Subitizing practices and market decisions

Subitizing Practices and Market Decisions:

The Role of Simple Graphs In Business Valuations

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Abstract

The 2x2 matrix is the premier figuration for representing business valuations (Lowy and Hood 2004) but remains the unexplained success of the business world. Scholars have a rather vague sense of how to theorise its influences on processes of decision making and valuation in markets. The temptation - understandable, but unsatisfactory - is to dismiss the matrix as 'overly simple' (Lissack and Richardson 2003). More difficult still, however, is to account for the disproportionality between the simplicity of this format and its effects. One reading - the reading pursued here - is that the capture of business by the matrix suggests that simple graphs are not mere supplements but intrinsic and constitutive parts of business evaluation processes. But in what ways? And how to show this? In developing this point we extend the recent interdisciplinary discussions of 'calculative agency' (Callon and Muniesa 2005) which is defined broadly as a process of 'framing' and 'disentanglement' where devices mark the boundary between information relevant to a decision making process and that which is not. Rather than this catch-all definition however, which Callon and Muniesa (2005, 1232) suggest can be applied "as much to supermarkets as to stock exchanges", we argue the case for more specific terminology to capture the heterogeneity of calculation in business settings. We want to show how the matrix frames decisions in a way that is 'immediate', 'fast' etc, as compared to other devices, which provide for apparently more 'complex' or 'slower' means of valuation. We take our inspiration from the idea of 'subitizing' which was borne out of early research on visual calculation. Our discussion is based on material stemming from a long-term ethnographic study of the production and use of a well-known matrix from the information technology realm.

Keywords: visual, decision making, calculative agency, devices

The Capture of Business by the 2x2 matrix

> *The 2x2 matrix represents the most notable analytical tool ever to emerge in business management (Lowy and Hood 2004, xiii).*

Whether or not one agrees with the above statement there can be little doubt that the 2x2 matrix (hereafter the matrix) has become one of, if not the most important form of valuation tool used in business settings. One only has to think of the 'Cost Benefit matrix', the 'Product and Market matrix', the 'BCG Product Portfolio matrix' to name but a few (Lowy and Hood 2004). Today it is hard to imagine a business meeting that does not revolve around this (or some variation of this) format; the business report is not considered complete unless it includes such diagrams; and a great deal of business education involves generating and communicating ideas through these figurations. Yet despite its prominence, the matrix remains the unexplained 'success' of the business world. Scholars have but a rather vague sense of how to theorise the matrix's rise to prominence or the influence of this mode of decision making on business settings. Whilst there has been some focus on its 'interactional' (Pels 2003) features, or how the matrix might 'frame' complex organisational problem solving (Morrison and Wensley 1991, 112), the common response has been to ignore or, worse still, dismiss the matrix as a 'simplification' (Lissack and Richardson 2003), albeit a 'powerful oversimplification' (Ghemawhat 2002). Some go as far - because it is seen to reduce and hide complexity - to describe it as 'unethical' (Lissack and Richardson 2003). This is an understandable but unsatisfactory response. More difficult still is to take this figuration seriously and to analyse the kind of valuation that it provides. There is more to these devices than just reducing information to manageable dimensions; the notion of a simplification fails to appreciate its important transformational practices and characteristics.

Espeland Stevens (2008, 423) argue that every professional community has its own unique kinds of 'numerical pictures'. The business community is no different in this respect. Ghemawhat (2002) has discussed how, towards the latter part of the 20th century, there was a profusion of figurations attempting to depict complex strategic and managerial decisions in relatively straightforward ways. Writing about the most famous of these, the 'Boston Box', Morrison Wensley (1991, 114) note how the benefits of this device are that the "...reader is informed *at a glance* of what may take several paragraphs to explain". Whilst the potential to foster insights 'at a glance' is not confined to business graphs (see Coopmans (2014)), it would seem a particularly appreciated feature in these contexts. What we attempt in this chapter, through exploring this characteristic of the matrix, is to develop Espeland and Stevens' (2008) point. That is, to investigate whether matrices provide for unique kinds of valuation in business settings, as compared to the formats used by professional communities elsewhere.

To help in this endeavour we draw inspiration from recent discussions from disciplines as diverse as Science and Technology Studies, the Sociology of Finance and Economic Sociology on 'calculative agency' (Callon and Muneisa 2005). We attempt to supplement the discussion of calculative agency with a much needed focus on 'temporality'. For this, we work up the term, drawn from early research on visual calculation 'subitizing'. The notion of subitizing is developed with material stemming from a long-term ethnographic study of the production and use of a well-known matrix from the information technology realm.

The Role of Devices in Fostering Calculation in Markets

There is a growing interest in how artifacts constitute markets and market actors. The idea of 'calculative agency' was developed to capture how calculations were never performed by individuals alone but, rather, how people were always propped up and aided by various kinds of material artifact (Callon and Muniesa 2005). In this view, artifacts, and not only people, are seen to have 'agency', as they produce specific kinds of effects. In terms of who or what makes someone – or something – an agent, Latour (2005, 71) argues that: "anything that [can] modify a state of affairs by making a difference is an actor". The notion of calculative agency has been defined broadly. A calculation may need not necessarily be mathematical or numerical; it "...starts by establishing distinctions between things or states of the world…" (Callon and Muniesa 2005, 1231). Callon and Muniesa describe calculation as a process of 'framing', 'disentanglement' and 'overflowing' where devices help mark the boundary between entities and information relevant to a decision making process and that which is not. To give one example of how this work has been applied empirically, Preda (2006) discusses how the stock market 'price ticker' was, when it was first introduced at the beginning of the last century, an agent in leading to different forms of decision making in the trading of stocks. The price ticker produced a constant flow of prices that meant the market could be, from then on, visualised and framed in new ways. The technology constituted stockbrokers' practices such that they switched from being 'observers of the market' to 'observers of the tape' (Akrich and Latour 1992, 232).

In studying the devices undergirding markets, Miller (2008) reminds us that we require a simultaneous investigation into the ideas behind these objects. There is a 'parcel of thought' behind even the most mundane object, he argues. Thus scholars have flagged how various 'market devices' (Callon et al. 2007) not only create a *market* or *economic* point of view but stem from theoretical ideas and assumptions about the economy (Callon 1998). There are parallels here with work from accountancy, where 'mediating instruments' (Miller and O'Leary 2007) are seen to create - but are also borne out of - an *accounting* view of the world. Similarly MacKenzie (2009) has discussed the 'intellectual equipment' (the theories or models) that are seen to facilitate processes of *financial* calculation within stock markets. We find this work stimulating for our own discussion of business graphs. It begs the question What is the parcel of thought behind the matrix?

Subitizing Practices

We offer the notion of *subitizing* or *subitizing practice* to help throw light on the set of ideas that sit behind or are fostered by simple graphs in business communities. Kauffman et al. (1949) defines *subitizing* as the human skill to immediately make rapid, accurate and confident judgements about small numbers. The term derives from the Latin adjective *subitus*, meaning *sudden* and the medieval Latin verb *subitare*, meaning *to arrive suddenly* (OED). It is based on psychological experiments from the late 19th Century where it was shown that a fundamental law of visual counting was that the reaction time necessary to recognize a small number of entities was dramatically different from those required to identify entities above 7 or 8 (Cattel 1886 in Dehaene 2009). During these experiments, participants were shown dots on a screen and the time taken to recognise the actual number of dots was recorded. Kauffman et al. (1949, 500) argued that a "...small number of things, from 1 to 7 or 8, are discriminated in one way and larger numbers are discriminated in another way". There are different ideas about where the point of discontinuity lay (Kauffman et al. (1949) say it is 7 or 8; Trick and Pylyshyn (1994) suggest 4; whilst Cattel (1886) and Dehaene (2009) say it lies near 3). However, the specific number is not relevant for our argument. What is of interest is that there is a 'point of discontinuity' between small and large numbers. Whilst small numbers are treated by human perception as a single picture, larger numbers apparently require a sequential algorithm (i.e. we start to 'count'). According to Kaufman et al. (1949), participants were not counting, but nor were they guessing. Kaufman et al. (1949, 520) argued that a new term was needed to capture the way people could immediately apprend small quantities: "We wish to avoid terms now in use, having other meanings, and terms with the misleading connotations of estimating, counting, or grasping by intuition". They identified the ability of people to immediately apprehend small numbers as a process of what they called 'subitizing' and numbers that could be treated this way fell within the 'subitizing range'. They write "[s]ubitizing is, on average, more accurate and more rapid than estimating, and it is done with more confidence" (ibid., 520).

What does the notion of subitizing offer our analysis of the matrix? We deploy the findings from this early experiment on subitizing for analytical purposes only. It provides, to quote Garfinkel (1967), an 'aid to the sluggish imagination'. We attempt to strip the notion of its existing psychological overtones and refer to the more sociological issues of how different groups of people coordinate their practices through graphs and how figurations, in turn, come to constitute evaluation practices. Findings from early research on visual calculations are important for the sociological understanding of business graphs, we argue, because they challenge the idea that all graphs operate on a common textual surface. The concept suggests that distinctions are important. In particular it highlights a *point of discontinuity* between complex and simple graphs. Complex figurations create one kind of sensemaking and simple graphs another. In terms of our analysis, the distinction between complex and simple refers not to different things, insofar as they all are the work of 'calculation' (cf. Callon

and Muniesa (2007)), but the discontinuity relates to the value these figurations hold or are seen to provide to the reader. Here we suggest that these devices are deliberately constructed to channel and define the evaluation practices of readers (Lamont 2012). The value they hold therefore is that they allow readers to arrive easily at certain conclusions or decisions. In the remainder, we pursue the concept of subitizing with illustrations deriving from the work of industry analysts.

The Case of Industry Analyst Research

The bulk of our fieldwork was carried out on the industry analyst firm Gartner Inc. (though towards the latter years of our research we also conducted interviews with and observations of rival firms, IDC and Forrester, which we also briefly focus on here). Gartner, the largest industry analyst firm in the industry, was founded in 1979 by Gideon Gartner (who has long ago retired). The firm employs more than 4,000 employees and has offices in over 80 countries. They operate predominantly but not exclusively in the information technology (IT) sector and their client base is said to contain up to 10,000 of the largest and most important corporations from around the world (Pollock and Williams 2010). The bulk of their activity and where most of the analysts are employed and revenues generated is in the production of 'research'. In relation to this, there is no more important piece of research than the 'Magic Quadrant' (hereafter the MQ), which is widely described as the firm's 'signature research' (Pollock and Williams 2009). The MQ rates the competence and performance of IT vendors. It is predominantly used by technology adopters when procuring new hardware or software (see Figure 4.2). There are over 150 MQs produced each year for different technologies/markets. This number changes as Gartner are continually creating new ones and "retiring" older ones. They come with a 5 page 'research note' attached and cost over £2k to buy (but can be found easily for free on the internet). The MQ has its own distinct ontology (e.g., it contains its own unique presuppositions about what 'good' performance consists of) (ibid.). It is also very much a 'dividing object' (ibid.). By this we mean that is has a dramatically different significance and importance for people: it has been described as "[o]ne of the most influential pieces of business research in any industry" with the "power to make or break a technology" (Violino and Levin 1997); at the same time, it has also been widely described as 'flawed' and 'overly simple' due to the narrow range of criteria that it assesses (Pollock and Williams 2009).

<Insert figure 4.2 here>

Fieldwork

In terms of the fieldwork conducted, we have studied the MQ for nearly 10 years. Initially, we came across how people were influenced by the MQ as part of an Economic and Social Research Council (ESRC) study on the implementation of enterprise resource planning systems (Pollock and Williams 2009). We were later funded by the ESRC to investigate how the graph was constructed (Pollock and D'Adderio 2012). This fieldwork on the MQ is still ongoing as we have now become interested in how news groups of experts - influencer relations professionals - attempt to work with and influence its shape. In studying the format we have deployed a variety of methods to collect data: this is conventional semi-structured interviews, periods of participant observation, archival research, through to photo-elicitation techniques etc.

Empirical Story: Three Episodes

We present our empirical material in three episodes. The first reports on the value that these simple visual graphs provide for the people who use them. The second revolves around the agency of graphs and how the subitizing range contributes to shaping IT markets. The third develops an account of how the subitizing range is achieved.

Episode 1: People Build immediate choices on it

The main purpose of the MQ is to support adopter firms in attempting to procure large-scale software systems or hardware. Procurement is a complex, multi-step process. It is complex because adopters have to make a decision on hard to assess technologies. There are not only many possible offerings available but adopters are rarely able to directly inspect these products directly. The aim of a procurement therefore is to whittle down the many possible vendors to a shortlist. Shortlisted solutions will be given more intense scrutiny. The difficulties arising during this process are manifold. One common issue is that Chief Information Officers (CIOs) often lack the necessary technical expertise or market knowledge. Thus, in terms of what information the MQ provides, according to an analyst, these charts help clients "position or understand their particular vendors...where those ones are in the *landscape*" (interview, IDC analyst). "What the [MQs] say", we are told by a software vendor and former analyst, is "this is the *battlefield*" (interview, vendor a). As reported by an independent industry analyst, the MQ therefore provides a useful guide for CIOs to help them construct a shortlist: "If you put yourself in a CIO position, if you do not really know about the market and you want to figure out *really fast* who are the top companies and what you want to put in your shortlist, the MQ is an excellent tool to do that."[i] Not only do they help the CIO but they can be used to communicate a decision to others in the adopting organisation. For instance, as one of our informants puts it: "These are very simple tools to communicate to executive management. For

example if a CIO wants to buy a new ERP or CRM…this is a very simple tool to *defend* or make a *quick evaluation…*" (interview, vendor a).

The MQ comes in the form of a box with an X and Y-axis (labelled 'completeness of vision' and 'ability to execute') dimensioning a two-by-two matrix, with four segments. Each segment is individually labelled (niche player, challenger, visionary and leader). Those placed further to the right are seen to have more 'complete visions', whilst those placed towards the top an elevated ability 'to execute' on that vision. One unwritten rule of good procurement, our informant explains, is that those procuring "should have 1 or 2 or 15% of these guys [pointing to the top right quadrant] in their evaluation list and invite them to a tender" (interview, vendor a). The MQ serves here as a shared frame of reference or "powerful totem", as another of our informants put it (interview, vendor b). It has the capacity to "rubber stamp" decisions (interview, IDC analyst) such that the old adage about buying IBM has been replaced. Today it is "nobody ever got fired for using a [MQ]" (interview, IDC analyst). Another feature of the MQ is its seemingly intuitive format, which facilitates communication across roles: "Imagine" - our informant continues - "a CIO wants to buy a new CRM system for a large organization costing...£15m and then he makes a decision, and he has to justify this decision in front of the board where…the CEO has no idea about IT" (interview, vendor b).

A downside of the MQ, according to some of the analysts we talked to, is that it has become "too good" in imparting information. What is meant by this? There are two aspects to this. On the one hand this appears a positive comment and relates to how they require very little time to decode. There is no need to "sit down and discuss in detail these charts" (interview, adopter), says one adopter. People find them "easy to read". Apparently they can be read and understood in the time it takes to point a camera (see Figure 4.3).

<Insert figure 4.3 here>

They are (too) effective because people have become familiar with and know how to read the format:

> The success [of MQ] is because of the repeatability. People have learned how to use it. It's predictable. It's the same each time, so it's easy to go back to it and not have to *figure out* what the analyst is trying to convey (interview, Gartner Analyst, JL).

On the other hand there is also a downside to the MQ in that they seemingly encourage *quick* decisions. As one analyst put it, they invite people to jump to conclusions 'too fast'. Why is this problematic? The analysts seemingly attempt to warn clients against taking procurement decisions by only looking at the MQ: "Our clients tell us…things that we find scary, like we've just narrowed our shortlist down to anyone who's in the latest quadrant. We say: 'don't do that'" (interview, Gartner analyst, JL). The analysts also complain that even though the MQ comes with a detailed research note that provides further detail and caveats, that this document is seldom read. They attempt to encourage their clients to talk more fully with the analysts who compiled the MQ in the first place. These experts have much more information and detail on the vendors but surprisingly, they point out, this is rarely required. An analyst describes how "most users don't care. They want to know that the vendor is in the top 10 biggest revenues and this is enough" (interview, Gartner analyst, ET). Another analyst notes how:

> …it would be very worrying if the user were simply to take one MQ or one Marketscape…and say, because this is there on that picture I am only going to go with this solution, or only look at these three. They'd need to do a lot more due diligence, including interrogating the analyst…reading all the research material from probably Gartner, Forrester and IDC, especially when making the big decisions, and including going around talking to some of the vendors' customers and talking to some mates in the industry. So the amount of value and the amount of importance that can be attached to a graph has I think not to be overestimated (interview, IDC analyst).

Others we interviewed also echoed this point about due diligence and taking time. For them the MQ was only a small part of the process: "When a major decision like that is being made it would mainly be a cross-party, cross-group decision so that we tend to be fairly slow about selecting things but then we would do more research" (interview, adopter).

The figure below (see Figure 4.4) captures the range of views found concerning the usefulness of the MQ and similar matrices. What we want to flag is the point of discontinuity between: a) those who thought the tools encouraged people to "jump to conclusions too fast"; b) those who would look at tools like the matrix but would take more time over the process and do more research; and c) those who thought the tools give them "just enough" information to understand the "landscape" (eg. to help begin the process of taking of a decision). In other words, the first episode demonstrated how, for certain groups of people, the matrix is easy to understand and familiar. It establishes a certain confidence in the reader that s/he has grasped the situation - and importantly – that is has all happened rapidly. However, it might be argued that these features can be found within any simple graph. What is specific about the matrix described here?

<Insert figure 4.4 here>

Episode 2: The Magic Quadrant *is* the Marketplace

What we want to show in this second episode is that its producers are trying to achieve a figuration that is neither too simple nor too complex for the reader. They are attempting to create what we are calling (building on Kauffman et al. (1949)) the *subitizing range*. One aspects of this argument can be found in the words of this analyst below:

> In all these kind of graphics you have to be careful that you *don't introduce complexity or something that's counter-intuitive*, that's the first thing. You want something that is simple and that follows people's understanding. If we started introducing different shapes, something that went against a 'quick glance kind of view' then the amount of time spent in interpreting it for users to understand, and users interpreting it to get buy impacts when they're looking for budget from CIOs. You've got to factor that in, a lot of these people are very busy and they want something that can be assimilated in a fairly 'quick glance', certainly at that kind of level (interview, IDC analyst).

The analyst flags how the matrix can never be too complex. The subitizing range applies in particular to temporality. If it takes too long to decode, the matrix would lose its power over other measures. But again this might be a feature of any graphical format. What makes the matrix distinctive? The next example demonstrates clearly the crucial point of our argument. The achievement of the subitizing range is not just about simplification. The work of subitization also involves a very particular rationalization process. Achieving the required range sometimes requires *adding* entities rather than just taking away. In the excerpt below, for instance, an analyst talks about how the goal of the MQ is to get all of the players onto one space:

> I think the interesting issue is, it's a way of getting all the main players in a market on one piece of paper in an interesting way you can talk about it. That both the buyer and the analyst and the vendor can all talk about things. They may disagree about where the dots are but they can all talk about it (interview, Gartner analyst, ET).

No matter how numerous (or scant - as we will see below), if the players are to be pictured on a piece of paper, then they should total a certain amount: "Gartner [MQs] are designed to deliberately limit it to a *specific* number of vendors, not an *exact* number, you don't have a [MQ] with 100 on, you don't

have a [MQ] with 2" (interview, Gartner analyst, ET). Our informant discusses the extremes of the range, where complexification does not work but neither does straightforward simplification:

> ...graphically, you can't - you can, we've done it, you can have a 100 dots on the chart - but it is unreadable. It is just garbage. It is just a bunch of dots [...] And likewise when there is 3 dots on it, it is meaningless. What's the point of having a [MQ] with 3 dots? (interview, Gartner analyst, ET).

He gives a concrete example where the situation had become too simple and as a result the clients had lost interest in the particular MQ:

> …we used to do things like operating systems [but] when Microsoft started dominating operating systems on…desktop applications it was pointless having 4 dots on a chart…and the colleagues all turn around and go 'what was the point in that?'. The clients don't read them anymore, they are not so interesting...their value is very, very low. The dots hardly move. And nobody is very interested (interview, Gartner analyst, ET).

Finding the right range keeps the analysts 'in the game' (e.g., their clients will still come to them and - importantly - *purchase* their advice). Strikingly, the different analysts we spoke to seemed to converge on what they thought the right range was:

> So, while it is in that sort of state between about 25 down to maybe 10 vendors, there is a choice, there's a multiple different dimensions to it, and different ways of evaluating, how you write each vendor up. There is complexity in it, and therefore there is a game for us to play (interview, Gartner analyst, ET).

Another analyst similarly reports:

> It all depend on how you define that market. [...] When it settles down to a market where you have anywhere between, anywhere between 8 and maybe 25 vendors, something like that. And you can define a nice box around that. And there are competing relatively similarly. And there is a whole lot of discussion about what is a market.... (interview, Gartner Analyst, PM)

When analysts provide graphs that are within the range it means that their research potentially has value for the client. If it is outside the range then it is likely that it won't be read. But if it is inside the clients will find them useful. An analyst talks about the value of the MQ for readers:

> from the PR, corporate and marketing side they value them [the MQ] very highly. They know that they get a lot of hits. The list of the top ten most read documents on any given month, 4 or 5 of them will be [MQs]. They get long repeat hits which is good for Gartner. Readership is a key

element to it. Retaining membership. It directly correlates with our retention of clients, so there is a financial incentive up to a point (interview, Gartner analyst, ET).

Not only did we find the search for the subitizing range to be a common feature across analyst firms, but most strikingly, that if the subitizing range failed to emerge "naturally", then the analysts firms had various strategies to go out and create it. For instance, an analyst from a competitor firm to Gartner, and creator of the Forrester Wave, describes how: "in general we try to be clutter cutting and we don't want more than 10 to 12 vendors cluttering up a Wave, right. We've seen quadrants where you have 40 and they are all blasted on there and your eyes start to glaze over. Our job is to *prioritise*" (meeting transcript). What does "to prioritise" mean in this context? An analyst describes how these firms will intentionally leave large numbers of players *out* of the graphs in order to obtain what they perceive to be the correct range:

> Gartner's [MQ] will exclude people, exclude companies, organisations that don't have a certain size or don't have presence in more than X or Y countries, so it leaves the small guys out, or the local guys out and again that can be very misleading. Indeed, even if it has a local player in they may be very much dismissed. BT on the global stage will be very much overlooked in comparison with AT&T (interview, IDC analyst).

Creation of the subitizing range is far from neutral and can lead to contestation. We observed one meeting between analyst relations professionals working for IT vendors and a Forrester analyst, for instance, where a participant voiced his concerns in relation to the narrow perspective taken by those producing the matrices:

> I guess it is quite *arrogant* in some ways to define, to try and define the market based on the number of dots you can put on a graphic…Specifically, when you look at the number of hardware players. You can limit the Wave to 10. I am cool with that. When you look at business consulting it becomes, not only irrelevant, but almost risible in some ways (meeting transcript).–

In the figure below (see Figure 4.5) we depict how there is a point of discontinuity between: a) those graphs that were too simple, such that they were "meaningless" for the client and thus in all likelihood wouldn't be read; b) those where there were too many dots such that the client couldn't easily and (importantly) rapidly make sense of the situation; and c) the situation where they had seemingly found the delicate balance between too much and too little information such that reading and making sense of the graph required neither extensive or fleeting periods of time or effort. This takes us to the final empirical episode. How did the analysts come up with this format? Is it just an accident (or 'arrogance') or was there method in what they were doing? Moreover, what does the analysts' research process looks like?

<Insert figure 4.5 here>

Episode 3: Format not an Accident!

With this last episode we take a more historical lens to the rise of the matrix and subitizing range in this firm and across the industry. Our empirical material here mainly derives from interviews with Gartner's founder Gideon Gartner and from analysis of his blog. The temporal component of these graphs was a key feature discussed in previous episodes. We saw how graphs were designed with assumptions about how much time was required for readers 'to get' the picture. We continue this theme since timeliness was also an important component in how the MQ was constructed. There was a constant push within Gartner for analysts to be "productive". There was a correct *range* also for time spent in producing the graphs. To understand this, we first need to briefly look at the origins of the MQ.

When Gideon Gartner first entered the industry analysis business he found that all the existing analyst firms were producing and selling "lengthy" research reports. These not only took, in his view, an inordinate amount of time for executives to read but also for the analysts to produce. His immediate reaction therefore, upon setting up Gartner, was to introduce an alternative format – the 'one pager'. This not only shaped how his own firm went about communicating their findings but also the norm for reporting across the industry:

> We had reports, but I decided to do very brief reports instead of long reports, which everybody was doing in those days, which is really getting into issues and perhaps some of the companies. I wanted the notes to be very brief so I designed a one-page format which everybody had to adhere to (interview, G.Gartner).

The key aspect of the 'research note' was its design. This was to encourage simplicity and (importantly) speed in reading and writing:

> …designed to provide what I considered to be "incremental" information, broken into user-friendly categories, while being sufficiently brief to be completed within 1-2 hours (which would lead to attractive analyst productivity). Of course, we produced medium-size reports as well, but the one-pagers were quite appreciated by our clients (G.Gartner, blog).[ii]

The MQ directly builds on these earlier moves when it was introduced internally within Gartner a few years later:

> …around 1987/88 I…happened to introduce the 'stalking horse' graphic as one technique which our analysts could occasionally use when presenting at research meetings to support a conclusion. This initiative was meant to be for internal discussion only, because the method seemed an oversimplification (yet an interesting starting point for certain confrontations which would be challenging and educational at our meetings) (G.Gartner, blog).[iii]

Within a short period of time the "MQ feature grew to be a major deliverable" (G.Gartner, blog). Gideon Gartner's early concern was to maximise research productivity. He describes how in the initial days of the firm Gartner enjoyed low variable costs but suffered from high fixed costs. Therefore, not only did much work go into the production of the MQ, but there was also a push to bring down the effort required to create and publish each MQ. For instance, when asked to give us an estimate of how long the research process took to produce a MQ today, an analyst responded:

> An average analyst might do…about 330, 350 enquiries a year. So that is 300 conversations. And then face to face like we are doing here, that might be another 150, 200 conversations like that a year. So, 700 face to face conversations at between 20 minutes up to an hour. That is a lot of data in just one area (interview, Gartner analyst, ET).

Gideon Gartner described himself as "neurotic" about the productivity of research staff (G.Gartner, blog). Any improvements in the productivity of analysts would therefore be significant. The skill required was the ability to "find the right mix", "getting it about right", "nailing it". In what follows one analyst tries to define the exact range of effort that takes to recognise a pattern:

> [You] could then have another 100 conversations, it won't change [what] you have learnt already. Somewhere between 10 and 15 [conversations] you have pretty much … as long as you have got the right people … *you have nailed it* (interview, Gartner analyst, ET).

Having the right people means finding the right mix between informants: user, vendor and financial or academic. Getting in touch with the right mix of people gives analysis an "element of truth", as mentioned below:

> …at the heart of it there is a sort of *truth element* to it. In other words, [vendors] are lying to me and there is an assumption, I mean I was told when I started that I should get 70% of my information from users, 20% from vendors, and 10% from financial or academic. That should be the kind of mix. And that is about right. And most of us trust what the users say to us (interview, Gartner analyst, ET).

Interestingly, this 'subjective' form of research is criticised internally by the more quantitative Gartner researchers. In response, analysts point out that by being in constant interaction with market players, they are "more on the button":

> …our primary research guys are always very sarcastic about the way we do our research, this qualitative type research. Now we point out that we are always ahead of you, we are always *more on the button* about what is going on in our area. But we are doing it all through rather subjective enquires (interview, Gartner analyst, ET).

To summarise this final section, what we show is the range of views on the research process behind the MQ. There were those a) who thought it unnecessarily protracted and could be improved (e.g., speeded up). In the view of the founder of Gartner, for instance, analysts took too much time to produce the necessary picture. There were b) those, by contrast, who that thought the exercise should be longer still and include research on even more actors. And c) there was the situation where a seasoned analyst could recognise pattern and put together a picture ("nail it") in a relatively short period of time.

Discussion

Our argument is that specific forms of action and processes of decision making have become possible in the late 20th Century through the production and use of simple graphs. Scholars have taken a rather reductive lens to study the way these figurations have taken hold in business settings and have thus only partially captured their influence. "Graphical representations", writes Quattrone (2009, 109) "…are always so partial and simplified that they essentially contain very little; they have little truth in them; for, if it ever existed, it has been lost in the process of diagrammatic representation which has sacrificed details and context for the sake of clarity". Quattrone argues that it is only through a process of simplification that graphs can "effectively communicate and engage the user in a performative exercise" (ibid., 109). We agree with this point but would argue that the success of the matrix is only in part about simplification. It is also about what we are calling 'subitization'. Subitizing is different from simplification because it is not just about sacrificing detail and reducing features for the sake of clarity and visual manageability. Those producing matrices can *increase* as well as decrease the information portrayed. Our findings resonate with the view of Lynch (1985, 43) who argues that visual displays do more than simplify because they also *add* features not found in the original knowledge. While Lynch addresses the "device of the dot" in scientific settings, our argument wants to be specific about the amount of dots needed for a figuration to be meaningful in business settings (see also Pollock and D'Adderio (2012)).

The work of subitization also involves the deployment of an alternative set of conventions and tools. To appreciate these points we need to supplement our understanding of these graphs for it turns out

that even the most apparently simple graphs have their 'rules'. There is a specific rationalization processes associated with them. We have shown that those who produce matrices have dedicated and methodic practices for finding or 'creating' the delicate balance between too much and too little information.

Their aim is to produce figurations that encourage readings that are neither prolonged nor fleeting. Subitized business graphs are those which can be portrayed and communicated instantly (often in the time span necessary to point a camera – see Figure 4.3). Subitizers hope to identify a clear point (or 'range') to allow people to apprehend the situation straight away. Understanding subitized knowledge should not be time consuming or protracted; there should be no need to "sit down and discuss in detail these charts", to paraphrase one informant. But, at the same time, just as these graphs shouldn't be overly complex, neither should they encourage a guess or conjecture. There should be enough information for the reader to understand the situation ('the battlefield', 'the landscape') and to be able to act with confidence as a result.

The notion of subitizing helps throw light on a number of connected issues related to the 'temporality of calculation'. What do we mean by the temporality of calculation? As Preda (2006, 757) has argued, once we accept that devices have agency we have to treat them as having their own "temporal structures". This means they do not reproduce existing time structures but generate their own. Figurations that offer a complex picture will elicit a different response than those that offer a simple one. A matrix that presents 100 possible choices will differ from one that offers 25 or 4 for that matter. The graph that is 'cluttered' will be read differently from the one where the information has been 'prioritised'. This challenges the assumption - implicit in much of the writing about business graphs - that all figurations operate on a common textual plane or that there is a continuum from the complex to the simple.

In terms of how this chapter relates to the overall theme of the book, subitizing meets Lamont's call for further study of some of the 'constraints' placed on valuation practices. Subitizing is the study of how valuation practices are structured through what Lamont (2012) might call a 'technology of evaluation'. Matrices create or afford particular kinds of decision making or decision maker. The matrix, if designed in the subitizing range, can help modify the decision of the client. The agential significance of subitizing is in enabling predictable and conscribed business decision-making within and across heterogeneous contexts. It both transforms and at the same time frames the decision. How do buyers draw up shortlists when there are so many vendors and their products appear so similar? In this respect, the matrix plays a role. From the many possible options available it offers the buyer a ready solution - choose not between an infinite number but between these selected few! In the discussion above, we were struck by how precisely informants could identify this range (for the MQ is it is between 10-25 and the Forrester Wave 10-12). These numbers are clearly not arbitrary. The

selection of this range is, on the one hand, aimed at providing value to the client, because, to paraphrase Karpik (2010), the matrix is 'consumer oriented' and 'commercial'. It is also, on the other, created to provide value to the analyst firm. To quote from Karpik: it is "...committed to the conquest and the keeping of customers" (ibid., 52).

Conclusion

The notion of subitizing draws on but also attempts to supplement Callon and Muniesa's (2005) definition of 'calculative agency'. Calculative agency is concerned with the creation of 'calculative spaces' whereas the notion of subitizing attempts to adds a more temporal dimension to this. Callon and Muniesa (2005, 1231 write: "[i]t is important to take the variety of such calculative spaces into consideration. An invoice, a grid, a factory, a trading screen, a trading room, a spreadsheet, a clearing-house, a computer memory, a shopping cart - all these spaces can be analysed as calculative spaces, but all will provide different forms of calculation." We would add to this list the matrix and look to foreground the particular forms of calculation afforded by this device. For Callon and Muniesa (2005, 1238), the power of a calculation depends on the number of entities that can be portrayed and sorted in a single space: for them this is a "long, yet finite list of diverse entities". This contrasts with the matrix where the information to be included is clearly bounded to create immediate forms of sense-making. Whereas Callon and Muniesa (ibid.) are interested in what entities are included we focus on 'how much' information is required to foster a decision. What makes the matrix powerful is that an identifiable limit is drawn around what needs to be considered. This recognisable limit (the "range") then acts as a shared coordination mechanism for the business community (Millo and Mackenzie 2009)

In his recent critique of the upsurge in interest of how economics performs the economy, Miller (2008) has argued that we need to be careful of assuming that all modes of calculation are a direct derivative of economics. He suggests that different disciplines, such as accounting and finance amongst other things, will constitute markets in different ways (though he doesn't say how exactly!). His point, of course, raises the question as to whether there are further forms of calculation - perhaps those that stem from business settings themselves - that we might need to consider. Indeed scholars have noted the distinctive, hybrid characteristics of the business domain and how it is influenced and constituted by lots of disciplines - not just economics or accounting but also, going back a century, engineering, psychology and sociology (Khurana 2007). Indeed, Miller (2008, 59) argues, it is exactly the 'hybridisation of practices' that occurs over time that shape economic life. In this respect, this invites the conjecture as to whether the hybrid processes we have tried to capture here through the notion of subitization might feature as a mode of calculation that has evolved out of business and which continues to exert enormous influence in this domain today.

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