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Man–machine–music: Resonances of craft and technology in a study of guitar building

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Abstract:
Craft is often discussed from the perspective of the maker or artisan, but seldom addresses the assemblage of other agents involved, like materials and tools, and how they affect the outcome. One way to examine this issue could be to use a Deleuzoguattarian perspective in order to draw attention to the role of the various vibrating parts of an assemblage on an individual as well as an abstract level. This article argues that a musical interpretation of the process of craft can help render visible several agents involved in the shaping of a guitar, an assemblage composed of intentions, craftsmanship, material and tools. Juxtaposing David Pye's notions of 'workmanship of risk' and 'workmanship of certainty', the works of luthiers reveal several traits of what Deleuze and Guattari called the 'nomadic sciences', which, in turn, can point towards more polyphonic perspectives on research in the crafts. The text offers an associative application of the Deleuzoguattarian concepts to expose how several 'kinetic melodies' can help expose guitar building as a craft in resonance with contemporary technologies.

Keywords:
Guitar building, Instrument building, Workmanship of risk, Resonances, Ricercare, Nomadic science

Introduction: The craft of musical instrument building

Within the conventions of craft and craft research, the hand has traditionally been the focus of action and reflection. Handicraft, with often tacit knowledge of specific craft assignments and uses, has been approached as something specifically human, almost spiritual in nature. Craft is seen as an essential expression of *Homo Sapiens*, man-the-tool-maker. Certain crafts, concerned with the production of musical instruments such as violins, have been surrounded by mysticism. The quintessential examples of this phenomenon are the Stradivarius violins, enigmatic for all academic spheres including the sciences, technology and the arts. Historians, musicians and builders all have their stake in the debate, asking the questions; is it the lacquer, the choice of wood, the glue or simply the secret magic of handicraft, which ultimately determine the legendary sound of these instruments? The underlying question seems to be how to determine what processes are really engaged in the production of a musical instrument.

This text explores how a multiplicity of agencies or voices, including skills, materials, tools and techniques, come to play together in the formation of a musical instrument, in this case a guitar. It does so by employing a Deleuzoguatarrian perspective and terminology (Deleuze and Guattari 2004) to frame the intersection of agents shaping an instrument, primarily emphasizing skills, technology, materials and tones. Specifically the article uses an experience where the author builds a guitar under supervision of Michael Sandén, a master builder in Scandinavia, as well as a series of interviews to study the process of practice-based craft research in instrument building.

The modern guitar, having a history of about 160 years, is a development from the Spanish guitar, coming out of the tradition of European stringed instruments. Whereas the classic Spanish guitar has not gone through many changes, it is especially the steel string guitar that has lately seen an explosion in innovation, especially since the 1960s. Being primarily an American invention, the steel string guitar development has shown different traits than the works of the traditional nylon string guitars. The American market, coming to mature in the 1920s, was primarily aimed at bands and at wide distribution and big production lines, compared to the individual craftsmanship of the European *lutherie*, often building single and custom instruments (cf. Jahnel 2000; Noonan 2008). Thus the development of the steel string guitar has constantly been on the edge between crafts and industry (cf. Taylor 2011), and it is this specific field we will examine further.

Compared to earlier craft and design studies on guitar building this study does not primarily focus on capturing what *is done* or how work is *reflected upon* (cf. Pedgley 2007; Pedgley et al. 2009) but rather how processes of workmanship *resonate* and are *intensified* by tools, techniques and thought. Neither is this a direct comparison of builder literature, or practical help (cf. Sloane 1966; Cumpiano and Natelson 1987; Kinkead 2004; Bogadanovich 2007). Stepping slightly sideways from the 'reflective practice' of Donald Schön (1983) and into the ideas of craftsman David Pye (1995), we will see how the negotiations between the work of hands and that of machines follow a non-linear development in resonance with the material and tools, between 'risk' and 'certainty'. This process needs to be navigated by the builder in order to produce the well-resonating assemblage of skills, technology, material and tones that is the finished instrument.

A recurring theme in Deleuze and Guattari's seminal work *A Thousand Plateaus* is that of music, resonances, counterpoint and refrains. For example, in several references to biologist Jacob von Uexküll, ecological relations nature is referred to in musical terms, something already done by von Uexküll himself (cf. von Uexküll 2010). It is important to mention that what this study seeks in the terminology of Deleuze and Guattari refers to the *organizing principles* of the world, that is, how things are sorted, come together or come into being, the *morphogenetic* processes. Deleuze and Guattari's endeavour does not suggest an analogous reading between concepts and their manifestations, but neither are the concepts mere metaphors. The concepts are tools with which we can intervene in reality in new ways, as Brian Massumi distinguishes in the foreword to *A Thousand Plateaus*: 'The question is not: Is it true? But: does it work? What new thoughts does it make possible to think?' (Massumi in Deleuze and Guattari 2004: xv)

Using Deleuzoguatarrian terminology to approach craft and specifically the art of musical instrument building can help put craft in a process of continuous *becoming*, decentring the craftsman as the sole actor in the making process. Instead it highlights how the craftsman acts as an orchestrator, or *intensifier*, of the different agents involved in shaping the instrument, and makes their polyphonic voices come together as a whole. Indeed, Deleuze and Guattari connect metallurgic craft and music:

> If metallurgy has an essential relation with music, it is by virtue not only of the sounds of the forge but also of the tendency within both arts to bring into its own, beyond separate forms, a continuous development of form, and beyond variable matters, a continuous variation of matter: a widened chromaticism sustains both music and metallurgy; the musical smith was the first 'transformer'. (2004: 453f)

Even if matter and form seem rigid in metallurgy, Deleuze and Guattari emphasize the variability and continuous development of the forging process, where the capacities of the material overspill the thresholds between various stages of the production process, each activated by specific operations. Indeed, 'artisans are those who follow the matter-flow as pure productivity' (Deleuze and Guattari 2004: 453). Yet, the work of the artisan is not to force matter into new solid and eternal being, but to tease out the capacities of matter to vital assemblages. In such process material capacities come to resonate with each other throughout the transformation, indeed suggesting certain music at work in production.

The music of technology

As noted throughout the works of design theorist Arnold Pacey (1974, 1983, 1999), technology and innovation are steeped in ideas, idealism and culture. Technology is not separate from culture, but an outcome of human activity and organization. In order to understand technology, Pacey directs the attention to situated meanings within culture, how technology is shaped by wishes and dreams, social needs and ethical principles, and not least, by economic exchanges and value systems. Pacey's analysis of technology is not limited to machines, but to how we structure human thought, produce patterns of behaviour and learn skills by 'kinetic melody' (1999: 21). The procedures of guitar building serve as an ideal example of Pacey's ideas, as he sees one specific cultural framework tightly knit together with technology: the realm of music.

Meaning in technology is, for Pacey, best understood through music, as technology engages the senses with qualities similar to that of music; rhythm, pace, tune and technique, and in technology 'musical aspects of a machine may inform the design and development at every stage' (1999: 18). To Pacey, music is not only a metaphor, but an analytical quality for understanding technology.

> If we wish to understand what technology means to those who invent, tinker with, build, or just use its products, we must investigate how the aesthetic is intertwined with the practical; how the giving of meaning is related to building and making, and how work with tools or with hands may have some correspondence with musical experience. (Pacey 1999: 18)

Pacey calls this type of experiential technologies ‘participatory technologies’. Here technology and science meet the senses in a transparent way, where meaning is produced and co-produced by many agents, especially everyday users. These technologies differ from the written sciences of the West as several of the user’s senses are engaged in producing the meaning, and the technologies shape a concrete or diagrammatic ‘visual thinking’. Examples used by Pacey are the ‘songlines’ of Australian aborigines or the stick maps of Polynesia (1999: 112ff). Both are dynamic forms of navigation, which positions the traveller as co-producer of the map, taking on melodic journeys in resonance with the landscape, rather than the western spectator, who aims to master the geography by observing and visually fixating it.

As noted by Pacey, many crafts, and also sciences, engage several aesthetic senses, such as touch, smell, sound and even taste, as was a hazardous common practice in early chemistry (1999: 66). Metalworkers ‘develop new skills through aesthetic response to sense experience’, that is the ‘visual observation of the sheen, texture, and “watering” of metal surfaces, but accounts of early technology also mentions sounds, such as the ring of metal on a smith’s anvil’ (Pacey 1999: 66). In a similar vein, the tonewood of a guitar rings in different musical notes, dependent on species, density and the wood’s dimensions, as some relations between these qualities creates a high degree of *liveness* or ‘Q’ (Somogyi 2010a: 59). Tapping on the tonewood and listening to the response reveals how it resonates. In addition, the builder needs to flex the wood to feel its material properties, not seen by the eye. Two identically cut guitar tops can differ by as much as 100% in density, 200% in longitudinal stiffness and 300% in lateral stiffness, all judged by the touch in order to define what bracing is needed (Somogyi 2010a: 7).

In accordance with Pacey’s ideas the workflow of the guitar-building workshop follows several rhythms. This is especially obvious when working with warm hide glue that is preferred by many custom builders because of its ‘non-destructive reversibility’, that is the joint can be opened with hot water for future repairs. However, the hide glues can be tricky to work with, as the glue needs to be kept at a constant temperature throughout the day. The parts to be joined should be preheated for better bond, and excess glue in the pot needs to be thrown away at the end of the day if not used. Nevertheless, to builder Jose Oribe, the procedures when working with hide glue creates a certain rhythm to the work process:

> A careful independent craftsman finds that these preparations become routine and simple and bring great satisfaction in light of the quality of the bond. (1985: 42)

The hide glue structures certain moments through the day into ‘precise procedures’ with alternating pace and rhythm; the unhurried attention of keeping the glue at the right temperature throughout the day, and the rapid accelerations during a gluing operation before the exposed glue cools down. As argued by both Oribe and Somogyi, the slightly higher risk of the hide glue could be juxtaposed to the modern adhesives that are easily applied, but producing bonds that are too tight, making repairs become very complicated. The service aspect, combined with the rhythmic work process required, makes hide glue the preferred adhesive for several master builders. As Oribe notes, there is also another temporality at work when producing a guitar, a slow rhythm of lifelong maintenance;

‘while a short life may be satisfactory for most commercial products, it is not good enough for an art object’ (1985: 40).

The risk and certainty of crafts

The builder takes on a precarious process of work from conceptualizing to finishing the instrument, and the journey involves risk on many levels and at several stages to make sure all the parts of the instrument fit together and create the desired result. The builder is imagining the finished model, creating a mental version of the separate integrated parts, choosing and preparing the wood, shaping the parts and gluing them together, finalizing the project with adding varnish and setting up mechanisms and strings. These processes, executed in a specific order, come to form a musical rhythm or ‘kinetic melody’ in themselves. The harmony of the work, for example, the precision of attention when paring with the chisel or the flow in a gluing session, will come to resonate with the final sound of the guitar (Sandén 2010). In such work, some operations are manual and rely on little support, such as paring the shape of braces with the knife or the mixing of the hide glue, while other procedures use very elaborate jigs to produce expected and precise results, such as drilling the symmetrical holes for the tuning keys using a CNC-routed template for guiding the drill-head. In some cases, as in the guitars of Sandén, some precise radius cuts, which are joining three irregularly shaped pieces on the back of the guitar body, would be immensely hard to cut accurately enough by hand. Sandén instead uses a CNC router for the perfect conjunctions, thus increasing the accuracy of the joint. Among builders there seems to be very little argument on where the demarcations are between hand and machine, even if the matter was debated in the 1970s. Today almost every technological tool is accepted in order to perfect the work and the magazine *American Lutherie* often includes technological insights and tips from the workshops of featured builders. The fascination for perfection in production gives the impression of a seamless augmentation of jigs between the modest metal rulers and guides of the luthier to the CNC-routers employed on mass scale by some big brands, most notably in the case of Taylor Guitars (Taylor 2011).

Crafts theorist David Pye, who draws no demarcation between hand and machine, has elaborated on this seamless matching of hand and machine (1995). Pye distinguishes between two types of ‘workmanship’, as he calls these manual skills: a *workmanship of risk*, and a *workmanship of certainty*. Pye sees workmanship as ‘using any kind of technique or apparatus, in which the quality of the result is not predetermined, but depends on the judgement, dexterity and care which the maker exercises as he works’ (1995: 20). This process, specifically where the result is continuously at stake, he calls workmanship of risk. As the opposite he puts the workmanship of certainty, where the ‘quality of the result is exactly predetermined before a singe salable thing is made’ (Pye 1995: 20). Writing a letter with a pen is a risky work, while using a typewriter for the same character is certain. For this certainty, the ‘judgement, dexterity and care has been concentrated and stored up before the actual printing starts’ (Pye 1995: 21). Thus, the jigs and tools of the craftsman offer a temporal disposition of the risk; even if the production of the jig might first be a work of risk, it reduces the future risk of a work process.

> If you want to draw a straight line with your pen, you do not go at it freehand, but use a ruler, that is to say a jig. There is still a risk of blots and kinks, but less risk. (Pye 1995: 21)

As mentioned before, several factors are important to produce a good sounding instrument; the quality of the wood, the proportions of the assembled pieces, the tightness of the gluing surfaces, the finish and final set-up. Each step carries a condition of risk. Several jigs are used to reduce risk, working on different levels. From the machine for controlling the humidity of the workshop that ensures the wood has the right dryness, to special rulers for the shape of the braces. Especially joinery is a work of risk as there exists almost not straight angles in the instrument, thus many parts are bonded together supported by specific jigs to produce accuracy. Some jigs and measures are custom made and only fit one model and bracing layout, while others have a more improvised character. An example of the latter could be a simple jig using a washer for drawing the outer contour of the body shape onto the top with a pencil before sawing. The pencil tip follows the contour perfectly at a few millimetres distance as the washer rolls along the plastic edge of the body template (Figure 1).

Figure 1

Pye promotes a special distinction between design and workmanship. The essential facet of a designer's work is the creation and transposition of an *intended idea* into a medium that can be communicated, such as a drawing, numbers or specification (Pye 1995: 49). Workmanship is the interpretation of the design, the execution and materialization of a communicated idea. The design can be a mental image, a sketch seen in the 'mind's eye', but it still needs to be executed. Here a specific problem arises, as 'in a designer's drawing all joints fit perfectly!' (Pye 1995: 31). This problem appears in all workmanship, but as noted before, making the parts join smoothly is a key feature in the workmanship to make the guitar sound well as everything is connected and 'there are no isolated components' (Bogadanovich 2007: 7).

In resonance with this, as Pye notes, 'all workmanship is approximation' (1995: 30). To negotiate from risk to certainty most tools have various degrees of jigs integrated in them or are 'self-jigging' (Pye 1995: 35). To cut a paper straight the knife offers a big amount of risk with no support guiding the blade, while the scissors, being self-jigging where the newly cut edge butts against the upper blade and thus steadies the sheet, reduces the risk. A paper guillotine furthermore reduces the risk, making the paper fit firmly with a fence to produce high regularity to the cut. Also the chisel has a jig in the bevel, used to steer the blade when paring. To tune the braces of the top, the builder uses the chisel to shape the wood, lowering the risk by carefully using the bevel jig of the chisel in order to avoid the edge splitting the pieces. The jig helps the builder to execute his workmanship closer to the intentions of the design.

As is noted in the workshop, interviews and literature, guitar building is the craft of modulating resonances for actualizing resonances between skill, form and material, very often in risky ways. Each resonating component of the assemblage has its own capacity and offers a range of possibilities that guides the builder towards the intended result. The builder negotiates between material expressions and player demands in order for them to meet in ways that are *com-possible* (Deleuze 2006: 67f), that is in a combination of material traits that make up a 'playable' assemblage and an instrument that sounds well and in tune and is responsive to the player's demands.

Somogyi is precise when he frames the desired qualities that make up a 'responsive' guitar: it must play in tune, have an evenness in tone (up and down the neck), a richness of sound, project sound evenly, have a good dynamic range and perform well in the recording studio (2010a: 4). To create a well-responding guitar the 'path of energies' (Somogyi 2010a: 153) needs to be taken into account, which is evident in the ringing of the string upon the player's touch, and which is different to bowed instruments that excite the string over time. Thus the builder needs to make several materials, forces and qualities com-possible, for example, the individual traits of playability with the configuration of materials that produce sustained sound and projection.

In building a guitar, the luthier proposes what material possibilities can be combined, and what capacities are com-possible, such as materials, tone, music style and player technique. To build a guitar is, in this sense, the ability to combine existing formats or protocols, active materials, pregnant with morphogenetic capabilities, and the builder's role is to tease a form out of them, guiding a material as well as human level, into one playable, resonating body that is the assemblage player-guitar. To Deleuze and Guattari this is the process at work as the blacksmith forms a 'musical' assemblage that forms a singing resonance between the material capacities of metal ore, coal, fire, oxygen, hammer and anvil. This process is described by Deleuze and Guattari as being 'not a question of imposing a form upon matter but of elaborating an increasingly rich and consistent material, the better to tap increasingly intense forces' (2004: 363). David Pye addresses a similar issue as he examines the relation between workman and material capacities: 'Some materials promise far more than others but only the workman can bring out what they promise' (1995: 18).

Development: Ricercare and vague para-science

An abstract approach to the evolution of guitar building embraces everything from the material properties of the individual guitar to the process of becoming of the instrument in use. The instrument is not finished when it is leaving the shop, but it has just begun its journey to *become* a played-in guitar. We could say that the instrument is an *objectile*, an object that is a projectile into the future; it is on its way towards its 'true self'. To Deleuze the objectile is an event where the object 'assumes a place in a continuum', a 'temporal modulation' of an object in continuous movement (2006: 20). Even before the guitar is built, the wood has been dried and cured, often for several years (Oribe 1985: 17ff). When finished and delivered to the customer, the guitar keeps moving and actually needs to be in motion, to be played, to 'warm up', which means to 'relax, stop sounding green and adopt a more mature voice' (Somogyi 2010a: 168). A wooden instrument is not yet mature when leaving the shop and usually sounds 'raw' in the beginning, and its sound improves as it is being played as the sound 'opens up' or becomes 'freer' (Oribe

1985: 24). As the instrument is played, the fibres dry out, oxidize and crystallize, a process that adds to the tone. A classic guitar takes about five to ten years of playing for the top to be played in, during which time the sound smoothens, mellows and improves. If it is too open in the beginning, the sound might later on 'turn hollow and wolfish in tone' (Oribe 1985: 29). Over time, the guitar can be over mature, as Andres Segovia's famous Hauser guitar that he had to donate to the Metropolitan Museum of Art in New York as it 'lost its voice dramatically' (Somogyi 2010a: 290). To reach similar maturation a violin can take about 100–300 years.

During development Somogyi suggests thorough methods for record keeping to let the builder know 'which changes or refinements are constructive or not' – and such records are essential for custom works (2010a: 13). Such notes include longitudinal and lateral stiffness of tops, density of topwood, weight of complete tops, species, thickness, taper of top and back, depth of body, body model and scale length. Photos of bracing complement the notes and every soundhole plug is saved to give a future reference of the grain tightness. Yet, the variables are still wide, shifting between models. Somogyi's himself builds seven models, with a variety of scale lengths, different combinations of wood and stringing, different tapered bodies, but for every guitar built, the documented experiences constitute an impressive record for development and improvement.

The work process of instrument building, and also that of craft research, is similar to that of the *ricercare*, the Italian term of early fugue, which in turn means to 'search'. The ricercare, building on the technique of the canon, was an exploratory preludial operation to 'search out' a key or a mode of composing. Within a given motif, the ricercare would explore the permutations and possibilities of a musical arrangement, following several lines of development and setting them against each other in various ways to examine the dynamics of key resonances within a scale. This is similar to the modulations of scores and repeating relations, algorithms and simple programmes, like the formulas popularized in Hofstadter's explorative *Gödel Escher Bach*, a work also based on the principle of the ricercare (1979).

The ricercare is a musical way to elaborate on com-possible protocols between risk and certainty. It is an itinerant research of scales and assemblages; exploring what intensities can be tapped into, and what resonates with the rest. It is an open search, as every new assemblage rests on approximate parameters, yet herein lays the potential of com-possibility:

> We know nothing about a body until we know what it can do, in other words, what its affects are, how they can or cannot enter into composition with other affects, with the affects of another body, either to destroy that body or to be destroyed by it, either to exchange actions and passions with it or to join with it in composing a more powerful body. (Deleuze and Guattari 2004: 284)

As a chord is played on the guitar, six different fundamental frequencies, along with a multitude of harmonics, drive the top, and these vibrations resonate throughout the whole body of the guitar. All parts of the body affect the resonances, and even the shape of the neck and head affect the overall sound, as weight and mass adds to the sustain of the tone. This complexity has triggered a wide array of experiments, especially with bracing to amplify tonal distribution. Several risks of bracing has been taken, for example, the Martin Guitar's X-brace, the 'flying braces' connecting the top braces into the sides, or the experimental Kasha bracing, inspired by the ideas of biophysicist Dr Michael Kasha, created to tune the top between the base and treble sides (cf. Schmidt 2003). Yet the basic parameters are the same; the sound, framed within the musical scale, shall come out in a responsive way.

To frame what kind of research process the builder takes on it can be helpful to examine the Deleuzoguattarian distinction between 'royal' and 'nomadic' sciences, as these seem to correspond to Pye's distinction between design and craft. To Deleuze and Guattari, the 'royal sciences' take on the ideal and imperial essences through axioms and theorems, reproducing reality with induction and deduction. 'Reproduction implies the permanence of a fixed point of *view* that is external to what is reproduced: watching the flow from the bank' (Deleuze and Guattari 2004: 410). This is the realm of the designer's ideal forms or renderings, where everything is certain and predictable. It is a supreme form of knowledge, an architecture of axioms and propositions, like ideal geometry, and could be parallel to Pye's idea of design, 'where all joints fit perfectly'.

The nomadic sciences, on the other hand, are 'vague' (as in the etymological sense of vagabond), and they are 'anexact yet rigorous' (Deleuze and Guattari 2004: 405). Where the royal sciences discuss the essence of the circle, the nomadic sciences work with roundness, 'essentially and not accidentally inexact', a para-scientific fluent essence. This is the craftsman-like science that shaped the knowledge of the journeymen, the ambulant craftsmen building the Gothic cathedrals, essentially vague yet rigorous, not reproducing geometry, but 'following' the protogeometry of 'applied science' where concepts are tools with which to open and tinker with the world:

> There are itinerant, ambulant sciences that consist in following a flow in a vectorial field across which singularities are scattered like so many 'accidents' (problems). (Deleuze and Guattari 2004: 411)

It could be argued that guitar building is a Deleuzoguattarian nomadic science, which follows the execution of com-possible capacities, continuously using a *ricercare*, 'searching out' and modulating intensities, such as tracing the frequencies that drive the top or using braces to guide the vortical flow of sound throughout the guitar body. This is the risk of workmanship, the approximation and improvisation that cannot be predicted, but which instead follows the resonances throughout the assemblage that is the guitar as a vague applied science.

In the workshop, Sandén has a tool exhibiting such qualities and it is the 'first tool he would save in a fire' (2010). This tool is a little wedge-shaped stick with three lines across. During set up and tuning the stick is placed on the 12th fret between the fret board and string. As the string is picked the stick 'feels' the string height depending on how much the string vibrates, and how hard the string is picked. The height of the saddle can be adjusted accordingly. As the vibrations of the string vary depending on gauge and intensity of the picking the tool is 'anexact'. Measuring the string height with a ruler, however accurate, would not give the same result. The stick renders the vibrations both visible and audible and the three lines expose where the rattle of the string should be heard, the treble between the first and second line, the bass between the second and third, a vague scale dependent on the playing style; anexact yet rigorous (Figure 2).

Figure 2

Concluding discussion – resonating crafts

As noted by art historian Edward Lucie-Smith, craftsmen have shown an eminently practical approach to their trade, taking as much interest in reducing costs and increasing efficiency as any modern factory manager, and they thus enabled a quite smooth transition in work organization from the workshop to the early factories (1981: 146). Lucie-Smith draws our attention to how the illustrations of Diderot's *Encyclopédie* shows most crafts in proto-industrial modes of operation with strict divisions of labour, brought in accordance with the emerging world-view of the time; the universe as a mechanic clockwork. Lucie-Smith notes that 'workshop organization therefore followed a universal intellectual tendency' (1981: 168), where machine production became a tool for competition and patents turned into a common marketing tool to express the uniqueness and newness of a product, replacing the exclusivity of the hand's work. If the crafts once had a minor drift towards secrecy and mystique, the rise of mass production and industrialism made esotericism and the quest for authenticity the official doctrine of the crafts. Likewise, the sharing of ideas and models was pushed to the fringes of the system, to be practiced mainly among amateurs and laymen, as the craftsman claimed a position among the higher arts.

Parallels can be drawn to the luthiers, who, just like the those engaged in the scene of studio crafts, had heavy debates in the 1970s on how much machinery should be allowed to be used within the crafts for it still to be considered authentic. However, as shown by Bob Taylor of Taylor guitars, machines can be used for increased accuracy and repeatability, and Taylor now have over 50 CNC routers, 500 employees and make over 500 guitars a day, still with a quality widely acknowledged among luthiers (2011). Along this journey, Taylor has developed own applications for the digital routers, and he shares his methods and programmes with other builders, a trait of communality that frequently occurs within the whole luthier community. A look at the luthier magazines, like *American Lutherie* or the catalogues of supplier Stewart Macdonald, reveals a generous culture of sharing knowledge, ideas, instrument plans and smart workshop jigs. Noted by Sandén, it is an open innovation culture, which increases accuracy, reduces risk and facilitates the making of better sounding guitars, and this 'brings the whole craft forward' (2010). An innovation quickly resonates among the builders, changing technologies, assemblages, maintenance and the tone of the instruments.

What we can see in guitar building is a meeting of craft and design, handiwork and industriousness, risk and certainty, where the interfaces between these fields are in constant change. The dynamics between builder, material, technique, technology and musician is that which makes the craft resonate, spreading waves through the whole community of builders. Yet it is in the care and dexterity of workmanship we can see the craftsman's special practice, anexact yet rigorous. When comparing the handmade with the manufactured guitar (or the individual luthier-built guitar with the factory-built one), Somogyi notes that while the factory can make good sounding guitars, it cannot 'compete with the luthier on the level of attention to detail, care, and exercise of judgement in the work' (2010a: 10). Similarly, it is the pride in workmanship, the personal relation and customization that the buyer is paying for when getting a guitar from the luthier. As Oribe puts it, the finalization of a guitar is a teamwork between builder and musician.

> The instrument maker orchestrates materials and techniques towards perfection; the musician's artistry breathes life into the instrument and music and magic happen. (Oribe 1985: 95)

Among the luthiers there seems not to be much romanticism of the tacit work of the unaided hand, but instead a dynamic scene negotiating between risk and certainty, which makes the trade experimental and contemporary. Guitar building may be craft, or may be industry, but it is still a form of art. It may be tempting to position the craftsman as a lonely genius in the workshop, deeply entrenched into his own tacit craft, but as the luthiers show, guitar building is a very networked and engaged craft. Throughout the trade, builders share skills and create an open and common culture of 'workmanship of risk', even as parts are CNC-routed, adding yet another socio-technical resonance to the assemblage of the guitar. The scene of luthiers affect the evolutionary development of the instruments at least as much as the works of the individual master builder. Even the most isolated manual craft has an intimate connection to technological systems, from simple self-jigging edges to socio-technical scenes of practitioners.

This article has aimed to identify some of the abstract mechanisms and processes that are engaged throughout the building of a guitar, spanning from the resonance of individual parts of the guitar body to the constitution of the socio-technical scene of the trade. When taking an abstract perspective on craft to examine resonating assemblages, the individual builder is decentred to allow more materials and their capacities to be rendered visible. While not focusing on the result but the process of becoming, the individual object, or *objectile*, together with its evolutionary lineages, can be exposed and examined. Here the Deleuzoguattarian concepts help put special focus on the morphogenetic mechanisms that form craft assemblages. In a similar vein, framing the craftsman as an *intensifier* acknowledges the craftsman's engagement with several participatory technologies and vibrant capacities of matter, 'orchestrating' them, as Oribe puts it. Part of the builder's 'tacit' practices may be addressed by examining the morphogenetic processes engaged in such orchestration work.

Guitar building is not something done only for the craft itself. It is an art form that serves a customer and a musician. A part of the luthier's work is to accept that one makes an instrument on which someone else performs the 'real art'. But as Somogyi says, '[guitar building] ain't quite the same as being an artist, but it's better in some ways: it produces paychecks, not to mention happier mates' (Dembroski 2010).

References

Adamson, G. (2007), *Thinking through Crafts*, Oxford: Berg.

Bogadanovich, J. (2007), *Classical Guitar Making: A Modern Approach to Traditional Design*, New York: Sterling.

Cumpiano, W. and Natelson, J. (1987), *Guitarmaking: Tradition and Technology*, Hadley: Rosewood.

Deleuze, G. (2006), *The Fold*, London: Continuum.

Deleuze, G. and Guatarri, F. (2004), *A Thousand Plateaus*, London: Continuum.

Dembroski, S. (2010), 'Interview with Edvin Somogyi', Dream Guitars Blog, 11 December, http://blog.dreamguitars.com/2010/11/09/an-interview-with-ervin-somogyi-part-1/. Accessed 3 February 2011.

Hofstadter, D. (1979), *Gödel, Escher, Bach: An Eternal Golden Braid*, New York: Basic Books.

Kinkead, J. (2004), *Build Your Own Acoustic Guitar*, Milwaukee: Hal Leonard.

Jahnel, F. (2000), *Manual of Guitar Technology: The History and Technology of Plucked String Instruments*, Westport: The Bold Strummer.

Lucie-Smith, E. (1981), *The Story of Craft: The Craftsman's Role in Society*, London: Phaidon.

Noonan, J. (2008), *The Guitar in America: Victorian Era to Jazz Age*, Jackson: University Press of Mississippi.

Oribe, J. (1985), *The Fine Guitar*, Vista: Vel-or.

Pacey, A. (1974), *The Maze of Ingenuity: Ideas and Idealism in the Development of Technology*, London: Allen Lane.

____ (1983), *The Culture of Technology*, Cambridge: MIT Press.

____ (1999), *Meaning in Technology*, Cambridge: MIT Press.

Pedgley, O. (2007), 'Capturing and analysing own design activity', *Design Studies*, 28:5, pages 463–483.

Pedgley, O., Norman, E. and Armstrong, R. (2009), 'Materials inspired innovation for acoustic guitar design', *METU Journal of the Faculty of Architecture*, 26:1, pages 157-176.

Pye, D. (1995), *The Nature and Art of Workmanship*, Cambridge: Cambridge University Press.

Sandén, M. (2010), in-person interviews, Gothenburg18–29 October.

Schmidt, P. (2003), *Art that Sings; the Life and Times of Luthier Steve Klein*, Clifton: Doctorow.

Schön, D. (1983), *The Reflective Practitioner: How Professionals Think in Action*, London: Maurice Temple Smith.

Sloane, I. (1966), *Classic Guitar Construction*, New York: Dutton.

Somogyi, E. (2010a), *The Responsive Guitar*, Milwaukee: Luthiers Press.

____ (2010b), *Making the Responsive Guitar*, Milwaukee: Luthiers Press.

Taylor, B. (2011), *Guitar Lessons: A Life's Journey Turning Passion into Business*, Hoboken: John Wiley & Sons.

von Uexküll, J. (2010), *A Foray into the Worlds of Animals and Humans: With A Theory of Meaning*, Minneapolis: University of Minnesota Press.