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Tacit Knowledge Characteristics: a research methodology

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Abstract

Little literature deals with the measurement or mapping of tacit knowledge. Our approach makes use of expert vs. novice comparisons as a means of interpreting the likelihood of an individual possessing such knowledge. The incorporation of formal concept analysis provides an alternative visualisation of questionnaire responses. Social network analysis maps the flows or likely non-flows between individuals within the IS domain. Such an approach allows us to visualise the potential for tacit knowledge bottlenecks. Initial results seem to indicate that certain personnel, who may not necessarily be senior may be tacit knowledge receptors, whilst other employees may actually be inhibiting tacit knowledge flows within the workplace.

Keywords

AL01 Knowledge representation; AL04 Knowledge acquisition; AP Psychology; AI0801 Positivist perspective; DD07 Information flows; FC15 IS models; HB26 Simulation and modelling IS; Formal Concept Analysis; Social Network Analysis; Tacit Knowledge; Diffusion of knowledge

INTRODUCTION

Although much information systems research to date has dealt with explicit or articulated knowledge, and without a doubt this has been the case in its more established cousin, computer science, the issue of tacit knowledge has typically been given only passing reference from an empirical research point of view. Certainly many papers discuss the sure existence and importance of tacit knowledge, and its cultural aspects, for example the East's (meaning typically Japan, see for example Nonaka *et al.*, 1998; Nonaka *et al.*, 1996), appreciation for it, over and above the West's. Why however should one begin tacit knowledge related research? After all tacit knowledge deals with soft information that is not easily codifiable and (in the West at least), has traditionally been little valued (Nonaka *et al.*, 1998). Arguably the area concerned with the study of tacit knowledge within the information systems domain, falls broadly within the purview of knowledge or information management, and the importance of capturing tacit knowledge is considered fundamental to this arena (Casonato and Harris, 1999). What is acknowledged however to be an issue, is that although information management is considered important by organisational researchers, information systems as a discipline has treated information management as the management of information technology (Anand, Manz and Glick, 1998), where it has been argued that,

To achieve effective information management, organizations will need to pay greater attention to managing soft knowledge such as tacit knowledge, judgement and intuitive abilities. The development of advanced information and communication technologies has increased the need for adopting an organization-level approach to information management. Consequently, efforts to implement technically oriented management information systems

can contribute to effective information processing only when accompanied by an appropriate set of organizational strategies.

(1998: 797)

[Furthermore], there is also increasing pressure for increased externalization of soft knowledge that may be required for constructing and structuring problems in the face of incomplete information

(Daft and Weick, 1984; Huber, 1991 in Anand, Manz and Glick, 1998: 806).

Tuomi (1999/2000) also agrees with the overemphasis on the management of information systems, with an underemphasis on the 'sense-making aspects' of these systems. In other words, the effectiveness of information systems is being compromised by the view toward their management as a set of information producing machines, with little regard for the soft human knowledge component that facilitates effective 'knowledge' creation and management.

A WORKING DEFINITION OF TACIT KNOWLEDGE

On the one hand, it is argued that *some* tacit knowledge can never actually be articulated (Leonard and Sensiper, 1998), or indeed *all* tacit knowledge (Burstein, 2001 [personal communication with Assoc. Prof. Frada Burstein, Monash University]). On the other hand, economists arguing in reductionist terms consider that: "only cost considerations prevent residual forms of tacit knowledge [from being] codified" (Ancori, Bureth and Cohendet, 2000: 281). Indeed, it is often accepted "that tacit knowledge (as distinct from intangible investment more generally) is non-codified, disembodied know how that is acquired in the informal take-up of learned behaviour and procedures (Howells, 1995: 2). Tacit knowledge also has its traces in Gärdenfors' Conceptual Spaces (Gärdenfors, 2000). Research by Aisbett and Gibbons (2001) identifies the "subconceptual layer" of Gärdenfors as being represented, for example, by neural nets. This suggests that if we equate the brain's subconscious with tacit knowledge, then we have an explanation of tacit knowledge processing as subconscious pattern matching. Such pattern matching is not explicitly codified of course until a conscious effort is made to articulate such tacit knowledge, make it conscious, and codify it.

Tacit knowledge, depending on one's interpretation, may actually be, we speculate, any pattern matching process from sensory skills such as 'learning to ride a bicycle', through to 'tricks of the trade'. The latter often articulated and passed on from the senior to the apprentice. Our use of tacit knowledge in this paper refers to the 'street smart' knowledge that employees have gained from experience and make use of, but which is not necessarily written anywhere, yet to a large degree can be articulated if necessary. When such tacit knowledge is shared from mutual experience and culture it gains a dimension within an organisation. We choose to call this *tacit knowledge*, however others may feel comfortable calling this 'implicit knowledge'. We may comprise by calling this knowledge: 'articulable implicit managerial IT knowledge'. Either way, what we wish to examine is the extent of soft organisational knowledge that all personnel make use of, and secondly, and more importantly how well or otherwise we may see a diffusion of such knowledge in the IS organisational domain. Our objective in this paper is to present a complete outline of a research methodology for testing and mapping likely flows of tacit knowledge, with some initial results to support our methodology.

THE SIGNIFICANCE OF TACIT KNOWLEDGE RELATED RESEARCH

Reasons for undertaking tacit knowledge related researches are many and varied. From an academic workplace perspective, there is certainly the desire to examine an interesting phenomenon and produce publications. From the IT workplace point of view, a study of tacit knowledge is usually, but not necessarily, concerned with the area that has come to be known as Knowledge Management. And the capturing of tacit knowledge has been noted as being fundamental to such management, indeed it was noted, that "through 2001, more than 50 percent of the effort to implement knowledge management will be spent on cultural change and motivating knowledge sharing (0.8 probability)", which Casonato and Harris (1999) had envisaged as including the more effective utilisation of tacit knowledge. More

practical reasons for examining tacit knowledge have been noted to incorporate, “improv[ing] the quality of a person’s or a team’s performance, help[ing] to communicate knowledge to another person, keep[ing] one’s actions under critical control by linking aspects of performance with more or less desirable outcomes, [and] construt[ing] artefacts that can assist decision making or reasoning” (Eraut, 2000: 134). All of the latter arguments for researching tacit knowledge point to intra-organisational self-improvement with an emphasis on the individual.

Indeed whilst tacit knowledge literature, especially within the knowledge management domain, typically does focus on the macro-organisational level (Donaldson, 2001; Athanassiou and Nigh, 2000; Thorburn, 2000; Cantwell and Santangelo, 2000; Marcotte and Niosi, 2000), the significantly smaller proportion of literature concerned with the *testing* of such knowledge focuses on the individual level (Herbig, Büssing and Ewert, 2001; Sternberg 1999; Colonia-Willner 1999; Reber 1993; Larkin 1980). Notably however, those focused on tacit knowledge at the individual level tend to be psychologists. Certainly from a psychological perspective, one of the leading reasons for undertaking tacit knowledge research is the improvement to intra-organisational welfare, that tacit knowledge testing brings (Ramaprasad and Rai, 1996). For example, it has now become very popular for professional organisations (including those in the IT domain) to implement practical knowledge (meaning largely tacit knowledge) tests that ask potential employees questions in relation to soft knowledge situations (Coates, 2001), these tests are largely along the lines of tacitly enquiring as to whether employees are likely to fit into the *culture* of the organisation. They do not actually test for a candidate’s knowledge of codified information *per se*, furthermore the tests for tacit knowledge at least in Sternberg *et al.*’s (1995) case, are not considered to be intelligent tests in disguise.

From an economic point of view, the ultimate value of any new knowledge, including tacit knowledge, is that codification leads to a greater return on investment, increased workplace efficiency and overall lower organisational costs (Nonaka, 1991). Of course this is all defeated by an organisation that employs a high proportion of contract staff that upon termination walk out of the door carrying their soft knowledge with them. Tacit knowledge plays a direct role in enabling an organisation to attain a competitive advantage as the knowledge is itself difficult to acquire (Johannessen, Olsen and Olaisen, 1997; Lei, 1997), or as Sternberg *et al.* (1995) would say, “is acquired [in the face of] low environmental support”. If the knowledge is difficult to acquire it is also likely to be difficult to transfer, at least from a competitive advantage point of view. If we have worked hard to acquire the knowledge, we are often reluctant to pass it on easily, hence the low environmental support for its transfer. Certainly a proportion of tacit knowledge research (Richards, in press) is focused on attempting to make tacit knowledge explicit, particularly within the artificial intelligence or expert systems domain, a process which Nonaka, Takeuchi and Umemoto (1996) refer to as *externalisation*.

Broadly speaking tacit knowledge is gained either through (a) personal experience over time (and perhaps place) (personal communication with Dr. Antonakis, Yale University, October 2001), or (b) by serving in an apprenticeship fashion with someone who is senior and able to pass the knowledge on to the ‘trainee’ (Goldman, 1990). Tacit knowledge cannot of course be passed in written format, as at this stage the knowledge is no longer tacit, but explicit.

When tacit knowledge is articulated and data are created out of it, a lot of flexibility in interpretation is lost. This may lead to organizational rigidity. It may look attractive, for example to create organisation-wide information systems where the data repositories of data are used in all organizational processes. Underlying this view is sometimes an exceedingly empiristic and objectivistic belief that when we get the semantics “right” the organization will be able to function as a perfect machine. In some cases, one could argue that, indeed, the organization has become a perfect machine that is fixed in its operation by the information systems it has implemented. Therefore a major challenge for the designer of organization memory and knowledge management systems is to understand, not only the relationships

between tacit and explicit stocks of organizational knowledge but also the costs of changing their relationships when the world changes.

(Tuomi, 1999/ 2000: 111-112)

Colonia-Willner (1999) argues tacit knowledge does lead to competitive strategies from an inter-organisational or rather extra-organisational point of view, meaning that organisations are likely to retain the tacit knowledge they hold to the best of their abilities. From an intra-organisational perspective, research (Pierce and Delbecq, 1977 in Colonia-Willner, 1999) has shown that those workplaces high in intra-organisational communication were more likely to innovate with all of the respective benefits this would bring. The primary such benefit however was that of enabling experts to pass their knowledge on to non-experts. The flow effect from such a practice was noted to be “minimising [the] cost of work, build[ing] adaptability to changing competitive market conditions, [which] as a result may produce a fast return on investments, and a gain in market share” (Colonia-Willner, 1999: 609).

AN EMPHASIS ON LIKELY KNOWLEDGE FLOWS

Although much current workplace reform in the professional sector seeks to foster the increase of intellectual capital, ideally through research and development, but failing this through mere retention of skilled staff, movement has been underway within the last decade for staff to articulate their tacit knowledge. Mechanisms by which this has been made possible include those of mentoring relationships through to databases which enable employees to insert their ‘tricks of the trade’ so that others may learn from them, for example *Lotus Notes*[™] Databases. Other systems include *Tacitmail*[™] which mine an employees email for keywords indicating an employee’s area of expertise (Ploskina, 1999; Fridman, 1999; Lattig, 1999).

In undertaking the research presented here however, examination is not being conducted as to *how* the individual has inherited tacit knowledge on an individual level, although adoption of our psychologically-based test would indicate what *types* of individuals would appear to *possess* more tacit knowledge than others in the IS domain. Rather what is more specifically being focused on is the likelihood or non-likelihood of tacit knowledge being *transferred* from one individual to the other, for “tacit knowledge can be taught” (Sternberg, Jackson and Okagaki, 1993). Furthermore,

He [Dr. Galloway] recognised very early on that tacit knowledge, which resides in people’s minds, is acquired through person-to-person communication. Tacit knowledge arguably accounts for 70 to 80 per cent of a company’s most valuable knowledge assets, and is not always successfully captured and managed via document management systems or other technological approaches.

(Sbarcea, 1999: 32-33)

The major tool, which is considered effective in examining the relationships, and therefore the knowledge flows from one individual to the next, is considered to be Social Network Analysis (personal communication with Prof. Michael McGrath, Victoria University, February 2000, then at Macquarie University).

METHODOLOGICAL APPROACH

Although we broadly follow the techniques of Sternberg’s (1999; Wagner and Sternberg, 1991a; 1991b) research into Tacit Knowledge at Yale University, we choose specifically to focus on the Information Systems domain. Tacit knowledge is contextual, as such our research along with others (Colonia-Willner, 1999) makes use of expert vs. novice comparisons but importantly that these comparisons should take place *within* the *same* organisation, rather than comparing one organisation’s tacit knowledge profile with another’s. To that end, in December of 2000 an organisation selection process took place, whereby of 28 organisations sampled, some 8 felt interested enough to participate in our study of tacit knowledge diffusion. Of these 8, it was decided to proceed with one of these for the meantime, within which a CIO was particularly interested in tacit knowledge research. For the purposes of confidentiality, we shall refer to this organisation as Organisation X. It is

however a large privately listed, nationally based company with a Software Engineering staff profile of some 400 personnel, and a total IT profile of 1,400 personnel.

Given that we were researching IT related tacit knowledge, and that only IT practitioners were to be participants in our research, we felt justified in producing an electronic web based questionnaire which incorporated an IS specific tacit knowledge inventory, with the not unreasonable assumption that IT practitioners would be able to access a URL and use a mouse to fill out our questionnaire. In essence a subjective 'soft knowledge' judgement is called for which tests the management or experience based knowledge of the individual, for tacit knowledge is considered relevant to managing oneself, one's career and others (Wagner and Sternberg, 1991b). The expectation of the respondent to choose both an ethical and realistic Likert scale choice provides a 'reality check' for how 'street smart' an individual is considered to be compared to that of an expert in terms of how the latter would deal with the scenarios. An ethical value relates to how one might undertake a task 'properly', whilst a realistic choice tends to indicate what would 'really' do. If the values are the same, then all and well. However initial results do tend to indicate there is often an 'honest' way of doing things, and a 'realistic' way. Likert scales on the other hand provide a convenient means of gauging extremes in answer options, varying in our case from value 1 (Extremely Bad), through to 7 (Extremely Good). Examples of the IS tacit knowledge inventory and Likert scale may be seen in Figures 1 and 3.

January to March of 2001 saw programming of the beta version of the questionnaire take place, incorporating 3 sections. The coding utilised Javascript with a CGI backend, which was extensively custom tailored from sample templates that existed on the Internet. The first section was a biographical one, asking for age brackets and gender (two questions which were not compulsory); language other than English spoken; Occupation Now; Occupation 3 years ago; Occupation 6 years ago; No. of years with the present organisation; ACS level (regardless of whether respondents were members); Permanent or Contract position within the current organisation; No. of years of IT experience in general; No. of subordinates; Societies the respondent may happen to be a member of; Highest formal qualification and Computing/ Industry specific qualifications. The second component of the questionnaire related to Social Network Analysis. We wished to track the relationships of IT participants. To that end respondents were asked to select the individuals with whom they networked; the importance of the individual in relation to themselves; the frequency with which they met the individual and finally the type of occasion, which could range from formal organisational meetings through to email. Given that the questionnaire was going to incorporate the SNA component meant that anonymity would only be possible through individual de-identification. As such it was particularly necessary for the University's Ethics Committee to be in a position to sanction the research. The Ethics approval process took place from November 2000 through to January of 2001. The third component incorporated the coded tacit knowledge scenarios with answer options and for each answer option, a Likert scale. Error checking routines were incorporated into each question with the exception of age, gender and the social network analysis section. It was not felt advisable by the researchers to *force* people to indicate with whom they interacted or understandably for that matter stipulating in the questionnaire a minimum number of people with whom they had to provide details of their social workplace interaction.

Although 16 scenarios were originally formulated (through a separate development process), and Sternberg's approach makes use of some 12 scenarios with between 5 to 20 answer options per scenario, we felt that given the time constraints on the average IT practitioner. Requiring our respondents to spend up to 2 hours filling out a questionnaire with 16 scenarios would have been unreasonable, and likely would have led to a very low response rate, with a high error rate due to fatigue or rushing. Therefore, our final questionnaire incorporated 4 randomly assigned scenarios (from the test bank of 16 scenarios), as part of the articulable tacit knowledge inventory. However, two answer values would have to be provided for each answer option (namely those of an ethical and realistic answer), multiplied in turn by anywhere between 5 to 13 answer options per scenario. Completion of a social network analysis section was also expected, along with some 13 biographical questions. All of this meant that a respondent had in excess of 120 answers to

provide. Remarkably, the questionnaire seemed to take respondents only 20-30 minutes to fill out. We feel the reason for this was its electronic nature.

Letters were made out to 1400 people in the organisation in early November of 2001. This number in effect represented the entire IT workforce for the organisation nationwide. Unfortunately due to various political and logistical factors, letters were internally only sent to 164 people in selected areas of the organisation. No further explanation from management was provided. A follow up letter was sent out in late January of 2002 to those people that had not yet participated in the study. The social network analysis component of the questionnaire asked respondents to identify whom of their colleagues they considered to exhibit workplace task proficiency. The consequent list of names thus enabled the identification of experts. Select individuals of whom had not yet participated in the questionnaire were telephoned in early February 2002 and asked to participate. Of a total of 164 people who ultimately received letters, some 108, including experts eventually participated in the questionnaire (66%) (described in Table 1).

RESULTS

Table 1 essentially provides the complete breakdown of the sample population who ultimately participated in our study. One can see that the population was roughly 2/3rds male; concentrated between the 35-50 year age group; ACS level 3; generally with bachelor degree formal education; overwhelmingly permanent employees (though numbers of contract staff are not insignificant); and finally junior management level, in terms of numbers of employees supervised.

Experts vs. Normal				Subordinates responsible for	
Experts	32	Software Engineer	24	None	68
Normal	76	Systems Administrator	5	1 – 4	15
Gender		Qualifications		5 – 9	14
Females	40	High School Leaving	4	10 – 14	2
Males	68	Trade Diploma	2	15 – 19	2
Age		High School Certificate	14	20 – 24	2
20 – 24 years	6	Associate Diploma	7	25 – 29	1
25 – 29 years	9	Bachelor Degree	35	40 – 44	1
30 – 34 years	6	Honours Bachelor Degree	5	50+	1
35 – 39 years	28	Graduate Certificate	2	Undef.	2
40 – 44 years	26	Graduate Diploma	9	ACS Level	
45 – 49 years	19	Graduate Bachelor	7	ACS-0	4
50 – 54 years	9	Masters	19	ACS-1	3
55 – 59 years	3	Doctorate	1	ACS-2	25
60 - 64 years	1	Higher Doctorate (probably Doctorate)	2	ACS-3	59
Undef.	1	Undef.	1	ACS-4	15
Job Titles		Years of IT Experience		ACS-5	1
Account manager	1	0 – 4 years	15	Undef.	1
Analyst	4	5 – 9 years	13	ACS Level 0:	
Analyst: Business	6	10 – 14 years	23	Clerical computing work, not university graduate level	
Analyst: Technical	11	15 – 19 years	22	ACS Level 1:	
Application programmer	13	20 – 24 years	19	Little practical experience in IT work, may be supervising ancillary staff	
Business Development Manager	1	25 – 29 years	12	ACS Level 2:	
Business Systems Analyst	3	30 – 34 years	2	Experienced and capable of performing wide range of general IT work	
Clerical Support	1	35 – 39 years	1	ACS Level 3:	
Computer Engineer	1	Position		Experienced in specialised IT areas, well developed liaison skills	
Computer Systems Engineer	1	Permanent	81	ACS Level 4:	
Contractor	9	Contract	27	Managing a number of teams and the allocation of resources	
Data Administrator	1	Years with the organisation		ACS Level 5:	
Data Architect	1	0 – 6 months	9	Typically report to CEO; manage major function, extensive IT coordination	
Database Administrator: Junior	1	7 – 12 months	20		
Information Modeller	1	1 – 2 years	34		
IT Salesperson/Consultant	1	3 – 4 years	16		
Network Manager	1	5 – 6 years	7		
Programmer	2	7 – 8 years	3		
Project Director	1	9 – 10 years	2		
Project Manager	19	11+ years	17		

Table 1: Illustrating demographic breakdown for organisation X

Descriptive statistics were also produced for all 16 scenarios in the articulable tacit knowledge inventory, however space limitations prevent an in-depth discussion of these here.

Formal concept analysis interpretation of questionnaire results

The biographical section and articulable tacit knowledge inventory was also processed using Formal Concept Analysis (FCA) (Ganter and Wille, 1999). Space limitations do not provide an opportunity for in-depth discussions here; FCA has already been discussed in some detail in previous publications (Busch, Richards and Dampney, 2001). Generally speaking however the objects and attributes (ellipses) represent concepts, which in our interpretation are our respondents and their responses, the labels for whom are illustrated in rectangles below the actual concept identifier. The outer oval's position in the centre of the 'lattice' proceeds along the lines of the labels that are given at the top of the lattice. From left to right the ovals in the centre of the diagram represent the ethical values for *Extremely Bad*, *Very Bad*, *Bad*, *Neither Good nor Bad*, *Good*, *Very Good*, *Extremely Good*. Within the oval one may note a smaller lattice that represents the realistic answer. To summarise, the trend in reading our lattices is that the *ethical* answers to a scenario and question pair, are represented first or as the outer set of constructs, while the *realistic* answers are given as a subset of lattices within the outer ellipses.

Let us now examine a sample scenario from our articulable tacit knowledge inventory and the answers for this section of the questionnaire represented by way of Formal Concept Analysis. We present here Scenario 3, answer option 2 (Figure 1), because the standard deviation between expert responses of their ethical and realistic answers was considered significant (0.8 SD for non-experts, 1.1 SD for experts). Via formal concept analysis we may see the results from Figure 1 in Figure 2. Note for example the general trend towards the positive end of the scale, insofar as the majority of respondents chose from Neither Good nor Bad, through to Extremely Good for their ethical interpretations of the questions. The concept lattice illustrated in Figure 2 does nevertheless show a contradiction in terms of how some respondents answered questions ethically verses realistically. Note for example expert 14E (in the node to the far right), who felt that the ethical answer was *Extremely Good*, but actually felt the realistic answer was *Very Bad*. Interestingly 3 experts (25E, 21E and 34E) felt that the ethical answer was *Good*, but the realistic answer was in fact *Very Bad*.

Scenario 3

You as a team leader are responsible for implementing a payroll system for another branch within the parent organisation. Although you are expected to do the bulk of the work (55%), you do have five other colleagues able to help as you so desire. The project should take 12 months in total to complete.

You have undertaken some of the initial systems design work largely yourself for the past couple of months, and you now require your colleagues to further help you with the next stage which is mainly that of coding.

You are comfortable with hierarchy, however some of your team members are not. You delegate some tasks to subordinates within your team. One of the team members who specialises in programming has been allocated some software specification work, but would prefer really just to be programming. This person has performed well on coding related tasks in the past, but at this point in time lacks project management skills which would prevent him from becoming an effective team leader. Nevertheless you feel that the person should at least do some of the software specification work.

Rate each of the following responses in relation to the given scenario. It is advisable to read all of the responses before replying.

2. Consider approaching a mentor within the organisation or perhaps the Human Resources section, in the expectation they might provide you with some advice as to how to handle the individual in question

ETHICAL

Choose one:

Extremely Bad Neither Good nor Bad Extremely Good

REALISTIC

Choose one:

Extremely Bad Neither Good nor Bad Extremely Good

Figure 1: Illustrating showing scenario 3, answer 2 of the IS articulable tacit knowledge inventory

Note also that the black nodes indicate the presence of documents or results that indicate this particular value has been chosen, as opposed to the white nodes which are there to maintain the structure of the lattice, but indicate no respondent has chosen this value.

Given that we may consider experts to be more adept at making use of their articulable tacit knowledge, we can see that the majority of the experts here seem to favour ethically a positive approach to the idea of mentoring (answer scenario 2) (12 experts), however the results would seem to indicate that realistically speaking, they are less inclined to agree to this in reality (8 experts), more than likely for reasons of their own experience. What is perhaps more important is finding experts that are in a position to mentor junior staff, so that articulable tacit knowledge can be passed on. A comparison of results could lead us to believe that other employees such as 1593, 16, 24 and 7 for example whose results are along similar lines to those formally identified as experts by their peers, may nevertheless prove to be good mentors to lesser skilled employees, given the proximity of their results to that of experts. More extensive comparisons of results will permit some generalisations to be drawn.

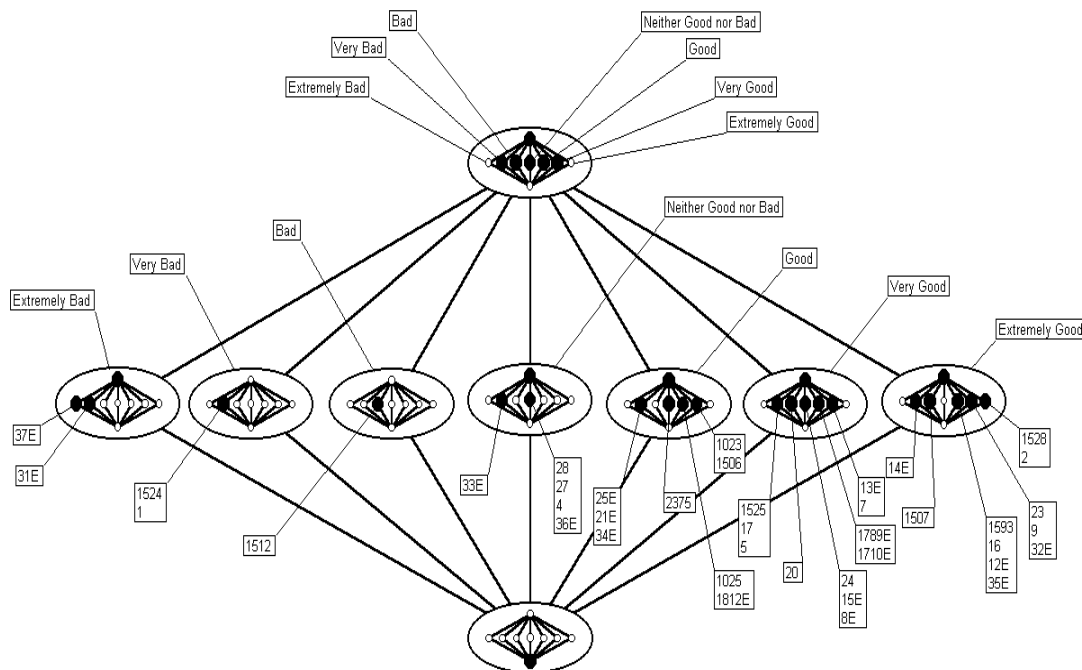


Figure 2: Formal concept analysis presentation of Scenario3, answer 2

Let us now examine another example from the articulable tacit knowledge inventory, this time scenario 6 and answer option 2 (Figure 3) (0.2 S.D. for non-experts and 2.1 S.D. for experts).

We may note an opposite effect to the previous concept lattice in Figure 4. For example the ethical trend to the scenario (scenario 6) not being 'one's own problem', is rejected to varying degrees by both experts and non-experts alike, only non-expert 1540 remains non-committal. Note in general however, how most of the responses appear to the left of the lattice, with a number considering the ethical and realistic answer to be either *Very Bad* or *Extremely Bad*.

Realistically however, the two experts appear to feel positively or non-committal at most (2303E) to the answer 2 in scenario 6 being the case. Non-expert 2257 scores are certainly close to the experts on this case. These results indicate that 2257 may perhaps another candidate to act as mentor, or perhaps someone to turn to for articulable tacit knowledge.

An interpretation through Social Network Analysis

Social Network Analysis (SNA) replaced as a technique our earlier vision of using participant observation, as a means of measuring the articulable tacit knowledge diffusion we assumed

would take place within the organisational domain (Richards and Busch, 2000). Social Network Analysis essentially maps the relationships between individuals and has numerous practical applications having its origins in fields as diverse as anthropology, graph theory and sociology (Knocke and Kuklinski, 1982; Scott, 1991). The advantage of using SNA is multitudinous. Participant observation of articulable tacit knowledge is difficult because IT practitioners on the whole do not undertake physically active tasks to the extent of say nurses (Scott, 1990; 1992), police officers or fire-fighters, therefore attempting to view the actions and knowledge transferal of IT practitioners is difficult.

Scenario 6

The most senior person in your section is close to retirement and is essentially at the peak of his career. While this colleague is capable and involved typically in administrative matters, he nevertheless likes to 'keep his hand in'.

The problem is you feel the knowledge used by him is outdated. Although you respect him, you feel you are not on his 'wavelength', and to make matters worse the project you are working on is one for a firm in which the senior person has good friends.

This senior person has now decided to do some of the analysis work for the project involving his friend's firm, which ordinarily is not such a problem except that your company has a policy which states that business and friends do not mix.

Rate each of the following responses in relation to the given scenario. It is advisable to read all of the responses before replying.

2. Simply admit to yourself that you are junior in the organisation and leave it there, it's not your problem

ETHICAL

Choose one:

Extremely Bad Neither Good nor Bad Extremely Good

REALISTIC

Choose one:

Extremely Bad Neither Good nor Bad Extremely Good

Figure 3: Illustrating Scenario 6, answer option 2 of the articulable tacit knowledge inventory

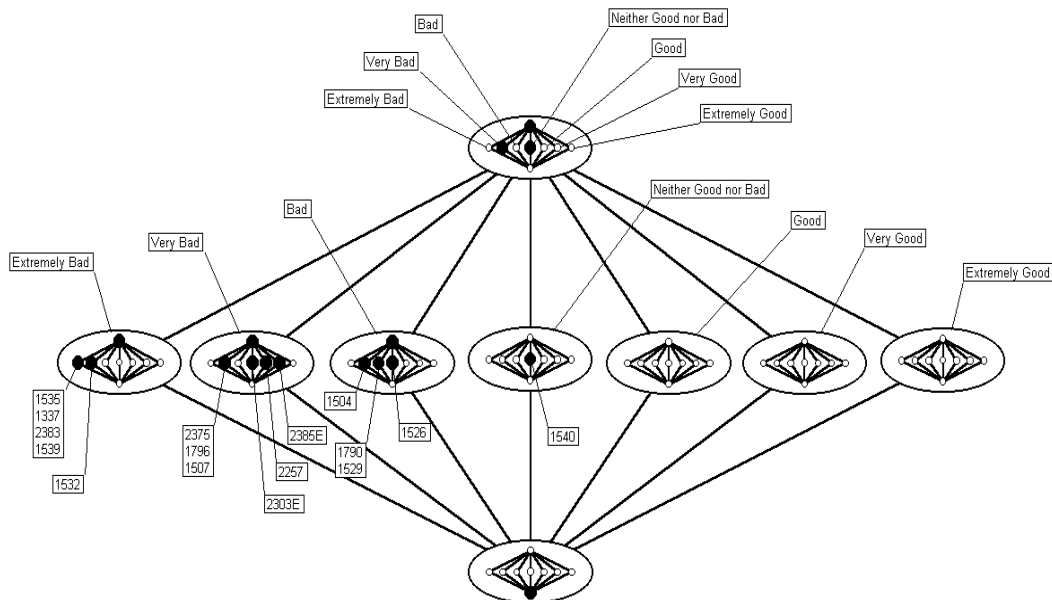


Figure 4: Illustrating formal concept analysis of Scenario 6, answer 2

From a articulable tacit knowledge mentoring point of view, the ability to see someone is as important as identifying who they might be, given that articulable tacit knowledge has already been identified as being acquired at least to some degree through person to person communication (Galloway in Sbarcea, 1999). Let us examine some of the social network maps that indicate the flow of relationships amongst individuals. The arrows are actually unidirectional and the gap in the line indicates the arrowhead. We may note in Figure 5 that people 1789, 21, 1732, 1812, 25 and 1829 have to be seen. Not surprisingly 1789, 21, 1732

25 and 1029 are in actual fact all experts. Experts are actually grouped on the bottom right hand side. Please note that although 108 personnel participated in the study, not necessarily all of these people chose any particular answer option presented in the following social network diagrams. This explains why Figure 5 (*have to see the person*), illustrates communication flows between only 13 people.

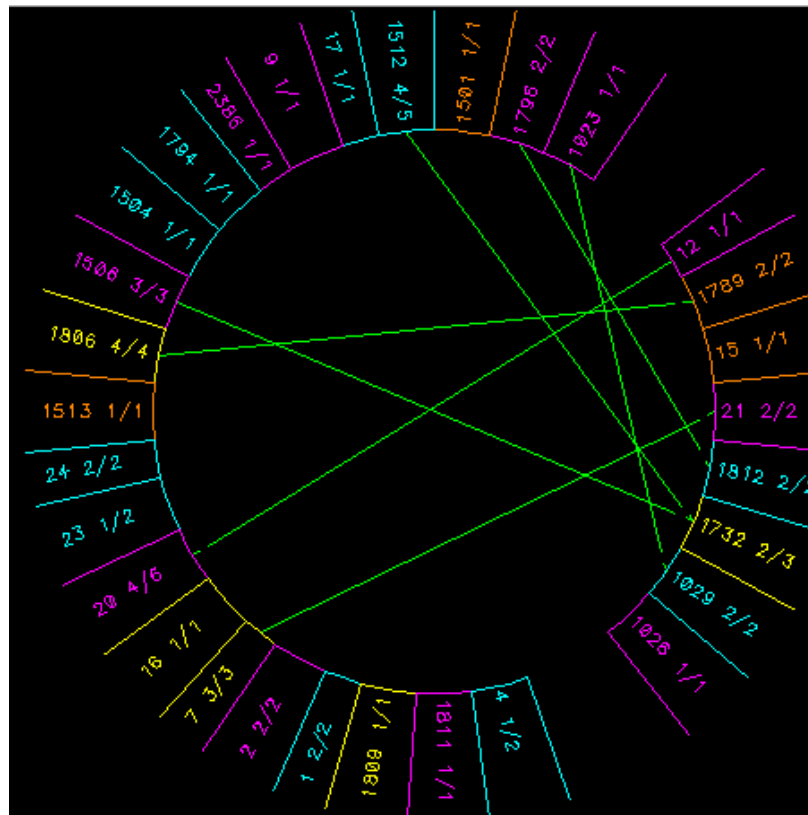


Figure 5: *Have to see the person*

When it comes to trying not to see a particular individual (Figure 6), we can see that a great deal of the arrows stem from the experts to the non-experts, in line with what was found in the pilot study, although non-experts 1, 2, 24, 1593 and 5 appear to have no great desire to establish contact with the expert sample, this may be either for reasons of difficulty of seeing experts, or that the experts may not lend themselves to being approachable. A similar trend was noticed in a concurrent study on two other smaller organisations (Y and Z, paper concomitantly submitted), namely that the experts appear to be the ones that have to be seen (strong positive correlation), yet the experts try often not to see non-experts (one surmises they have no need to).

Given that articulable tacit knowledge is typically passed in a person embodied relationship (Wyatt, 2001), what are the knowledge management ramifications, should people choose not to see others personally, rather preferring to acquire knowledge by way of non-direct means? An examination of Figure 7 reveals that a large number of the experts are contacted via email or fax. For example experts 1248, 18, 21, 1555, 1710, 8 and 1025 are certainly contacted electronically, not by other experts, but non-experts (the links coming from the larger semi-circle on the left). The attempts of *Tacitmail*TM and *Lotusnotes*TM aside, can one surmise that individuals only communicating electronically are more than likely to be missing out on the articulable tacit knowledge of experts? Given the size of organisation X, it is not surprising that some communication will naturally take place electronically.

At the opposite extreme note when respondents were asked whom they contacted on an hourly basis (Figure 8), not surprisingly the experts once again featured relatively strongly, with the majority of the unidirectional arrows pointing to them, only expert 1793 contacted non-expert 1795 hourly. Note the particular popularity of experts 1812, 1755 and 12.

Although we do not present the figure here, when the above relationship is expanded out to include *daily* contact, rather than just hourly, the prominence of relationships in the direction of experts is even more noticeable. Note however that the directions of the arrows for most of the relationships were towards the experts, which one would expect. What could be considered worrying however were the number of electronic communication links (Figure 7), particularly in larger organisations where personnel were likely to have more specialised knowledge in certain areas, yet not be reachable for person-to-person interaction.

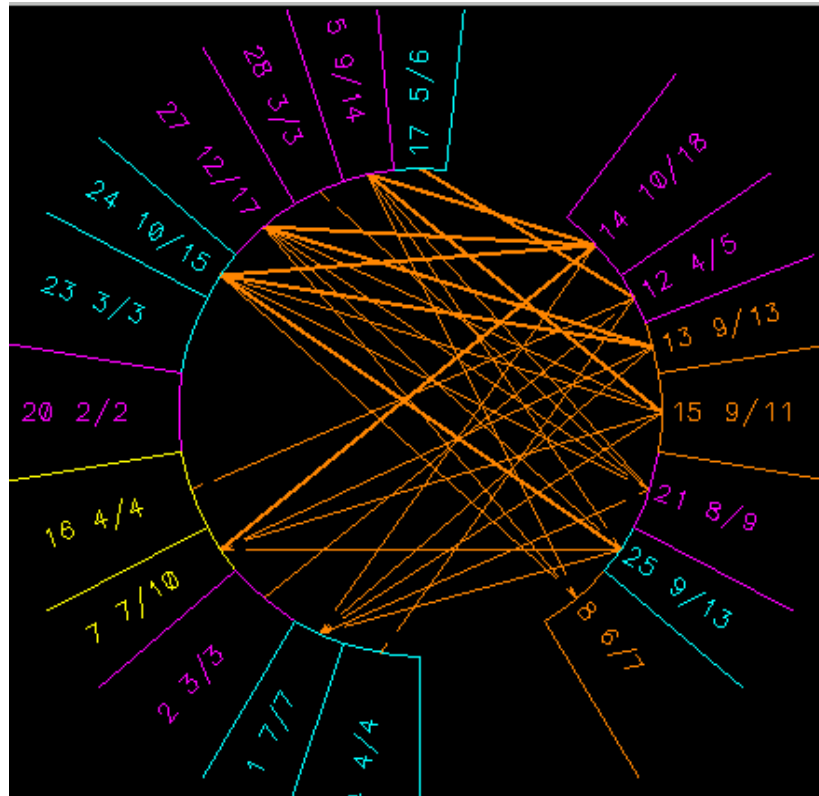


Figure 6: Try not to see the person

DISCUSSION

With the establishment of an articulable tacit knowledge inventory, we permit respondents to choose values in response to solutions for dealing with specific soft knowledge IS scenarios. The answers to these scenarios have been developed through prototyping them on various groups of people in the industry. The use of Formal Concept Analysis enables a visual presentation of results. We have presented the results of only one answer option for two scenarios here. We can see some patterns however, insofar as experts appear to be more divided in their opinions than the non-expert sample. Experts also appeared from initial results in almost all scenario and solution combinations to display a significantly greater standard deviation in terms of how they felt *ethically* vs. *realistically* towards answer options than did the non-expert sample, in line with our pilot study (Busch, Richards and Dampney, 2001), and previous studies (Gaines and Shaw, 1989). From a Social Network Analysis point of view, the trend towards non-experts needing to see experts can be seen in the figures presented above, however the matching up of articulable tacit knowledge scores with the social relationship attributes of particular experts will provide greater detail.

CONCLUSION

The overwhelming majority of the tacit knowledge literature, whilst acknowledging its importance, nevertheless makes little mention of techniques necessary for its capture let alone assessing its diffusion or more likely non-diffusion within the workplace. As such, we have outlined our approach to identifying and measuring articulable tacit knowledge. By using a Yale University based psychological technique for testing people's workplace 'street-

smartness', we are trying to gauge a difference between how a control population deals with 'soft knowledge' issues compared to the sorts of answers an 'expert' or group of experts collectively would provide. This technique thus enables us to determine who is likely to have more articulable tacit knowledge or at least be making greater use of it than others. More importantly, we are interested in examining how we may gauge the degree of articulable tacit knowledge diffusion throughout the knowledge workplace, in our case the information systems domain. It would appear for example that knowledge bottlenecking is likely to limit the flow of articulable tacit knowledge because of the latter's need to be distributed in a person to person fashion, something of lesser relevance to the codified knowledge management domain. We use social network analysis incorporated within our articulable tacit knowledge questionnaire as a means of examining the workplace relationships among individuals. Given the situational nature of articulable tacit knowledge, research conducted must necessarily be intra-organisational as well as specific to that organisation. It would appear from initial results that certain individuals display articulable tacit knowledge characteristics similar to 'experts' and that it is possible some communication bottlenecking is taking place in our test organisation.

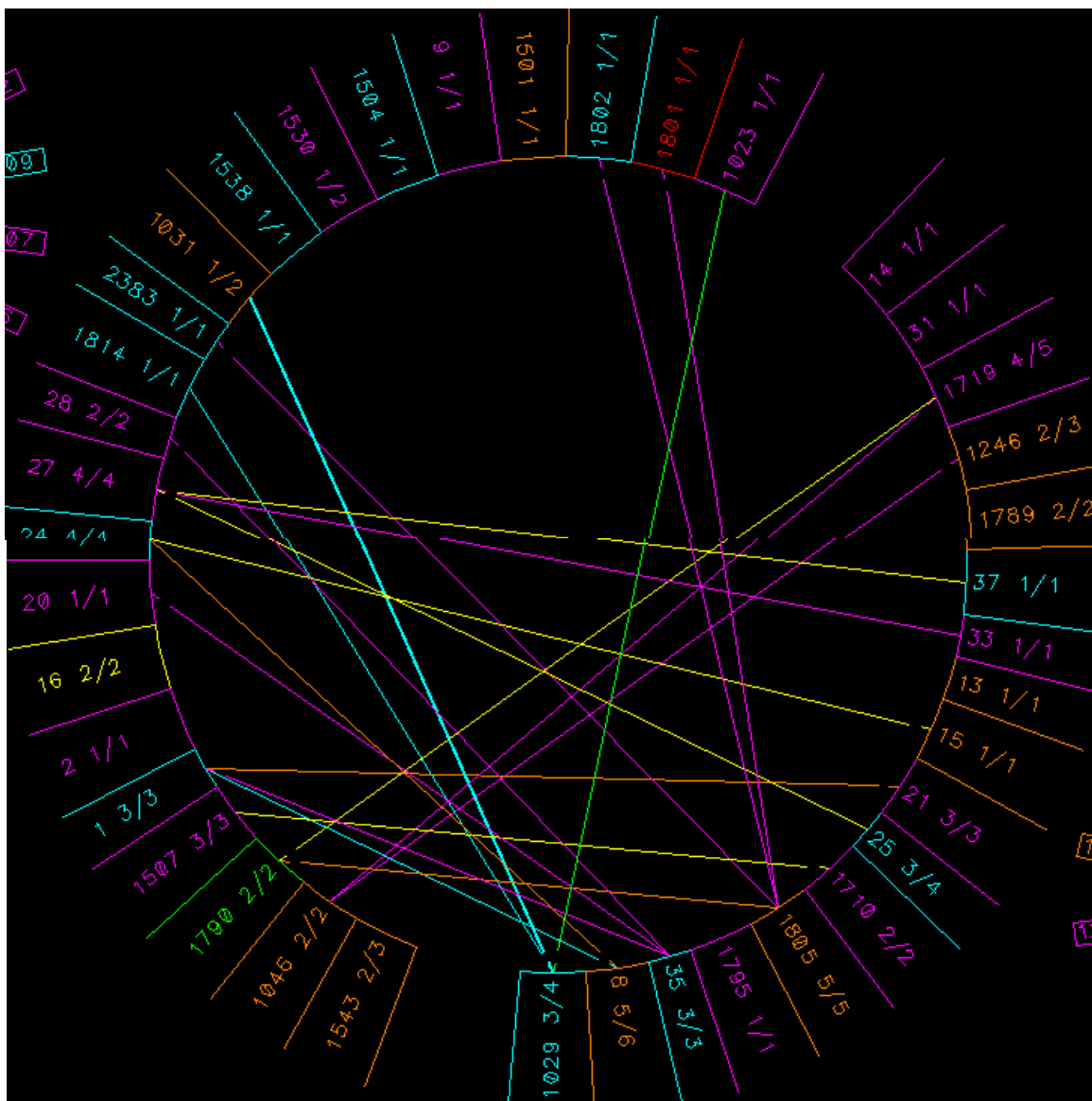


Figure 7: Send the person an email/ send the person a fax, in other words electronic communication

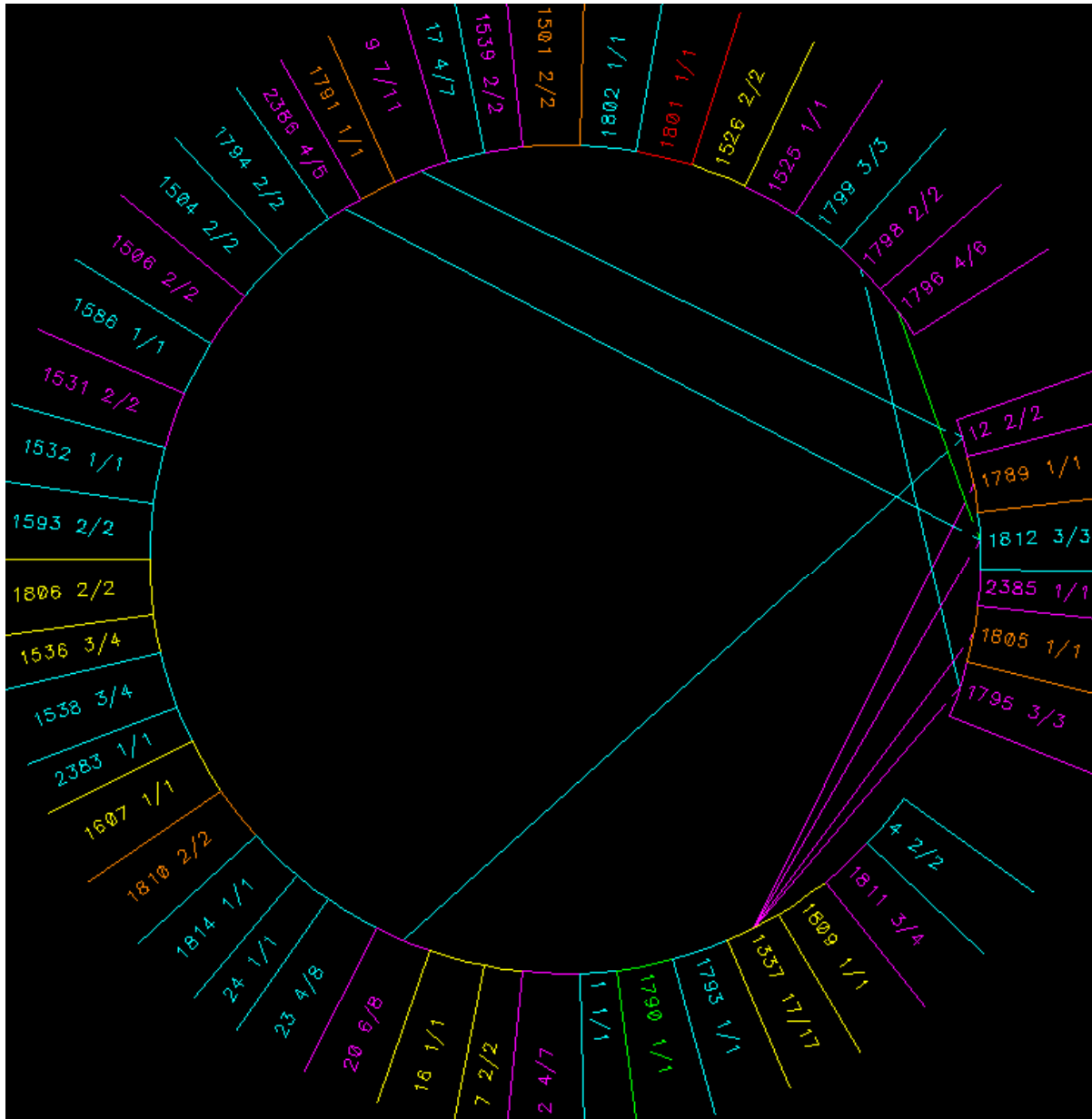


Figure 8: See the person hourly (again experts represented by the small 'semi-circle' to the right)

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