

# CODED ORNAMENT: CONTEMPORARY PLASTERWORK AND THE USE OF DIGITAL TECHNOLOGIES

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*The ornamental plaster industry is predominantly driven by the reproduction of traditional designs and by restoration work. The manufacturing technologies used in this industry have developed little since the 19<sup>th</sup> century.*

*The current resurgence in the use of decoration within interior and exterior architectural design along with the author's interest in digital technologies prompted him to undertake a practice based research project which sought to investigate the role of digital technologies in the design and production of contemporary ornamental plasterwork.*

*The research took the form of a collaborative project involving the author (a maker and researcher) and an ornamental plasterwork company (Hayles & Howe). The author was interested in not only the productive potential of digital technologies, but also their role in creating new forms of sustainable practice for independent makers. The specific questions addressed by this project where:*

- 1. By working in collaboration with an established manufacturer of decorative plasterwork, can an independent designer-maker be instrumental in developing an innovative new range of products or create the potential for new markets/contexts for architectural plasterwork.*
- 2. Can the integration of CAD/CAM technologies with the traditional skills and processes used in this industry help promote innovation and create the potential for mass customisation.*

*This project involved the author working within the workshops of the plaster company in order to gain an understanding of their 'traditional' production processes and assess how digital technologies could potentially extend their current working procedures. He then went on to undertake four small projects employing a range of different digital technologies, (including laser cutting, 2D and 3D CNC milling and rapid prototyping), in order to develop new design and production procedures and a number of new*

*plasterwork prototypes. The project culminated in a large scale exhibition of the new work developed, a documentation of process and demonstrations of some of the technology employed.*

*This paper takes the form of a case study report on the project, It will describe the aims; providing an illustrated description of the processes used to develop the new work and reflecting on the author's experience of the collaboration. The conclusion will discuss to what degree the questions posed have been addressed, with a focus on issues relating to new product development, and highlight any generalizable outcomes which may be of relevance to independent makers undertaking collaborative projects with industry.*

## 1. INTRODUCTION

This project was developed through a successful entry to the Automatic design research competition held by the 3D Digital Production research cluster at University College Falmouth in 2005 – 2006. The initial proposal sought to address two questions:

1. By working in collaboration with an established manufacturer of decorative plasterwork, can an independent designer-maker be instrumental in developing an innovative new range of products or create the potential for new markets/contexts for architectural plasterwork.

2. Can the integration of CAD/CAM technologies with the traditional skills and processes used in this industry help promote innovation and create the potential for mass customisation.

Underlying these questions was the aim of creating a more sustainable (economically viable) practice through industrial collaboration. It was intended that this would be achieved through the development of new products (NPD) which, as an independent maker, the author was unable to produce on the

scale, quality and complexity necessary to enter the architectural ornament market independently.

Research into craft activity in the UK, commissioned by the Crafts council in 2003, reports that nearly half the makers surveyed turned over less than £10,000 annually and three quarters made a loss or less than £10,000 profit (McAuley & Fillis 2004 p.31-32). Consequently craft activities are widely supported by other forms of income (McAuley & Fillis 2004 p.28). This low level of turnover and profit suggests the need for new approaches to creating economically viable craft practices.

This report proposes that 'Collaboration could be an important way forward for some of enterprises.....' (McAuley & Fillis 2004 p.46) and that of the 32% of makers in the study who were involved in collaborations, just over a third (189) were involved with industry in some way. Furthermore, two thirds of makers in this study stated that they were willing to undertake collaborative work (McAuley & Fillis 2004 p.47).

This suggests that there is considerable potential to develop this strand of craft practice,

which if successful, has the capability to make a significant contribution to the income of independent makers.

## 2. METHODOLOGY

This research project employed an action research approach in which the author was both researcher and practitioner. Information for this paper was gained through:

- Reflective practice.
- Observation of the workforce and environment to gain practical understanding of plasterwork production.
- Informal discussions with a range of employees at Hayles & Howe to gain contextual and industry specific knowledge and feedback concerning ongoing research results.
- Informal discussions with the general public at the final exhibition to gain feedback on the completed plasterwork designs.

From the range of approaches to real world research proposed by Robson, this project is one in which the ‘researcher obtains client collaboration on a researcher-designed project. The researcher would like client to be influenced by research outcomes.’ (1995 p.15).

Due to the specific circumstances in which this project was undertaken its structure had to be flexible and evolving. The managing director of the plaster company was supportive of the broad aims of the project and recognised the potential benefits to both parties. However it was clear that the research needed to fit within the companies heavy and highly changeable work load and creating a rigid structure to the

project was not deemed appropriate. One major element was agreed at an early stage in the project and this was to work towards an exhibition of new work to be displayed as part of Architecture Week in Bristol, June 2006.

It is recognised by the author that the ‘fast and loose’ approach this project adopted had pragmatic benefits in that it enabled him to work around both his and the company’s other commitments and adapt to changes in circumstances. However, it also created problems, most significantly related to communication and division of responsibilities. This issue will be discussed in the conclusion.

## 3. COLLABORATION WITH HAYLES & HOWE

### 3.1 Company’s background

Hayles & Howe are an established and successful ornamental plasterwork company who have been trading since the 1970’s. They have three workshops, two in the UK and one in the US, with a workforce of around fifty split between these sites. Approximately one third of their business involves restoration and conservation projects (e.g. Windsor Castle after the fire in 1992), one third comes from the production of scagliola (imitation marble) and one third from the creation of one-off reproduction plasterwork designs adapted either for new builds or period properties. This reproduction element of their business includes many stock items, which make up around 20% of this sector’s sales<sup>1</sup>. Due to the highly variable nature of work the company undertakes, Hayles & Howe do not employ a rigidly structured NPD process. However, most projects outside the restoration sector, do involve a large proportion of new and bespoke

plasterwork designs. On large scale projects overall decorative schemes tend to be developed in close consultation with clients. This often involves clients wishing to either have a specific existing plasterwork design reproduced (e.g. the 'Robert Adams Niche' from Kenwood house library), or have a design developed with characteristics of a particular period (e.g. a Tudor style strap work ceiling). Initially to fulfil the client's requirements 2D (e.g. paper or CAD based) decorative designs are developed to fit the intended location, and cost and time estimates produced. If these stages are successful clients will then commission the work to be undertaken. Many one-off pieces will be produced in this type of project and all moulds of new designs will be retained by the company. Through a yearly review of these retained items the company selects decorative elements which have proven popular, or are considered to have a general appeal, are then included in their stock catalogue. Therefore their catalogue stock evolves in relation to the other elements of the business, rather than being developed in relation to any formal NPD process. Currently there is no permanent R&D department or speculative NPD outside the requirements for particular projects.

Their workforce is from a diverse range of backgrounds; from specialist modellers with art school training, to plasterwork fitters from the building trades. It is an industry where art/craft meets construction.

The company uses well established 'traditional' processes, which apart from the introduction of some new casting and moulding materials, have changed little in the last 100 years. Hand

modelling, moulding, casting, 'running' and 'spinning' are the backbone of their production. Due to a relatively low level of specialised equipment and tooling, plus the one-off or small batch nature of much of their production, this company has a highly flexible manufacturing system. The use of digital technologies is focused on 2D architectural drawings being produced using AutoCAD. To date, no 3D modelling software or digitally controlled equipment is used by the company.

### 3.2 Maker's background

The author is a practising artist and maker who has been exploring the use of digital design and production technologies in his work for over 10 years. He has undertaken a range of research projects investigating the creative employment of digital technologies, principally in ceramic art, design & architectural work. He has also undertaken a number of projects which involved working in an industrial context to facilitate the development of new work. These projects were more focused on the author accessing specific facilities rather than true collaborations.

For a couple of years prior to this project he had been working independently with some of the production processes used to produce ornamental plasterwork, creating one-off plaster artworks (*Figs 1 & 2*). This previous experience and the growing interest in the field were factors in prompting the author to develop this collaborative project.

*Insert figures 1 & 2 here*

### 3.3 Establishing a new relationship

The project was instigated by the author approaching the company director of Hayles & Howe with a broad project proposal based on the competition entry. This prompted an open ended discussion concerning the possibilities for developing new decorative schemes and the potential benefits of digital technologies within the context of ornamental plasterwork. His initial response was positive and although the author's proposal only brought with it a small amount of funding he agreed to undertake the project.

It is believed that the established prior work of both parties opened up a conduit for communication and project development. Specifically, Both Brown (2004) and Yair et al (2001) recognise the need for 'contextual fit', where there is a high level of convergence between the context<sup>ii</sup> in which the maker and the manufacturer are working, in order to create a successful collaborative project. In addition the author's prior experience of creating plasterwork allowed him to have an appreciation of the need for 'congruence between product specification and manufacturing resources' Yair et al (2001 p.381) when discussing possible new plasterwork designs.

Unlike other documented craft-industry collaborations (Yair et al 2001) this project was not instigated through Hayles & Howe recognising that their traditional markets were decreasing. Their scagliola, restoration and period reproduction business continues to be successful. The company was interested in this project because it introduced them to a family of technologies which they had no previous experience. In addition, the managing director,

although rather cynical about many architect's perception of ornamental plasterwork, was interested in the possibility of developing new products for the contemporary architectural market.

Diagram 1 provides an illustration of where the author's NPD and Hayles & Howe's existing NPD sit in relation to some general categories of new product types. As there is little ornamental plasterwork currently being produced in the UK which is aiming at the contemporary architectural market<sup>iii</sup> and Hayles & Howe have yet to make any significant inroads into this market, the author's new plasterwork designs sit somewhere between 'line extensions', 'new product lines' and 'completely new' products. In contrast Hayles & Howe's existing NPD (as discussed in section 3.1) sits further down the diagram between 'core product revisions' and 'changes in augmented products', the implications of this will be discussed in the conclusion.

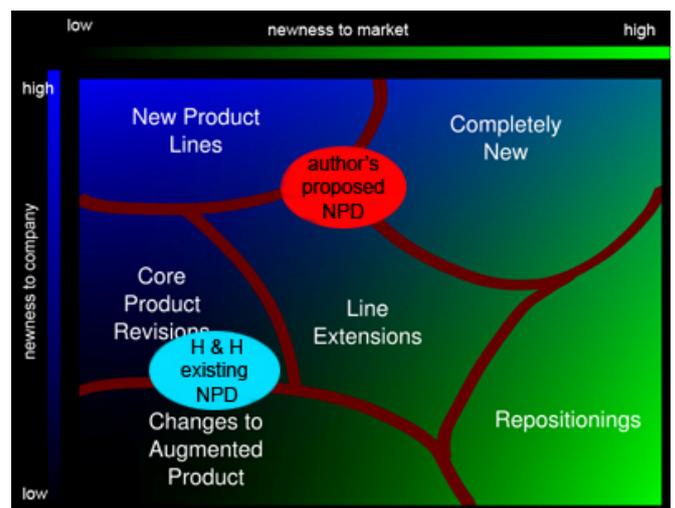


Diagram.1 Location of author's proposed NPD and Hayles & Howes' NPD in relation to the market and the company's current product range<sup>iv</sup>

In this context the project, which was to last approximately one year, was started with an open and exploratory attitude from both parties.

### 3.4 Particular characteristics of this case study

There are some elements of this project which make it distinct from others cited in the literature. Much of the literature discusses projects in which the independent maker is bringing the 'handmade' aesthetic and craft sensibilities to mechanised industrial production (Dormer 1985) (Brown 2004) (Levien 1998 & 1998a) (Harrod & Margetts 1986). This project was different in the fact that it was the independent maker/researcher who was introducing digital mechanisation to an industry principally centred on hand skills. In addition, the traditional nature of the ornamental plaster industry's production processes means that a substantial proportion of the product is produced by one individual, or a small team for larger pieces. This means that unlike many industries, there is relatively little division of labour in the production of ornamental plasterwork.

The potential of digital technologies to transform industrial mass production into a more flexible system of manufacturing is cited as one of the defining features of 'post-industrial' production. It is argued by McCullough (1996 p.179) that these flexible 'post-industrial' production systems can be associated with craft practices because they involve less division of labour and greater flexibility. Another unusual aspect of this case study is that the company involved could be perceived as 'pre-industrial', with little division of labour and highly flexible production

methods. Therefore the introduction of digital technologies did not hold the potential to transform an industrial system into a 'post-industrial' one, but potentially challenge the 'traditional' craft skills on which the company is founded.

### 3.5 The practical projects

In order to inform himself about the production methods and capabilities of the industrial partner (recommended by Brown (2004) and Levien (1998 & 1998a)) the author started the project by spending a week assisting and working alongside the workforce at Hayles & Howe. This provided useful first hand knowledge of production methods, but not of the design development or installation phases. Further work periods within the company were intended, but due to a change in the author's circumstances this did not happen. The consequences of this will be returned to in the conclusion.

During this work period the author had many informal discussions with the production workforce concerning the aims of the project and how digital design and production technologies could potentially be employed within the design and production of plasterwork. Initial feedback was mixed from this group, and although it was made explicit that the project was not concerned with introducing digital technologies to replace existing methods or people, there was an underlying perception of these technologies as a threat. This was articulated through light hearted banter based on 'who would not have a job next week'.

Regular visits were made to Hayles & Howe to discuss the project, and communication was kept up through email and phone. In terms of practical project structure, all model making and CAD work was carried out at UCF and all plasterwork production beyond the creation of test pieces was carried out at Hayles & Howe.

The author used the initial visit to make a preliminary assessment of where and how the introduction of digital technologies could extend current working practices. In discussions with production and workshop managers at the end of this work period the author proposed a range of possible ways in which this could occur. Their response was more positive than that of the production workforce. However they are principally concerned with solving practical day to day problems and although intrigued by what digital technologies could achieve in theory, they had a pragmatic view of any new production systems, and expressed a desire to see these technologies proved useful in specific contexts. From these discussions it was agreed that the author should work on the production of two traditional decorative motifs which were part of a project that Hayles & Howe was currently working on. The established process of producing these type of decorative elements would be to create a model in clay by hand from which production moulds would be taken. This traditional process is particularly suited to complex organic or figurative forms. However the author recognised that many decorative elements in plasterwork schemes are based on rigid geometric forms and as such maybe more effectively created using digitally controlled equipment.

The two elements created were of this type, one was produced using 3D CAD modelling and CNC milling, and the other 2D CAD and laser cutting (*figs 3&4*).

*Insert figures 3 & 4 here*

The results of the laser cutting were of particular interest. The speed, simplicity and accuracy of this process were recognised as having considerable potential in the production of repeat patterns. The small team of modellers employed by Hayles & Howe are in demand to create the organic highly complex and one-off decorative elements for many large-scale projects. The use of laser cutting technology for some of the 'donkey work' was recognised as a useful replacement for the hand modelling of elements that did not require the skills and finesse of a skilled modeller.

Having established some credibility with the workforce and within the company through these tests the author was able to develop three small design briefs, employing a range of different digital technologies, including laser cutting, 2D and 3D CNC milling. These projects briefs had the aim of both developing and testing new design and production procedures, and creating new designs for contemporary architecture. In the development of these briefs the author was mindful of the relatively low level of computer use within the company and proposed the use of relatively accessible and user-friendly 2D CAD software to develop new work, staying away from 3D modelling software wherever possible.

### 3.5.1. Project 1: Penrose strapwork

Most plaster strapwork is based on a regular repeat (periodic) of a number of decorative units, this process can create highly complex patterns, but only a limited number of overall designs (*fig 5*).

*Insert figure 5 here*

The aim of this project was to develop a series of low relief strapwork designs which did not rely on this traditional 'periodic' repeat system. Through the use of a tiling system developed by Roger Penrose in the 1970's (*fig. 6*), patterns were created which are 'aperiodic' and therefore never repeat. Based on only two units, these types of patterns can have a rotational symmetry, but can also appear random (*fig.7*). The two units can also be arranged in an infinite variety of configurations, enabling unique designs to be created from a minimum number of components.

*Insert figures 6 & 7 here*

Digital technologies were used to visualise the designs, as shown above, and to create the tooling from which the physical plasterwork was produced (*see figs .8 & 9*).

*Insert figures 8 & 9 here*

Two full-scale pattern generating systems were finally produced based on Penrose tiling (*fig.10*).

*Insert figure 10 here*

### 3.5.2. Project 2: Greyscale to low relief ceiling rose

The aim of this project was to investigate methods for the production of relief patterns using only 2D CAD software, and so develop procedures by which designers without any experience of 3D CAD modelling can create complex relief surfaces within the digital environment. In order to emphasize how little CAD computer skills are needed to exploit these methods, the designs in this project were developed using only typeable symbols (*fig. 11*). Using text based symbols as the underlying structure of the designs also opens up the potential for creating a wide variety of new designs by changing the font rather than the actual layout, so introducing a simple mechanism for customisation. The employment of software that turns 2D greyscale imagery into low relief 2.5D models was central to this project and although used widely in the tiling and stamp making industries, to the author's knowledge, it had not been used in the ornamental plasterwork industry before. The advantage of this system is that through the relatively simple process of manipulating 2D imagery, rather than the often complex process of modelling 3D forms, relief designs can be easily created and modified.

*Insert figures 11,12&13 here*

### 3.5.3 Project 3: Stepped relief

From a process perspective, the aim of this project was to produce a 3D work without using any 3D CAD software **or** hardware. From a design perspective the aim was to produce a decorative system based on a small number of units that which could be configured in a number of ways, creating the opportunity for each consumer to create their own unique design.

Designs for three basic units were derived from a pattern developed using the Penrose tiling system (*fig. 14*). The units were designed to fit end to end so creating the potential for a continuous patterned line to be created.

*Insert figures 14, 15 & 16 here.*

The resulting plaster units can be configured to create a meandering decorative line through an interior space (*fig. 17*). These designs could move from wall to floor to ceiling and navigate around existing features (*fig. 19*). Layouts could be developed to indicate directions or to highlight/demark areas. Within the limitations of the rectilinear design of the units, large scale 'line drawings' could also be produced to create strong graphic imagery on a grand scale.

*Insert figures 17, 18 & 19 here*

#### 4. THE EXHIBITION AND ASSOCIATED EVENTS

As a means of disseminating the results of the project, and promoting the new design work, an event was organised as part of Architecture Week 2006 and held in Bristol, entitled 'Coded Ornament' This event involved an exhibition, talks, demonstrations of both traditional and digital production techniques, and educational workshops. Funding for this element of the project was gained from Arts Council England and Arts & Business, however it was still heavily subsidised by Hayles & Howe and University College Falmouth.

For the author, the principal aim of this event was to stimulate interest among architects, public art commissioners and other potential

clients in the southwest region. The director of Hayles & Howe had a number of other objectives for the event and took the opportunity to stop production for the week of the exhibition and concentrate on staff training and development. In conjunction with this a series of hands-on plaster workshops were run for local schools aimed at stimulating interest in apprenticeship schemes for school leavers.

The exhibition and associated events were well received and very positive feedback was gained. For the author not enough contact was made with potential clients, however the director of Hayles & Howe was satisfied with the developmental outcomes from the event. The documentation from the exhibition (images, presentations and a DVD) have been an important resource and are being used to stimulate interest in the project on a wider national level.

#### 5. CONCLUSION

In relation to design work developed through the projects, the following conclusions can be drawn:

##### Penrose Strapwork:

It is believed by the author that the use of 'aperiodic' tessellations has considerable potential for generating many more systems capable of producing patterns of infinite variety and complexity. However it is recognised that due to the author's lack of in-depth knowledge of the installation side of the plasterwork business the initial designs produced have limited applications. This is due to the designing work made up of too many small elements which would be impracticable to install in many situations. This has been

rectified in later design solutions, the managing director of Hayles & Howe stated:

‘The strap work ceilings designed and executed in collaboration with [...] exhibited beautifully and showed the full potential of the project for the future’. (Harrison 2006 p.5)

### Greyscale to low relief:

Although not satisfied with the final design, the author believes that this process could be further developed and become a design and production system which could be adopted by the existing design team at Hayles & Howe without a significant amount of retraining.

### Stepped relief:

The work produced in this project was considered by the production team to be the most successful of the new designs created by the author. The hard edged nature of the laser cutting process creates designs with strong shadows which are one of the defining characteristics of successful plasterwork designs.

To date, the specific outcomes from this project are:

- The setting up of a joint venture between Hayles & Howe and the author to develop and promote new plasterwork designs, including the commercial development of a set of large scale Penrose tessellating tiles to produce a flexible ceiling strapwork system.
- The planned adoption of laser cutting as an additional method of model making by Hayles & Howe.

In relation to the original questions the project sought to address:

Question 1 concerned the development of a new work which had the potential to create new markets for ornamental plasterwork. It is believed that this project has partially answered this question. A range of new designs and production processes have been developed which, from the positive feedback gained at exhibition, are felt to have the potential to stimulate new markets for ornamental plasterwork, further promotion of the new designs is currently being undertaken.

Question 2 concerned the integration of digital technologies and with traditional production processes and how this may hold the potential for mass customisation. This has also been partially answered. The author believes that the processes which integrate traditional and digital processes he developed all hold some potential for creating plasterwork with new visual characteristics. In addition the methods are flexible enough to create designs which allow mass customization, either in their creation or in configuration during installation. However, he recognizes that further development work needs to be undertaken to create systems that are specifically appropriate to Hayles & Howe. On a functional level, the potential of laser cutting as a method for producing particular types of models has been recognized by Hayles & Howe and will be employed when considered appropriate.

The chart below illustrates the approximate final costs of the project including the ‘Coded Ornament’ event. In addition to these actual spend figures there are substantial amounts of

‘support in kind’ from both Hayles & Howe and UCF which have not been calculated. It is interesting to note that the initial funding provided by the Autonomic award ended up being the smallest contribution to the final budget. The real cost of undertaking this type of collaboration can easily be underestimated and this chart is intended as an indication of funding required to undertake this type of project.

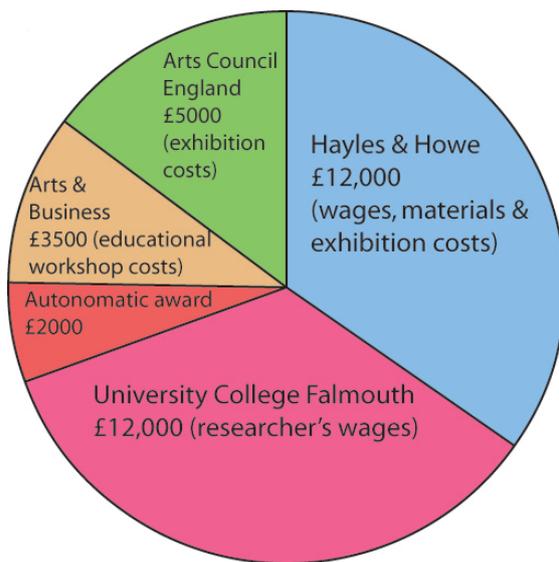


Diagram 2 Approximate breakdown of funding for the project and how it was spent

Although the author and Hayles & Howe are satisfied with the outcomes of the project to date, the author believes, on reflection, there were issues which limited the progress of the project. These are highlighted below and recommendations are proposed which could be tentatively applied to any craft-industry collaboration.

### Project structure

For the reasons discussed in Section 2 the structure of this collaboration was very informal, with initial agreements over principal aims, but little detailed organisational structure.

On the one hand this gave the author a freedom to organise the project as he wished and to follow avenues of investigation which may not have been open to him if he was working within a rigid project structure and to a tighter brief. However there were also problems associated with this informality, including:

- A lack of a mutually agreed division of responsibilities at the start of the project resulting in significant amounts of time being spent by the author undertaking fund raising and event organisation.
- A lack of regular feedback sessions involving all relevant individuals involved in the project, which, as discussed earlier in this section, resulted in the author developing designs that were not appropriate to plasterwork production and/or installation.

The author believes that the benefits of a clear and comprehensive project structure, including roles and responsibilities, being formulated and agreed by all participants at the start of the project, outweighs the possible limits to a maker's creative practice.

### New product development strategy

The approach which this project took to NPD was significantly different to that normally employed by Hayles & Howe (see diagram 1). There was greater 'newness' of the products being developed in this project, compared with Hayles & Howe's established NPD. Consequently the NPD process for this project would require more time and effort than the company would normally allocate to this process. Neither parties fully appreciated this at

the conception of the project and did not discuss NPD strategy in any depth. Consequently many elements of the NPD process listed in Table 1 were not fully realized.

<b>Possible Stages of New Product Development</b>	<b>Hayles &amp; Howe's established NPD</b>	<b>'Coded Ornament' project NPD</b>
1. Idea Generation	New designs mostly developed or adapted from historic/period pieces.	Original designs developed by author.
2. Idea Screening	NPD through designs commissioned by clients. Technical feasibility and costings already undertaken as part of quoting process. If item becomes stock, then these issues have already been dealt with.	No formal target audience research. Little initial feedback from Hayles & Howe on technical feasibility. No formal production cost and profitability analysis to date.
3. Concept development and screening	Many products developed in close consultation with clients. CAD drawings produced for technical specification, not visualization. To author's knowledge no formally structured testing of potential products with sample customers.	Some development of issues concerning product's unique features and production processes to be used. Some development of CAD visualizations. No testing of potential products with sample customers.
4. Business analysis	Established systems for pricing commissions and stock items, including installation costs. Established profitability and breakeven points.	Speculative project attempting to open new markets, so sales estimates were difficult to estimate. Limited discussions concerning profitability.
5. Beta testing and Marketing testing	To a large degree commissioned pieces act as prototypes for new stock items. New stock products promoted by catalogue & irregular trade shows. Feedback on products gained through informal discussions, no formal focus group or other methods employed. Most new commissions obtained through company reputation and limited market competition.	Production of prototypes. Review of products developed but no adjustments made to date. Launch of new designs through exhibition.

6. Technical Implementation	Technical issues resolved on project to project basis for commissions. These issues are then resolved before new designs become stock items.	No structured technical implementation to date.
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Table 1 illustrates the possible stages of NPD and how each of them was approached in this project and in Hayles and Howe’s normal NPD strategy<sup>v</sup>.

The author would recommend undertaking in depth discussions with a potential industrial collaborator concerning their existing NPD strategy at as early an opportunity as possible. If there are significant differences in the type of products to be developed within the collaboration, then a new strategy needs to be formulated and agreed at an early stage in order to optimize the chances of successfully developing a new product and bringing it to market.

### Communication, knowledge acquisition and knowledge transfer

Due to the lack of time the author spent working directly with the workforce at Hayles & Howe the appropriateness of some of the designs developed by the author to the nature of ornamental plasterwork was sometimes limited. Although this was often rectified in later design solutions, some time was wasted.

Greater time working directly with the workforce would have also provided more opportunity to informally discuss the project and so allay any fears that jobs were being put at risk through technology replacement and help overcome any resistance to change. In addition it allows two-way knowledge transfer on a practical production level. As Yair et al (2001)

point out, one of the benefits of an independent maker working with a crafts based workforce is that the shared experience of making provides a useful foundation for discussing new designs and finding solutions to problems as they arise. The author is convinced that if he had spent more time in the workshops of Hayles & Howe there may have been more comprehensive testing of new procedures earlier in the project and therefore a greater integration of digital technologies into the company’s production systems.

The author believes that there is no substitute for spending extended time working within the collaborative company. The type of knowledge gained, the commitment to a project engendered in the workforce at all levels and the in-depth understanding of how the company runs, cannot be gained by any other means.

### Project focus and implementation

The lack of clear communication of this projects aims and the support it required among key individuals in the company, led to the author being put in situation in which he had to negotiate ‘favours’ in order to achieve results. This situation limited the level of support and advice that the author felt comfortable asking from the workforce, who where often not clear what their obligations where.

As Yair et al (2001 p.382) has recognised, resentment of interruptions to production by the workforce can build up if there is not a clear

understanding of the what is expected of them. Although little resentment was recognised amongst the workforce in this project, it was clear that a significant number had no idea what the author was trying to achieve, which did not encourage requests for support.

In Yair's study the solutions too many of the problems cited was the creation of a small NPD team working independently from mainstream production. This team was headed by a manager whose role was that of project mentor, advocate and new product champion (2001 p.383). He/she acts as a focus within the company for all issues associated with a collaborative project and has the recognised authority to quickly negotiate solutions to problems as they arise. Other studies (Harrod & Margetts 1986) also emphasise the importance of a project manager within a collaborating company to create successful outcomes to projects.

Although the setting up a whole NPD team at Hayles & Howe would have been inappropriate due to the small size of the workforce, the author believes that almost all the problems encountered would have been solved by having a dedicated individual at Hayles & Howe as project mentor. In this project the managing director was the first point of contact, however he had too many other commitments to fulfil all the requirements of project mentor.

The author strongly believes that the establishment of a NPD team or NPD mentor within a company is key to the smooth and well managed progress of a collaborative project.

The author recognises that the aims of this project may have been over ambitious and that NPD projects based on forming new relationships can take a considerable time to reach fruition (Harrod & Margetts 1986 p.51). In addition a more structured methodological approach should have been employed. However the author felt that the opportunity to work with Hayles & Howe could not be passed over and he approached this project with an open mind and a flexible attitude to changeable circumstances.

The complex process NPD, especially when new to both the company and the market, was not fully appreciated by the author at the conception of this project. His background in art and craft practice has not given him any experience in NPD in an 'industrial' context. Due to the limited support/advice from Hayles & Howe in this process, significant elements of the NPD process listed in Table 1, were not undertaken, which resulted in many of the problems sited in this conclusion. This situation was exacerbated by the different, and perhaps over ambitious, approach to NPD which the author took in comparison with Hayles & Howe's more conservative and established system.

It is now recognised that the most significant outcome of this project is the creation of a new relationship and the building of strong foundations for further more focused projects. Both parties believe that when the right client base is located then there is considerable potential for financially and creatively rewarding ventures to be undertaken.

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## BIOGRAPHY

Justin Marshall is an artist/designer and researcher. He completed a BA in Fine Art at Lanchester Polytechnic in 1988, a MA in ceramics at Cardiff Institute of Higher Education in 1995 and his Ph.d, entitled 'An investigation into the role and significance of CAD/CAM technologies in craft and designer/maker practice', in 2000 at University Wales Institute Cardiff.

Since completing his PhD, his research has been predominantly ceramic based and involved investigating a range of CAD/CAM technologies to aid the design and production of new work. He has undertaken two small scale AHRC funded research projects, been a part time lecturer in 3D at both University College Falmouth and University of the West

of England, and visiting lecturer at a number of other colleges. He is currently a fulltime Research Fellow at UCF.

His current projects have concentrated on using digital technologies not only to extend aesthetic possibilities, but also their role in building new relationships between independent makers and industry, and to challenge the relationship between maker and consumer.

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ILLUSTRATIONS (these images are for reference only 300dpi images are provided on the accompanying CD)



*Fig1. 'Back to where I started 4', 1m diameter, spun plaster, 2004.*



*Fig2 'Drawing around myself', 2mx4m, run plaster, 2004.*

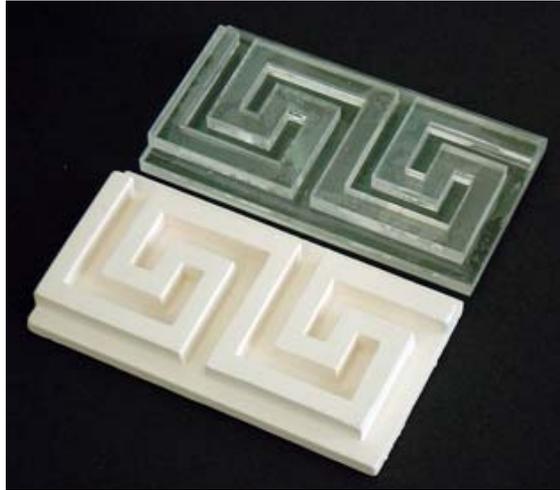
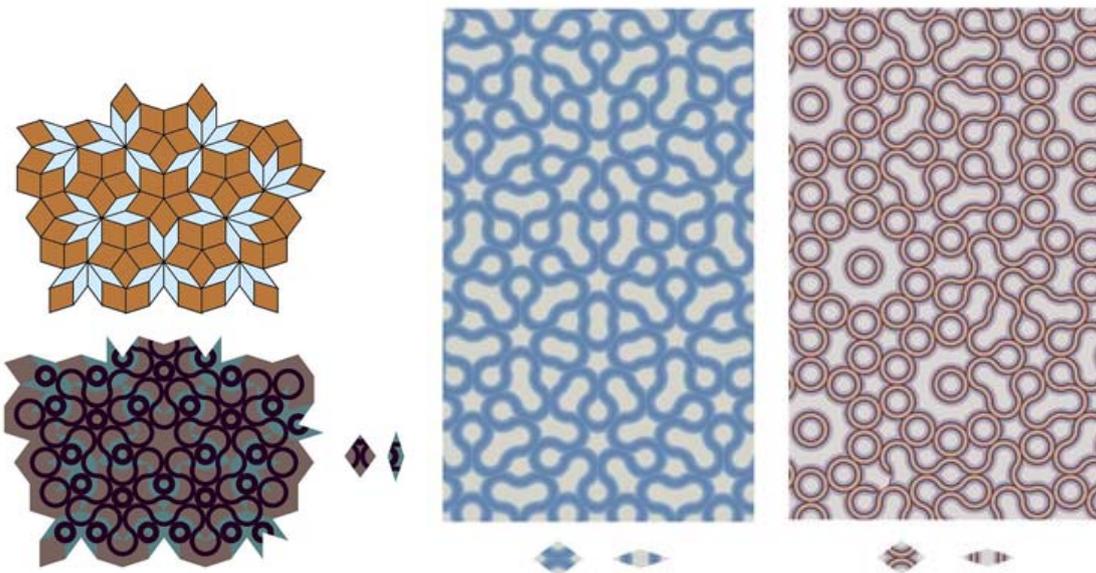


Fig 3 CNC milled 'guilloche', foam tests and final milled master 300x300x20mm approx.

Fig 4 Hand modelled plaster 'square spiral' and laser cut acrylic version, 250x100x15mm.



Fig. 5 One-off strapwork ceiling produced by Hayles & Howe



*Fig. 6 Basic Penrose 'rhombs' and illustration of how a decorative pattern is created through a particular arrangement of tiles.*

*Fig. 7 Two designs developed from Penrose tiles, one showing rotational symmetry and the other seemingly random.*



*Fig 8 CNC milling of metal profiles, spinning of plaster, construction of master models, moulded test units.*

*Fig 9. Range of configurations created with test units.*



*Fig 10 One completed Penrose design shown in final exhibition.*



*Fig. 11 Original font symbols, repeat design and design after Illustrator filter was applied.*

*Fig. 12 Milling of low relief surface developed from greyscale image.*



*Fig. 13 Completed plasterwork design, illustrated with one of Hayles & Howe's stock ceiling roses.*

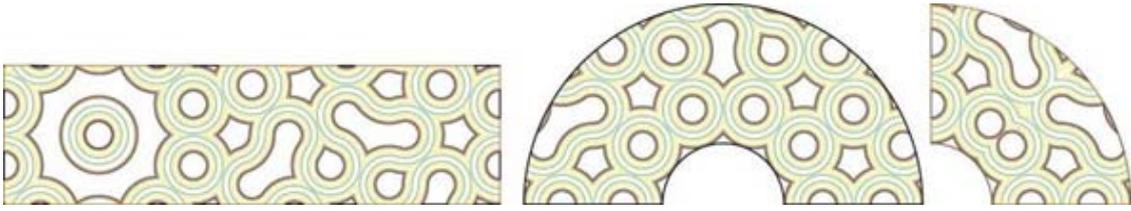


Fig.14 Three basic units which make up the stepped relief system, created in Illustrator.

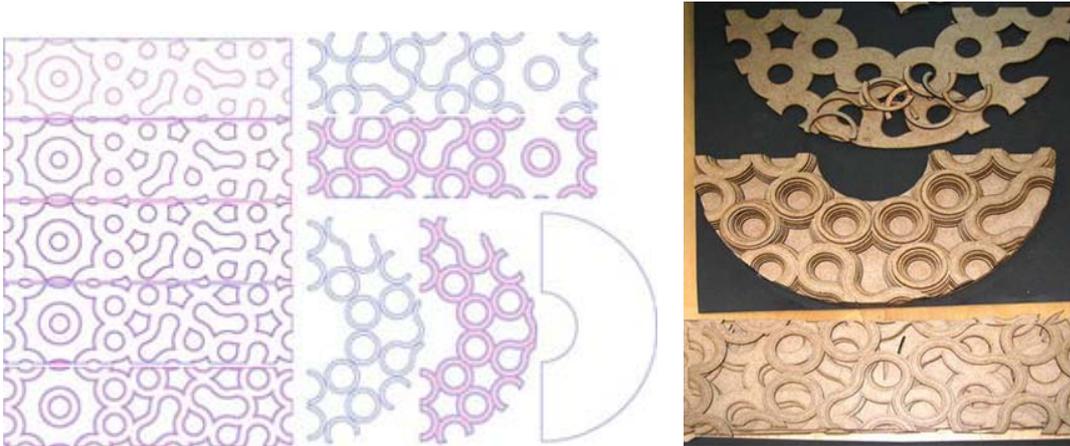


Fig. 15 Separated layers from the initial design.

Fig.16 Laser cut hardboard elements before final models were complete.

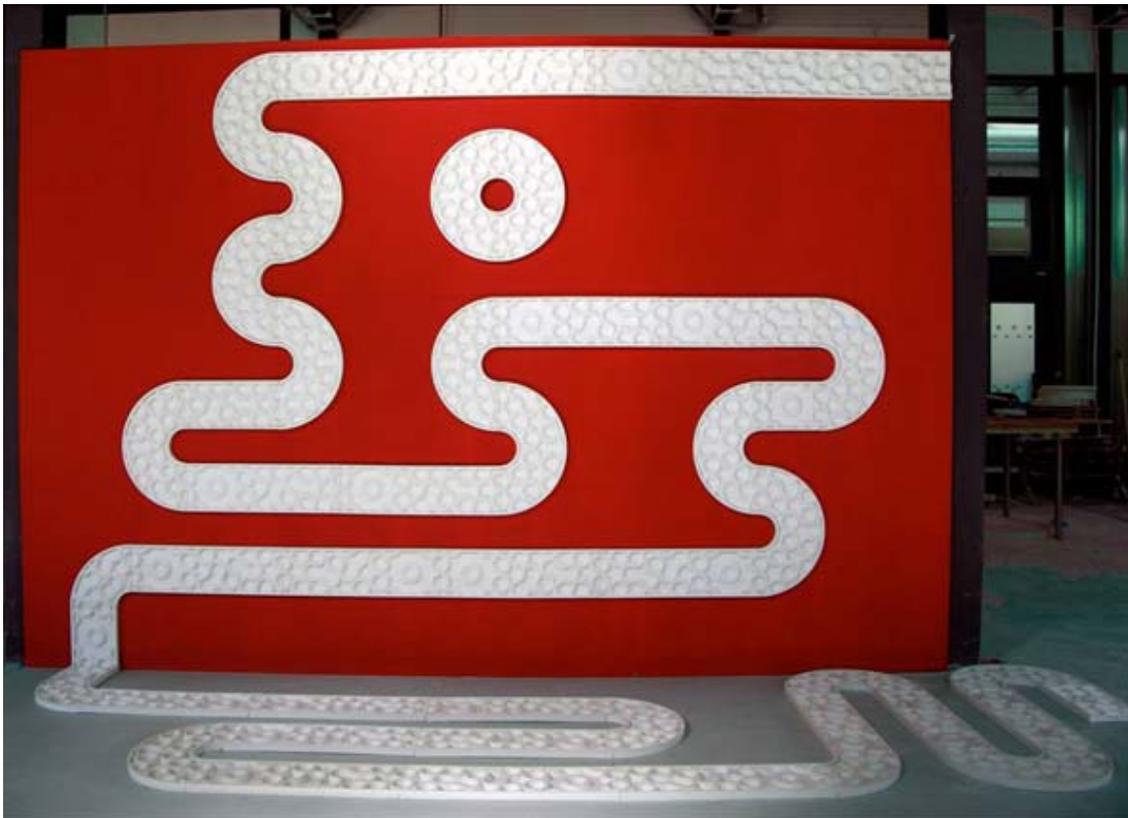
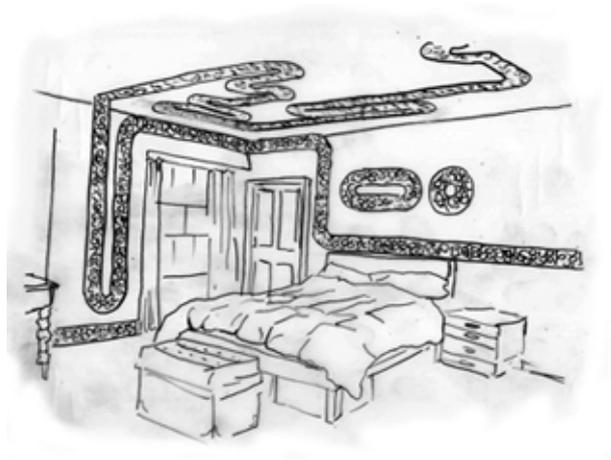


Fig.17 One possible configuration of the plasterwork units creating a meandering line.



*Fig.18 Detail of final relief units.*



*Fig. 19 Mock up of a potential installation of relief units.*

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<sup>i</sup> For further details of this company's products and services, see [www.haylesandhowe.com](http://www.haylesandhowe.com)

<sup>ii</sup> Both parties were working in the creative field aiming to produce work for the decorative interiors market.

<sup>iii</sup> An example of some contemporary plasterwork can be found at [www.kathydalwood.com](http://www.kathydalwood.com)

<sup>iv</sup> Adapted from NPD diagram available at: [http://en.wikipedia.org/wiki/New\\_product\\_development](http://en.wikipedia.org/wiki/New_product_development) (accessed 16/04/07)

<sup>v</sup> List of stages taken from [http://en.wikipedia.org/wiki/New\\_product\\_development](http://en.wikipedia.org/wiki/New_product_development) (accessed 16/04/07)