices who are involved with multifaceted operations. This 'single discipline' geomatics' approach encompasses the essential qualities of the beginning professional.

4.3.4 Summary of conception 2.

This conception focuses on providing spatially located geographic data for information systems or media and land management. In addition to professional methodology and techniques' knowledge and understanding across the spectrum of geomatics, the professional is expected to have a broad general knowledge and understanding of the needs and processes of related disciplines and society.

Of the three sub-conceptions, the two sub-conceptions of gathering and of presenting information are seen as interdependent but separate activities. In the first sub-conception, the professional's role is to gather, supply or set-out supporting geographic information in response to a specified need to support a client's enterprise. It is perceived as a specialised service and a core technical role of the geomatics' professional. However, with increasing automation, communications, remote data sensing, greater access to data