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DESIGN LITERACY, DISCOURSE AND COMMUNITIES OF PRACTICE

SHARON HELMER POGGENPOHL

Hong Kong Polytechnic University
Visible Language 42.3
Poggenpohl, 213–236

Rhode Island School of Design
Providence, Rhode Island 02903

ABSTRACT Presented primarily in the context of graduate education in design, this paper argues that apprentice-master pedagogical models of learning andthe development of exclusively tacit knowledge are inadequate resources for preparing the next generation of high level design practitioners or teachers. Today's design context requires more than formal aesthetic or technical skills—it requires the ability to operate critically in an ever-growing information environment, the global economy and within inter- and multi-disciplinary teams. While all three of the just mentioned facets are important, this paper focuses on the information environment through discussion of design literacy, discourse and communities of practice.

No graduate program can cover all of design, successful programs seek to differentiate themselves and they do so with their mission statement and philosophy. It is within this context that programs develop a particular literacy and discourse. This conversation is not only internal, it is increasingly an international conversation with like-minded individuals and programs—some call this a community of practice—and in design there are many such communities. Building a community of practice depends on faculty and student attention to issues and research of concern. How are perspectives and new knowledge shared? Do graduate students read as a way to contextualize and extend their work? Do faculty read in order to stay abreast of changing ideas in their area of interest, bringing relevant information to studio critique and seminar discussion? And if they read and write—what do they read and where are their writings published?

Designers are slow to embrace more scholarly information that requires reading and critical thinking; they are more inclined to viewing. Is this a problem? This paper addresses the following questions. What is design literacy and how does this relate to discourse and community building? How can an existing discourse within a program be identified and examined? How can a particular discourse be supported? Where can designers participate in sharing scholarly information? What peer-reviewed and other scholarly journals are available to assess the state of knowledge building in design. Why is this important? The paper concludes with the ways in which design education and practice is changing.

TACIT AND EXPLICIT KNOWLEDGE

A long tradition of learning by doing permeates design education.It is even possible that students who learn best through practical exercise are initially drawn to the design field. While this is an effective way to learn, it is only one of many ways and it is based on a context of design that is fairly stable. The most natural outcome of this approach is teaching based on a master-apprentice model. The master has exceptional skills that s/he attempts to pass on to the student through demonstration followed by the students' skill imitation with projects that are defined to bring the learning to fruition. Much undergraduate learning with regard to basic skills and visual sensibility are taught in this way through presentation of a model solution or tightly constrained criteria with limited development options. Trial and error and tacit exposure to skill development result in a gradual growth of sensibility. Another dimension of this form of learning is examination of trade magazines as they also provide master models of current

design trends in form making. Assessment of learning is often measured imitatively against what the master would do.

In *The Tacit Dimension*, Michael Polanyi (1966) discusses the basis of knowledge as encompassing aspects that are practical (tacit) and theoretical (explicit). His focus on practical, tacit knowledge reveals the basis of the master-apprentice model in learning. Many trades have been taught in the master-apprentice mode. Polanyi and others (Lave and Wenger, 1991) have given interesting and diverse cases of such learning. Tacit skills are learned through the doing of them, by repetition and fine tuning of performance. These skills resist being made explicit; they reveal an affinity for performance, a felt 'rightness' in execution that is context dependent with many interacting variables. Much undergraduate teaching depends on tacit knowledge. However, some things can be made explicit, i.e., they can be made plain through language, explanation, method, process or identification of recurring or related patterns. Yet even these explicit ideas must be brought into design action and performance. Knowing the theories or principles alone is insufficient; they must be adopted and adapted through performance. They become more abstract guides that assist performance. It is not that tacit elements disappear or are devalued; the context of design becomes more differentiated in that the ideas that can be made abstract and explicit are stated and the ones that rely on tacit sensibility, a kind of physical touch, remain so with both working together. This enhances the designer's performance. Moving from the tacit to what can be explicit is also an indication that a field is moving from its craft origins to a discipline.

Explicit description of design actions as principles, theories and methods sets the stage for another powerful learning strategy—transformation. Here the limitations of imitation are challenged with a complementary increase in creativity and control on the part of the designer, supporting a more open exploration of the design problem or its possible solutions. This is a more analytical and exploratory approach to design that uses analogies, metaphors, critical perspectives, alternative methods and representations to open issues and development with less constraint and more reflection on process. Development of the design in question is heightened, bringing students to reflective practice (Schön, 1983). This is an appropriate strategy in graduate education.

Many would argue that explicit, transformative learning has a place in much earlier education too. Early in the 20th century, John Dewey, a pragmatist and still controversial educational reformer in the United States, made a distinction between apprentice-based and laboratory-based learning (referenced in Shulman, 2004, pgs. 524-525). According to Dewey, apprentice-based learning looked backward to the demonstration and exercise of known 'best practices' that are particular in nature. Laboratory-based learning is transformative

and requires a critical and experimental approach to new practices and ideas; it looks forward to improvement in the well accepted and preferred mode of the research university. Despite the dichotomy set up here by the author or others that sets apprenticeship against transformative (laboratory-like) learning, both are essential and have a role in developing the next generation of designers.

Within tacit learning and its master-apprentice model, there are communities of practice; sometimes very strong communities that center on a particular master. Certain ideas may also form a center around which practitioners gather. Examples can be drawn from design history, the Bauhaus for example; or art history, Futurism or Fluxus for example; or contemporary design process with its user studies, interaction or experience design for example. In all these cases there are some core concepts or processes that give shape to the community and its concerns. Within explicit approaches to design, such communities of practice are even more evident as they tend to publish cases, theories and research in their attempt to develop knowledge and transform its practical extension into design performance.

Locating three key terms

A few terms and their interrelationships need to be sorted out for clarity. Design literacy underpins a discourse that becomes the focus for a community of practice. Design literacy refers to knowing the history, seminal writings and objects, practitioners and current controversies that establish continuity and change in design. This is less about knowing the fleeting fashion of design and more about understanding cultural shifts that push design to re-evaluate and re-think its position. Such literacy is behind the development of a discourse that is an ongoing—internal conversation within a faculty, but increasingly also an international conversation with like-minded individuals, programs and practices. It is this discourse that brings into being, defines and sustains a particular community of practice.

Design literacy depends on the publication and dissemination of ideas through writing, image documentation, museum exhibition, conference and seminar. It looks through time, from the past to the future in its concerns. It provides a panorama in which a particular discourse resides. The discourse relies on the same vehicles just mentioned, but it is a connected set of particular ideas in either media publication or artifact that supports a community of practice—and there are many such communities in design. Some elements of design literacy coalesce to form a linked discourse that is sustained and developed by a community of practice.

It is difficult, maybe impossible, to cover the breadth of design in general. Identifying a discourse of interest provides entry to a community that shares design performance values. The diversity among communities is interesting, there is design management,

design and emotion, design research, creativity, human-computer interaction, design science—to mention only a few. Together they reveal the multifaceted nature of design.

Identifying the existing discourse

A simple, if crude, way to see what is the current discourse in one's education program is to ask students what are the keywords they hear over and over from various faculty in different subjects. Their answers may be surprising. Of course they'll identify the ideosyncracies of some of the more dramatic faculty members, but they will also reveal the repetitions (even if the exact words or the emphasis shifts a bit) that highlight the conceptual threads that pull the program together. This simple exercise can deliver a broad understanding of what is essential in a program and it can reveal useful information about the focus of either undergraduate or graduate programs. It may also be useful to ask faculty for the keywords that identify their particular learning objectives and then see the comparison between student and faculty responses. A more rigorous approach would be to perform a network analysis (Scott, 1991) that delivers a more dimensional view of the themes, their overlaps and the people that interact around them. Such interpersonal networks can be examined based on the quality of reciprocity, intensity and durability in their relationships. People come together based on shared interests and ideas to form a community of practice.

Understanding changes in design practice

Reliance only on the tradition of a master-apprentice learning mode, with its implicit concreteness and stable learning environment, no longer functions very well. The context in which we live and work is more dynamic with unpredictable change, that sometimes occurs quickly on many fronts. For example, technological change continues to alter how we communicate and what we expect from information, environments and products. Business sometimes sees design as a value creation center that requires better overall planning and integration, while end users of products and services become subjects for observation and investigation, or even participants in the design process. These few examples demonstrate the fact that contemporary design work goes beyond form-making and aesthetic decisions to the earliest stages of developing a possibility, addressing a felt need for something that does not yet exist, that could be made better or that could form a core business idea. These ideas stimulate change in design education, the scope it needs to cover and how learning opportunities are delivered.

BUILDING AN EXPLICIT DISCOURSE IN GRADUATE EDUCATION

If we agree that the undergraduate years are best suited to developing tacit skills, particularly in their earliest years, then more explicit knowledge needs to be developed in later years, largely in graduate education. It is these later years that are the focus of this paper. In particular, graduate programs seek to differentiate themselves by developing a particular community of practice, based on ideas that are evolving and subject to research and refinement. No graduate program can cover all of design, it necessarily sets its focus to develop some ideas while it ignores or downplays others. The faculty has their own particular interests, but in a focused graduate program, they share a philosophical underpinning for their educational goals and overlap to some degree in their interests. This promotes development and cohesion in what is a poorly organized, emerging discipline. These shared ideas become a discourse that runs through a graduate experience and colors the work of the students and the expectations of those with whom they'll later work professionally. Some programs become known for their discourse. For example, Cranbrook was known for its post-modern discourse; the Rhode Island School of Design for its semiotic interest and application as well as its attention to process and materiality; the Institute of design, IIT for its interest in planning and the design/business symbiosis; Milan Polytechnic for its interest in sustainability—the list could go on. Today, graduate programs are turning to an interest in design research within professional as well as in research-oriented programs. But research possibilities are expansive in a poorly defined field such as design, so programs focus on a set of carefully defined research interests that match faculty interest and university capability. Program focus also depends on a philosophical position and faculty with shared, but not necessarily identical interests, who are actively engaged in building a discourse that supports a community of practice.

Building a community of practice depends on faculty and student attention to issues and research of concern. This goes beyond what someone does in design practice, to how they think about and express ideas, making them explicit, connecting them to the work of others. The result may be a new perspective, a more complete synthesis of existing work, or new knowledge—all of these outcomes need to be shared. Presumably the faculty in a graduate program is reading to stay abreast of changing ideas in their area of interest; writing and publishing papers on their work as they need to bring new knowledge to studio critique and seminar discussion. Here the graduate faculty diverges from the undergraduate faculty; rather than be design practitioners who demonstrate tacit knowledge and its application in practical performance, they need to be design scholars who are focused on extending the limits of design thinking and performance

in their area of concern.

In 2002, some doctoral students and I decided to try to find out what design faculty members and doctoral students were reading in order to understand the importance of certain ideas and see how widespread their influence was. A broad list of books was posted online with an invitation to a PhD listserv to participate. People were asked to indicate whether they read a particular book, were aware of it or its author, and to add any notable books they thought were missing from the list. The results from this survey were discouraging—it appeared that the respondents read little.

Because of this we were forced to take another approach by contacting known design scholars who read and to ask them to add to our list and annotate selections. The participants in this were an informal community of practice who shared attitudes and perspectives on design scholarship. The outcome of this was a special issue of the journal *Visible Language* titled An Annotated Design Research Bibliography: by and for the design community (Chayutsahakij et al, 2002). Edited by doctoral students, it contained 90 books "…selected through two analytical approaches: the essentialness of the book determined through a design community on-line ranking survey and the discipline distribution through keyword analysis (Chayutsahakij, p.109). Besides an overview of process, there were three sections that listed the annotated entries: philosophy and theory of design, principles and methods of design research, and discourse between design theory and practice.

While the first study was based on books, the most recent investigation, presented here, is concerned with journals. If design faculty read and write, what might they read and where can their writing be published?

The process to identify a range of design journals was based on the author's attention to and experience with such journals over several decades. An online search using the keywords 'design journal' was undertaken in April 2007. Other online lists of journals from university sources and individual compilers were also consulted (see Designophy, Media Lab, Usernomics in the References). The twenty-nine journals represented in Table 1 demonstrate a range of scholarly interest in Design. Their data, with very few exceptions, covered the categories the author sought to present: journal title, ISSN number, URL, statement of focus (greatly abbreviated) and start date. No claim is made that this list is exhaustive or complete, however the twenty-nine representative journals offer a window on developing research and scholarship in Design. For example, if the start dates for these journals are examined by decade from the 1960s to the present, one notices the following: only 2 journals began in the late 1960s, 1 journal in the late 1970s, 3 journals in the 1980s, 11 journals in the 1990s, and 12 journals so far in the first decade of the twenty-

first century. The trend clearly demonstrates increased optimism regarding the need for and availability of more in depth scholarship in Design—more explicit information to guide design performance as a transformative practice. Another way to understand this is through the average start date spanning forty years with 1967 (the earliest journal) and 2007 (the latest); the average date is 1995, demonstrating how young this effort is.

Journals begin and sometimes disappear in a few years for a number of reasons; they are: unable to find their audience (either authors, readers or both), unable to sustain themselves financially or unable to generally define their mission and capture interest. Not all the new journals will survive despite the best effort of those involved. University libraries largely supply access to these journals and their use is often monitored as universities seek to contain their operating costs. It is doubtful that any of the journals listed make a profit. They exist as a social good to extend scholarship and are sustained by a community of practice. Two journals on the original list (*see Table 1* later discussed) were folded into other journals, largely disappearing no doubt for financial reasons. One, *Information Design Journal*, with a heritage from 1979 and respected by many, became part of *Document Design* when it moved to a new publisher. This demonstrates the fragility of such publications.

BUILDING COMMUNITIES OF PRACTICE

Design is a vital collection of ideas not all of which are compatible. Not only the broad ideas, but their fittingness to a region or locale are important. Which ideas fit the specific faculty, students, institution and professional practice? Identification of core ideas and competencies need not be monolithic or dogmatic, but they need to fit their environment and be shared. Some ideas lean toward social action with an emphasis on respect for people and their cultural forms; some lean toward science with an emphasis on logic, problem and solution, or evaluation; and some lean toward art and aesthetics. The philosophical bases for each of these is different and the values present in their performance lead to different kinds of assessment. One set of ideas is not superior to another—they are simply different. Design has no singular story; it has many stories and perspectives. As argued, these perspectives become a focus for a community of practice and this is particularly important in graduate programs. How does this work?

Literacy is a very broad concept that encompasses everything design might care about. Within this overarching literacy are specific kinds of discourse that might be big and well developed or small and at an early stage of development. The various forms of discourse

JOURNAL TITLE	ISSN	URL	FOCUS	START
Art, Design and Communication in Higher Education	1472 2273X	*http://www.ovid.com*	Interest in research in arts and media based subjects in educational institutions; fine art practice-based education, theoretical studies of media, cultural studies, art, design history	2003
Artifact*	1749 3463 1749 3471	*http://www.tandf.no/artifact*	Explores relevant topical themes for design researchers, practising designers, manufacturers to promote transdisciplinary connections	2006
Asia Design Journal	1738 3838	*Unknown*	Promotes design's ethical responsibility toward human life and society as well as a vision for the future environment	2004
Co-Design*	1571 0882 1745 3755	*http://www.tandf.co.uk/journals*	Reports new research and scholarship in principles, procedures and techniques relevant to collaboration in design	2005
Computer-Aided Design*	0010 4485	*http://www.elsevier.com*	Presents research and development in the application of computers to the design process	1969
Design Issues	0747 9360	*http://www.mitpressjournals.org*	Presents design history, theory, and criticism	1984
The Design Journal*	1460 6965	*http://www.ashgate.com*	Covers design practice, theory, management and education; encourages discussion between practice and theory	1998
Design Management Review (formerly Design Management Journal)	Unknown	*http://www.dmi.org*	Explores articles and case studies on design (products, communication, environments) as an essential resource contributing to long-term success and profit	1990

Design Research Quarterly*	1752 8445	*http://www.drsq.org/Issues*	Focuses on knowledge and its production in the design fields	2006
Design Philosophy Papers	Unknown	*http://www.desphilosophy.com*	Explores aspects of design as an object of philosophical inquiry in its relation between beings/worlds as they shape each other	2003
Design Studies*	0142 694X	*http://www.elsevier.com*	Provides an interdisciplinary forum for development and discussion of design activity and experience fundamentals	1980
Document Design	1388 8951 1569 9722	*http://www.benjamins.nl*	Covers communication studies, electronic/multimedia products, linguistics, and psychology	1999
Ergonomics in Design (formerly Human Factors)	1064 8046	*http://www.hfes.org/publications*	Reports on usability of products, systems, environments	1998
International Journal of Art & Design Education*	Unknown	*http://www.blackwellpublishing.com*	Disseminates ideas, research, case studies with attention to social and cultural values that inform education	1997

Note:
** designates peer reviewed*
First ISSN is print, second ISSN is electronic version

Table 1-1 A sample of current design journals

JOURNAL TITLE	ISSN	URL	FOCUS	START
International Journal of Design*	1991 3761 1994 036X	*http://ijdesign.org*	All fields of design research; industrial, visual communication, interface, animation, games, architecture, and related fields	2007
International Journal of Design Computing*	1329 7147	*http://www.intute.ac.uk*	Supports research and technology transfer in design computing through publication of interaction and multimedia	1997
Journal of Computer-Aided Environmental Design and Education	Unknown	*http://scholar.lib.vt.edu/ejournals/JCAEDE*	Research and teaching in CAD, computer-enhanced instruction and digital technology in design	1995
Journal of Decorative and Propaganda Arts	0888 7314	*http://www.jstor.org*	Fosters new scholarship for the period 1875 to 1945 in decorative and propaganda arts	1986
Journal of Design History	0952 4649 1741 7279	*http://jdh.oxfordjournals.org/*	Covers design history (including crafts and applied arts) and studies of visual and material culture	1988
Journal of Design Research*	1748 3050 1569 1551	*http://inderscience.com/jdr/*	Interdisciplinary, emphasizes human aspects as central issue of design through integrative studies of social sciences and design disciplines	2001
Journal of Visual Culture*	1470 4129 1741 2994	*http://vcu.sagepub.com*	Promotes research, schoalrship, and critical engagement with all forms of visual culture	2002
Journal of Sustainable Product Design*	1367 6679	*http://www.cfsd.org.uk/journal/*	Covers economic, environmental, ethical, and social issues in product design and development	1997

			in product design and development
New Media & Society	1461 4448 1461 7315	*http://www.sagepub.com/journals*	Draws on interdisciplinary theoretical and empirical research to discuss new media developments	1999
Planning Theory & Practice	1464 9357 1470 000X	*http://www.tandf.co.uk/journals*	Presents research, review, and analysis regarding spatial planning and public policy	2000
Point Art and Design Research Journal	1360 3477	*http://www.point.ac.uk/index.htm*	Offers a context for the presentation and discussion of research in art and design	1999
Research Issues in Art Design and Media	1474 2365	*http://www.biad.uce.ac.uk/research/rti/riadm*	Reflects on research process, particular methods or techniques, new and emerging themes and topics.	2000
Scandinavian Journal of Design History	0906 3447	*http://www.designhistory.dk/index.asp*	Supports articles on arts and crafts, decorative arts, industrial design, graphic art, interiors, etc.	1991
Visible Language* (formerly Journal of Typographic Research)	0022 2224	*http://trex.id.iit.edu/visiblelanguage*	Presents interdisciplinary research and scholarship on typography and visual language in digital media and beyond	1967
Working Papers in Art & Design	1466 4917	*http://www.herts.ac.uk*	Supports practice-based research in art and design	2000

Note:
** designates peer reviewed*
First ISSN is print, second ISSN is electronic version

Table 1-2 A sample of current design journals

might be isolated from others, design as art for example; or related to others, user studies and participatory design for example; or overlap another, sustainability and ecological design for example.

A community of practice that provides energy and ideas sustains a discourse. It encompasses programs, faculties and students that represent the teaching and learning of the discourse; practitioners who represent the practical performance of the discourse and who may be former students or current faculty. Faculty and practitioners can both do research that investigates the development and performance of the discourse, sharing their results and critical ideas with others through journal articles that help establish and expand literacy within the discourse, thereby coming full circle.

Why is design discourse and community building important now? As mentioned nearly a decade ago at the First Doctoral Education in Design Conference (Poggenpohl, 1998, p.104), "Not surprisingly, design [information] is invisible, dispersed within other classifications." Our literature and discourse are scattered; we publish opportunistically in ACM (American Computing Machinery) or IEEE (Institute of Electrical and Electronics Engineers) publications or other journals that are respected, but not quite directly in our field. In this way we add to knowledge broadly, but not necessarily in our own field as the information is hidden and not attributed to design in any direct way. The design journals with longer history cited in Table 1 are interdisciplinary—covering many design sub-disciplines and even disciplines somewhat aligned but tangential to design. When scholarly design information or research is not actively or broadly sought after by students, faculty or practitioners, a broad publishing agenda is a survival strategy. This is where building discourse and communities of practice with their underpinning literature intersect. It is such communities of practice that will create a mature design discipline and support more focused journals.

In October of 2007, the university where I teach (Hong Kong Polytechnic) requested all schools to submit a list of important high quality journals that support the various subject areas and discourse present in research and taught programs (table 1 is the author's list not the more extensive list prepared for the university). Identification of these journals and the grading of them according to their quality support the formal research assessment exercise that determines allocation of research money and support for research students. The sciences, engineering and social sciences can easily prepare such a list based on well developed and easily accessible citation indices. This is more problematic for design as it has no citation index; design lacks much of the typical infrastructure that other disciplines take for granted. While design has been something of an outlier on university campuses, this request for a journal list is a clear indication that some universities are trying to bring design into a tighter and more

accountable relationship with the university and that design's agenda must go beyond teaching to research and the development of new knowledge in design.

11	AUSTRALIA	1	HONG KONG	4	PORTUGAL
1	BELGIUM	3	INDIA	1	SINGAPORE
1	BRAZIL	2	ITALY	4	SWEDEN
2	CANADA	1	JAPAN	3	TAIWAN
3	DENMARK	1	MEXICO	6	TURKEY
2	FINLAND	2	NETHERLANDS	29	UNITED KINGDOM
5	GERMANY	3	NEW ZEALAND	11	UNITED STATES
		2	NORWAY		

Table 2 Distribution of PhD design programs wordlwide

Both design practice and education are changing. A look at the growth of PhD programs indicates that design research is now more present within universities worldwide. Table 2 is taken from a recent PhD listserv (see Melles, 2007). Here are ninety-eight programs across the world and more in the planning stages. You may be surprised to see emerging nations such as Brazil, India, Mexico and Turkey on the list. From an economic perspective, many emerging countries understand the connection between design and economic development. To this we can add the pressure from universities that encourage design programs to engage in knowledge building and to conform to the university mission to openly create and disseminate new knowledge, such as previously mentioned at Hong Kong Polytechnic University. In this way design is invited to take its place among other more established disciplines that balance professional preparation with knowledge generation. Design practice itself is becoming ever more multidisciplinary due to technological developments and the need for human-centered advocates with broad skills in synthesis. Crossing disciplinary boundaries requires explicit knowledge regarding what is known, how it is known, what constitutes evidence for what is stated and how other disciplines can accept or refute such information. Designers need an epistemological understanding of their own field and those of others with significantly different bases of knowledge in order to effectively interact and collaborate on multidisciplinary teams. As argued, this goes beyond tacit knowledge

but does not negate it.

Changes in design practice and education challenge the status quo and call for both explicit and tacit knowledge. The following six principles, taken from Lee Shulman, president of The Carnegie Foundation for the Advancement of Teaching, identifies "authentic and enduring learning" (2004, pp. 493-494, author italic additions):

The subject matter to be learned is generative, essential and pivotal to the discipline or inter-discipline under study, and can yield new understandings and/or serve as the basis for *future learning* of content, processes and dispositions.

*

The learner is an *active agent* in the process, not passive, an audience, a client or a collector. Learning becomes more active through *experimentation and inquiry*, as well as through *writing, dialogue and questioning*.

*

The learner not only behaves and thinks, but can '*go meta*'—that is, can reflectively turn around on his/her own thought and action and analyze how and why their thinking achieved certain ends or failed to achieve others….

*

There is *collaboration* among learners. They can work together in ways that scaffold and support each other's learning, and in ways that supplement each other's knowledge….

*

Teachers and students share a *passion* for the material, are emotionally committed to the ideas, processes and activities and see the work as connected to present and future goals.

*

The process of activity, reflection and collaboration are supported, legitimated and nurtured within a *community* or culture that values such experiences and creates many opportunities for them to occur and be accomplished with success and pleasure….

*

These more general principles for learning support the argument offered here that learning prepares one for the future and its uncertainties through experimentation and inquiry born of explicit learning that may be sharable through critical writing, visual reflection and the development of a literature. The active teacher or student can reflectively analyze (meta-cognize) their performance as a way to learn. Social learning, both formally and informally in a community of practice, support collaboration and pursues design knowledge and performance with passion. Graduate programs in design need to stake out their territories for development through building a particular literacy, discourse and community of practice.

The implication for this argument in favor of design literacy, discourse and communities of practice goes even further. For example, languages that are used only orally, that lack a writing system, are likely to disappear. Robust languages have not only a writing system, but also typographic development and extensive creative use. They continue to change and develop—they live. Likewise, design's limited explication of itself is cause for concern. It's infrastructural shortcomings put it at risk as other disciplines discover its methods of thinking and development and perhaps presume to poach on its intellectual and creative territory. Design learning and performance encompass border-crossing activities—between tacit and explicit, logic and intuition, artfulness and science, technology and human behavior, business and the social good. As such it is hard to pin down and this has prevented an easy or clear classification or reference. We have a serious stake in developing design literacy, discourse and communities of practice now.

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AUTHOR NOTE

Sharon Helmer Poggenpohl has taught design in the United States and Hong Kong for over twenty-five years with twenty or more years devoted to graduate and doctoral education. She has been the editor and publisher of *Visible Language* for over twenty years. She is now concentrating on writing and reflecting on Design and has recently contributed a chapter to *The Designer, half a century of change in image, training, and techniques* (Intellect Books, 2008) and has co-edited with Keiichi Sato a book titled *Design Integrations, Research and Collaboration* (Intellect Books, in press).

PALIMPSEST: THE FUTURE OF THE PAST

JANIE CHUN NEI POON

Hong Kong Polytechnic University
Visible Language 42.3
Poon, 237–264

ABSTRACT Palimpsest is a manuscript or parchment that has been reused by writing over the original writing, sometimes more than once. Scarcity has driven this practice of reuse. Here it is expanded into an appreciation of a representation that reveals past and present as the core for the study of heritage preservation by design. This paper seeks to propose a framework that applies tradition and modernity with the aim to preserve heritage and acquire modernity simultaneously. It begins by evaluating the meaning of heritage and its value, followed by introducing 'palimpsest' as a design concept framework for future design practice. In this study, 'palimpsest' examples from different fields are examined. Relationships between heritage, design value, culture and identity are identified with the intention to enrich the quality of design as a complete perspective on which to build future heritage. This study concludes with a concept framework that presents patterns that demonstrate practical ways in which heritage preservation can complement and support contemporary life.

We usually like to keep the present in the present tense, only note that today, but it was not today, but yesterday that things get changed.

Gore Vidal, ***Palimpsest, A Memoir***

It's the notion, for instance, behind a persistent argument in Berlin, where architects, city planners and citizens periodically squabble over how much of the footprint of the Berlin Wall should be remembered along the streets of the quickly redeveloping united city.

Richard Lacayo, ***Walk on the wild side***

Fostered by political change and economic advancement in the process of modernization, the world undergoes inevitable change. The rapid modernization of the world extracts a price—that of loosing linkage with past history. Issues from the emotional debate on preservation of the remains of the Berlin Wall to the recent (2006) demolition of Clock Tower at Star Ferry Pier[1] in Hong Kong despite the public's strong protest, caught the attention of the world. These issues reflect not merely the conflict between development and conservation, but demonstrate a more assertive approach to preserving symbols of our roots. The threat of loosing the history of self, society and the future generation must be envisaged. Preserving heritage, however, is not merely about historical architecture; aspects of mankind personally, socially and culturally also have to be considered.

This report is an attempt to highlight the heritage value for mankind and to examine the relationship between heritage and design value—to expand awareness of heritage preservation in design practice. It focuses on investigating the concept of 'palimpsest' through examples in our daily life, with an intention to allow new design opportunities to emerge.

Figure 1 The last day before demolition of Clock Tower in Star Ferry Pier, Hong Kong
http://www.interlocals.net/?c=noce/602

WHAT IS HERITAGE?

The word 'heritage' is naturally associated with 'antique,' 'traditional,' 'old' and 'outdated.' Actually, what is heritage? The United Nations Educational, Scientific and Cultural Organization (UNESCO) defines heritage as follows. "Heritage is our legacy from the past, what we live

with today, and what we pass on to future generations. Our cultural and natural heritage is both irreplaceable sources of life and inspiration."[2]

Cultural heritage is the numerous events, significant moments, sequences of life, childhood and old age, work and travel, love and war, chains of thoughts and images, together with accumulated experience and imagination, both tangible and intangible. Significant cultural heritage evokes special meaning and reflects particular customs and beliefs for us as individuals or members of a community. Natural heritage is also an important part of a culture; encompassing the countryside and natural environment, which serves as an important component in a country's tourist industry. Industrial heritage is the monuments from that culture and also the manifestation of technologies of the time. Cultural, natural and industrial heritage are vital sources in archeological discoveries of people, natural world and technology. They heighten our sensitivity to the indigenous natural environment and to the impact of human activity as they provide perspectives on life.

Heritage and time

Time is a fundamental measuring tool in the study of the past. It has a directional trail where the past lies behind and the future lies ahead. Past events ordered in chronological sequence shape the world and our life. Time also quantifies duration and compares the motions of objects in the world. 'Time flies,' 'a moment,' 'timeless,' 'timely' and 'time out' are different ways to measure and control time. Archeologists trace time (history) and judge the value of relics according to their age. By year or era, modern and old fashioned are placed within its time frame.

The concept of time is also related with advancement of technology, for example, when television or Internet created new opportunities with which to use time in different ways. The quest for new technology, for real time accessibility and in different spaces, result in constant 'upgrades' and thus an early 'fade out' of artifacts. Questions come to mind about whether these 'faded out' versions of artifacts and/or technology would be considered heritage in the future.

Old people usually look to the past, live in the past—here past incidents, events and environments make up a feel good sentiment. Each generation may look back to a younger age (like 20 years ago) with good sentiment.

> *...the way people respond aesthetically to objects will be determined by the categories they already have developed for understanding such objects—after all, this is how perceptual cognition operates. In addition, the extent to which a stimulus is typical—or prototypical—of the category accessed determines affect, whereby people will find more pleasure*

Figure 2 The famous Nail House in Chong Qing, China
http://time-blog.com/china_blog/2007/03/nail_house.html?xid=rss-china

> *in objects that fit well into their predetermined categories… Furthermore, the more typical—or prototypical—an individual chair is of the cognitive category 'chair,' the higher the evaluation of it.*[3]

We like what we know; people tend to like things that conform to their expectations where they find familiarity and pleasure. Different generations attach to times in which they have valuable life memories.

Heritage and value

While time is a significant factor to verify heritage, it is only one criterion. Rarity and significant memories are also key aspects in considering value. Rarity accounts for uniqueness, unusual quality and sustainability related to personal experience regarding certain artifacts, people or events. Significant memories generate familiarity with artifacts and places with which one identifies and acknowledges as carrying individual identity.

The famous Nail House[4] in Southwest China Chong Qing municipality is an example that displays heritage value in relation to individuals (*see figure 2*). In the three-year battle with a real estate

developer, the owner refused to move out and continued to live in the lonely house (the only house remaining in a 10-meter pit where surrounding old houses were demolished for a building site). Power and water supplies were cut off. This reflects the value of the place (that had been targeted for demolition and is now gone) to the owner; it was so strong that he stood up for his rights and wouldn't let it be pulled down. The physical value of the 'nail house,' however, may be doubted by many as it was so commonly and easily found in China. But to the owner, its meaning and value grew from the environment. Meaning and value relate to memories. Every past incident has a relation to artifacts and places that trigger memories and manifest the person himself; thus, this personal specific heritage leads a person to an inherent attachment to a place.

In the old days, people would leave objects with a pawnbroker in exchange for money; they wanted the object back when they returned the money within a certain time period. The object to the person was not only market value, but also a personal value that they did not want to sell or loose. Heritage is not only about personal value as in the Nail House, but is also about collective value as in the Clock Tower or Berlin Wall.

Is the Clock Tower heritage or an obsolete structure? What is so sacrosanct about it? What is the price of loosing heritage? An old clock is 'priceless' to the economic world—what would it cost to rebuild? How can one take account of its sentimental value? It is a quality that flows from the city's historical legacy including various cultural forms, ways of living, core values and institutional expression. It underscores the reason for the Hong Kong Special Administrative Region—two systems, one country principle. People rightly see buildings as part of the history and culture of the place they call home.

After the Chinese Cultural Revolution, China's historical reserves, artifacts and sites of interest suffered devastating damage as they were thought to be at the root of 'old ways of thinking.' Many artifacts were seized from private homes and destroyed on the spot. Much of China's thousands of years of history were in effect destroyed during the ten years of the Cultural Revolution; such destruction of historical artifacts is unmatched at any time or place in human history. In contrast, Taiwan, which did not undergo the Cultural Revolution still maintains traditional Chinese artifacts which are a traceable source of inspiration (cultural value) for the next generation.

From a commercial viewpoint, traditional arts and crafts are branded as heritage. Some are in antique stores and some are thoughtlessly reproduced turning heritage into tourist attraction. Are they preserving heritage or is it just a business game? Many seem to be just products of mass production with no soul. And what does this mean for our future world? What are we going to leave to our children? Will it be history of the past or a history of duplication?

Heritage and identity

Uday Athavankar observed:

> *If we agree that products speak their language through form, then we must allow them to speak in their own mother tongue, and also permit local dialects to be established… Only then can we evolve expressions of modernity and its local dialects that would make the current as well as the future generations feel a sense of belongingness and pride in local objects.*[5]

Under the process of globalization, the world is unified with similarities between people, cultures and nations. Mass production resulted in losing identity between the product and self. Cutthroat competition drives industries to innovate. It is likely that the desire to do something new (or innovate) simply to escape the old, is common. In this situation, people need to be reassured and grounded in order to move forward into a fast-paced and seemingly uncertain future. The practice of design might contribute to a critical aspect of establishing a sustainable condition with consideration for history, tradition and identity.

PALIMPSEST

A 'palimpsest,' from the Greek word *palimpsestos*, meaning 'scraped again,' is a manuscript written on parchment that has another text written over it, leaving two (or more) layers of visible writing. Palimpsests were common in antiquity because parchment was scarce and costly. Manuscripts were recycled and reused, their original content rubbed away and overwritten.

Palimpsest is common in architecture. It is interpreted as ghost architecture, an image of what once was. In spaces that are once shuffled, rebuilt or remodeled, shadows remain. Tarred rooflines, marks from removed stairs, paint marks, dust lines remain to demonstrate the palimpsest of shadows. These traces unfold the realities of the built past.

An extended meaning of 'palimpsest' is described as 'an object, place or area that reflects its history,' 'something having diverse layers or aspects apparent beneath the surface' or 'engraved on what was originally the back side' and 'interactions or reinforcement of a design idea over time. Therefore, 'palimpsest' is not only a fabric of accumulated evidence of the past, but also a way to justify existence and provide the linkage between past and present.

The concept of palimpsest expands into an appreciation of the past and present and is core for the study of heritage preservation in design

practice. In addition, investigating the relationships between heritage, design value, culture and identity will enrich the quality of design as a complete perspective with which to build future heritage. By re-conceptualizing and reconstructing the past and present, old and new, traditional and contemporary, 'palimpsest' demonstrates its role as a shaper of history and a maker of culture.

On architecture

Architecture is always a physical manifestation of a culture; it records cultural transformation and makes visible shifting social dynamics. Palimpsest examples are common in architecture, forming the cultural landscape that appears in different presentation. With the high speed of change, our way of looking at history and the world around us is transforming. New pictures of traditional culture are mixing with contemporary ideology. Residual zones of nature or mankind, of the old and the archaic still exist; here culture interacts with man-made nature and works to transform the world. The following examples demonstrate context transformation.

Landshaftspark Duisberg-Nord, Germany[6]

Cultural heritage is maintained in a landscape park in Germany, where a coal and steel production plant, abandoned in 1985 is transformed into a public park for enjoyment (figure 3). The concrete bunker creates a space for gardens, old gas tanks become pools for scuba divers and concrete walls are used for rock climbing. Each of these spaces allow for a specific reading of time. The integration of old industry with green vegetation not only preserves the remains of the old installations as valuable (industrial) heritage, but also sets the stage for recalling from older generations the story of their time working in the plant and bringing that story to the new generation. This contradictory idea of integration changed the context of the park, added to the park's overall effect and defined a culture of time.

Gas Work Park, Seattle[7]

Situated on the site of the former Seattle Gas Light Company gasification plant that operated from 1906 to 1956, the 50 years of history converting coal into methane gas to provide heat and light throughout the Seattle area is revealed. What remains now are the pieces of equipment used in the process, incorporated into numerous recreational facilities constructed around the equipment. Some stand as ruins, while others have been reconditioned, painted and incorporated into a children's 'play barn' structure. The transformation of the

Figure 3 Landschaftpark, Duisburg-Nord, Germany.
http://kap-man.de/a70-41185a/jpg
Retrieved March 15, 2007.

Figure 4 (next page) Highline in New York
http://www.preservenys.org/seven2001/High%20Line202.jpg
Retrieved March 15, 2007

old industrial manufacturing site to an urban recreational retreat reflects the transformation of human life and value from technologically driven to a more natural, humanized state.

High Line, New York[8]

High Line is the city's plan for the first elevated park, a green space stretching a mile and a-half along an abandoned railroad viaduct 30 feet above the streets of Chelsea. The idea of preserving the old railroad and establishing unique open spaces triggered the idea that technology can be put to surprising and/or ecological use. The ideal picture of walking in the city with no contact with vehicles heightened a desire to stretch urban perspectives and environment (figure 4).

Discovery in Guangzhou, China

The natural quest of discovery in human history was demonstrated in Beijing Road in Guangzhou, China in 2002. While excavating, layers of an astonishing ancient street, evidence of a past dynasty, were discovered (figures 5 and 6). Within the 10 layers of the old field (7.9 meters from ground level) a textual difference reflects the history of over 1500 years and reminds every inhabitant and visitor of the city they inherited. It was amazing to discover that the area round Guangzhou was located at the hub of the Tang Dynasty (618-907 A.D.) to the Republic of China period (1912-1949 A.D.). Brought forth by rapid development, today's urban Guangzhou is modern, crowded with shopping malls and restaurants. This leads us to think back to the old life style in the Tang Dynasty as well as consider how this area might look in the future. Nevertheless, archeology uncovers the life of a distant past and allows people to gaze at a superposition like a door into the past and present shown simultaneously.

Contradiction and discontinuity mark the following examples.

A contemporary building in Guangzhou, China

The contemporary interpretation of traditional building in Guangzhou along Guan Yuan Qian Station is obviously developed to attract tourists (figure 7). This intervention of contemporary design into a historical framework produces an architectural layering that reveals a dialogue between diverse moments of culture and creates a temporal narrative of time that allows the architecture to actively participate in contemporary society.

Figure 5 (top) Discovery in Beijing Road in Guangzhou, China Photo: Janie Poon, 2007, unpublished

Figure 6 (bottom) Discovery in Beijing Road in Guangzhou, China Photo: Janie Poon, 2007, unpublished


楼遗址


Coca-Cola


中意人寿


同昌大街
同昌大街
同昌大街

Figure 7 (top) Contemporary building in Guangzhou, China Photo: Janie Poon, 2007, unpublished

Figure 8 (bottom) Stone columns in Stanley Market, Hong Kong Photo: Janie Poon, 2007, unpublished

Stone columns along the pathway in Stanley Market, Hong Kong

Stone columns are remnants from the redevelopment of Shanghai Street in Yau Ma Tai, Hong Kong, and are one of the government's efforts to preserve architecture from the wartime (figure 8). They are integrated with the new structure of high tech steel to form a contemporary pathway. These stone columns with faded Chinese characters, write the name of an old pawnbroker and were once under the balcony of an old building. They remind the local people of the time when pawnbroker businesses flourished.

On technology and communication

Palimpsest, an overwritten parchment, was an early technological mode of communication and resource saving.

Development of iPod

While mobility is vital in modern life, iPod portable media player with its handy size and its simple application is popular. iPod maintained its unique style ever since its first generation was launched in 2001 continuing to its 5th generation in 2005. The design is basically a round central click wheel with a screen at the top. Each new generation of this product contains some elements of the previous generation, but changes some little things in each upgrade. The first model is a mechanical scroll wheel, followed by a touch sensitive wheel in the second model, touch sensitive buttons in the third model, button integrated into a click wheel, color display with photo viewer in the fourth model and slimmer design, large screen with video and lyric support in the fifth. iPod is a unique personalized entertainment tool. The layers of iPod development marked a kind of 'palimpsest' of different generations with advancement in technology and function.

Open software

This is another example of 'palimpsest.' Open source software refers to any computer software whose source code is available under a license (or arrangement such as the public domain) that permits users to study, change and improve the code. This software is not copyrighted, consequently, it encourages the public to contribute to its development. An example of open software is the UNIX operating system. In contrast, Windows is an example of a closed operating system—one that cannot be overwritten.

Wikipedia

Wikipedia, the encyclopedia website, is similar to open software in the fact that material can be sourced from user contributed materials and it allows users to change and improve the existing content. Such overwriting of a previous content is a direct example of 'palimpsest.'

On culture & media

The following examples focus on integration and simulation.

Film is a usual medium for 'palimpsest'

Film reconstructs and illuminates the very processes by which history on film is made, dismantled and remade to tell a story where the past is portrayed as well as the present. Many science fiction films that involve time travel use this. One classic example is the film "Planet of the Apes," where at the end of the film the astronaut discovers the Statue of Liberty buried in the beach, revealing to him that he's back on earth and that humankind has fallen to the apes. Another display of 'palimpsest' in film is set design. Like architecture, it reflects the past within the future. Film makes use of this, such as "12 Monkeys," "Blade Runner" or "Matrix." Old children's films and television programs are being reinvented for a new generation, creating new characters for the children and a sense of nostalgia for their parents. "Doctor Who," a cult UK science-fiction television series begun in 1963, is an example. The latest series combined special effects and storylines that appeal to younger viewers with just the right amount of nostalgia and humor for their parents. Finally, sometimes filmmakers today deliberately give their film an 'old look' by electronically inserting scratches and tilted frames that were commonly seen in the early days of this medium. This technique is similar to a few music producers who deliberately insert scratching and background noise that one used to hear with a record player in order to make their digitally recorded instruments and voices sound less 'cold.'

Music sampling

Sampling in music is another demonstration of 'palimpsest.' Musicians use a section of music from a previously recorded song in a new song recording and reuse an instrument or elements of even the new recording. Sampling can involve several seconds of a song, or only a small riff or sequence of notes or sung words. For many hip hop and rap musicians, the point of sampling a song is precisely to copy the sound

recording of a well known song to give their music a certain feel or emphasis. The intention is to link their song in this manner to the earlier song in the listener's mind. Most would not consider trying to reproduce the sound independently because it would not have the same feel.

Interior design

Shop displays often demonstrate 'palimpsest' in modern life. A local restaurant Moon Kee in Hong Kong used the simulated old bookshelf graphic as its current interior backdrop to reshape its retro image bringing patrons back to the old days (figure 9). Contemporary boutiques use old photos and picture frames hanging on the walls or as window display. Simulated old representations are a contemporary business game nowadays.

I once went into a store in Japan and tried on a jacket with a unique cut. I was surprised by the message printed inside the jacket which stated: "This garment can be considered as a piece of future archeology, a container of subjectively edited information contemporary in its making. You are invited to leave a trace of your ownership by signing the brand name." This is not only a good marketing statement that reflects the brand's image and ideology on history, but it also heightens the customer's appreciation of its value and their ownership.

Along the streets, layers of advertising materials are found on walls, lampposts, abandoned shop doors. A newly printed street name (figure 10) appears over the old ones—streets graphics and graffiti express a marking from a different time. These layers of evidence of modern lifestyle accumulate overtime into a 'palimpsest.'

On Fashion

Hybridization

The tailoring skill is marked by a long history of cultural craftsmanship with every single part being handmade. Traditional tailoring from body measurement to pattern construction is based mainly on manual calculations and human experience. It involves the drawing of two-dimensional blocks of patterns, which are subsequently assembled to form the three-dimensional garments that fit the human body. Now the body measurement scanner does all the calculation work and incorporates the tailor's experience on fitting a perfect pattern to a real body through adjustment. The traditional human-to-human tailoring


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Figure 9 (left top) Moon Kee's old bookshelf backdrop décor
Photo: Janie Poon, 2007, unpublished

Figure 10 (left bottom) New street name printed on the old faded one, Berlin
Photo: Janie Poon, 2006, unpublished

Figure 11 (top) Shanghai Tang adopted traditional craftwork in its collection
http://SHANGHAITANG.COM
Retrieved March 30, 2007

Figure 12 (bottom) Traditional ironmongery door lock detail applied to ladies' wallet

Figure 13 (top) Traditional Chinese symbols become a decorative motif on a contemporary fashion bag

Figure 14 (bottom) Fabric from some memorable old clothes applied to a new design to become one-of-a-kind fashion

technique integrates with technical communication for the desired outcome. The present human to machine process through a body measurement scanner that is non-contact, instant and accurate, still maintains the tailor's traditional skill. This process displays 'palimpsest' in the hybridization of traditional skill with new technology in fashion tailoring.

Traditional vs. contemporary

International fashion brands like Vivian Tam and Shanghai Tam use Chinese heritage as the brand image in their fashion collections (figure 11). These brands embrace classic Chinese clothing heritage such as the Qi Poa, Cheng Sam and Tang jacket, made of fine quality fabric with keen workmanship, while injecting contemporary style and details. Trimmings, piping and intricate details are all mastered by hand stitching. This includes embroideries, beading and sequenced details as well as the construction of signature Chinese fastenings (figure 12). Traditional Chinese motifs are applied to clothes and have traditional overt or hidden meaning, for example, the double fish pattern signifies prosperity, fertility and connubial bliss in Chinese culture, while the double happiness motif symbolizes great luck and fortune. They become symbols of cultural identity that reflect tradition, modernity, fashion and cultural change (figure 13). The re-interpretation of traditional heritage in a contemporary mode demonstrates 'palimpsest' in fashion.

Old vs. new

Italian fashion artisan workshops incorporate vintage clothes into their contemporary design. A desired part of vintage clothes like a panel, pocket, a pattern motif, a collar, a sleeve or even a half-body are cut and sewn on their special design to become one-of-a-kind fashion (figure 14). It becomes a new and unique design service by which custom design can be made with the customer's desirable old clothes or fabric. The concept of applying an old material, which has been with the owner for a period of time allowing it to reappear on a new design displays 'palimpsest.'

Transformation

In the past when the economic environment was poor, clothes were passed down within families; the elder brother's new jacket became the younger brother's new outfit the year after. There was also circulation of a tailored suit among groups of good friends for formal occasions. This transformation took place in the 1950s and 1960s when secondhand clothes were

worn for need, becoming generally despised as being socially inappropriate in the 1970s, and 1980s, when the economic environment was better, to becoming not just acceptable but fashionable to a variety of consumers from the 1990s onward. Today, secondhand items are mainstream in the young fashion market. Secondhand clothes are considered to be one-of-a-kind products, traded in flea markets or secondhand stores. The contemporary dressing mode, mixing vintage and contemporary fashion is another instance of 'palimpsest.'

Restoring history by deconstruction

Vintage jeans always move in the dimension of time and value. Fashion trends trace a lot of vintage inspiration from its historic lifestyle and marks of history. Jeans, originally work wear, have a history of over 200 years. It is a personalized icon of the wearer through which well-worn vintage jeans have a unique dialogue with time. It tells the story of its owner, his lifestyle, height, work, how he wears it and what was kept in the pockets. Vintage jeans look good when dirty with stains, faded with marks and aged with worn outs. The traces or marks of vintage, what the wearer did manually while wearing, becomes an industrially reproduced technique. The deconstructive finishing of jeans with frayed edges, deliberate holes and cuts became a fashion style. The creative inspiration in choosing the most original signs and colors of the time was reinterpreted to add that extra touch of exclusivity and one-off individuality to individual brands.

PALIMPSEST—FUTURE DESIGN PRACTICE

Realizing the need to rediscover the roots in tradition and to try to evolve new expression of modernity, future design has to evolve a contemporary approach and yet make reference to the past. New design value is thus derived from: awareness of local/personal heritage and awareness of the impact of heritage (tradition/folklore) on contemporary design.

The Design Concept Framework (*table 1*) is one way to revive heritage and apply these ideas to current design practice. It provides the platform for designer/users to think both intuitively and logically in the hope that more innovative possibilities result.

Palimpsest as design concept framework

The concept of 'palimpsest' is the core for preservation of heritage

as well as its implementation in design practice. It is used as a starting point for formulating the future framework on heritage design. Palimpsest is a tool to align heritage with contemporary design and provide support for design process and appropriate interpretation of heritage in design. The concepts defined in the framework for design practice are meant to reflect the contrast and correlation between two elements—old (O) and new (N). Old refers to an element revived from the past; and new refers to an element that was previously unknown. The concept development is primarily based on the integration of these two contrasting elements from different time zones— 'old or traditional' and 'new or contemporary' with varied outcomes under 3 basic conditions:

(O) = (N) Old and New are in equal proportion
(O) > (N) Old has a greater proportion than New
(O) < (N) Old has a smaller proportion than New

The 7 palimpsest design concepts are described in Table 1, Design Concept Framework.

Concept 1 Insertion: The concept is to put one element (N or O) inside another so that one becomes part of the other.

Concept 2 Overlay: The concept is to put one element (N or O) on top of another so that one can cover the other totally or partially.

Concept 3 Conjoin: The concept is to join the two elements (N and O) together. It can be melded together or be in parallel practice.

Concept 4 Juxtapose: The concept is to randomly put the two elements (N and O) together side-by-side to compare or contrast the two—to highlight similarities and differences.

Concept 5 Intertwine: The concept is to twist the two elements (N and O) together so that one element is revealed through or in between the other.

Concept 6 Evolve/Emerge: The concept is to place two elements (N and O) one on top another, only one element is revealed at the beginning while the underneath element emerges over time. The emerged outcome lasts for a desired period of time.

Concept 7 Interchangeable: The concept is to take design as

CONCEPT	OUTCOMES (Under three conditions)		
Overlay It is the concept of putting one element [N or O] on top of another in the way that one can cover the other totally or partly	 One on top of the other	 [O] on [N]	 [N] on [O]
Insert It is the concept of putting one element [N or O] inside another so that one becomes part of the other.	Nil	 [O] inside [N]	 [N] inside [O]
Conjoin It is the concept of joining the two elements [N or O] together. It can be melded together or in parallel practice.	 [O] & [N] meld together	 [O] fits in [N]	 [N] fits in [O]
Juxtapose It is the concept of randomly putting the two elements [N or O] together side by side to compare or contrast the two, to highlight the similarities and difference.	 [O] next to [N]	 [O] attach to [N]	 [N] attach to [O]

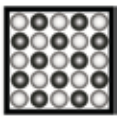
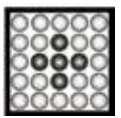
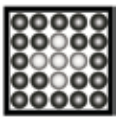
Intertwine It is the concept of twisting the two elements [N or O] together in the way that one element is revealed through or in between the other.	 [O] & [N] twisted together	 [N] reveal through or in between [O]	 [O] reveal through or in between [N]
Emerge It is the concept of placing two elements [N or O] one on top of another, only one element revealed at the beginning while the underneath element emerges over time. The emerged outcome can last for a desired period of time.	 [O] & [N] can be revealed	 [O] emerges in [N] over time	 [N] emerges in [O] over time
Interchangeable It is the concept of taking design as a surface platform formed by molecules. Each molecule has a light side [represent N] and a dark side [represent O] which rotate to create an image outcome. Mode of representation can change based on desired setting.	 [O] & [N] can be visualized	 Manifestation of [O]	 Manifestation of [N]

Table 1 Palimpsest design concept framework
[N] = New or Element not previously known
[O] = Old or Element revived from the past

a surface platform formed by molecules. Each molecule has a light side (represented by N) and a dark side (represented by O) that rotates to create an image outcome.

These concepts form a framework from which designers/users can choose based on the purpose and appropriateness of the representation needed in relation to the practice of their relative field. Ultimately, this framework can help designers create thoughtful designs based on the preservation or creation of heritage aspects most attractive or important to users.

CONCLUSION

Based on the above study, we can grasp the essence and value of heritage in its rarity and uniqueness, unusual quality and meaning, familiarity and pleasure, personal identity and sense of belonging, memory and connection, exclusivity and individuality. By embracing these values and putting them forward in our contemporary world, these principles identify the application of 'palimpsest' concepts which are subject to different applications in design, namely to: 1) re-invent, 2) re-construct, 3) re-conceptualize, 4) re-apply, 5) revive, 6) renew, 7) recall, 8) re-interpret and 9) re-imagine.

These principles can be implemented by referencing the Design Concept Framework that provides a visual pattern and a perspective for designers/users to look for decisions from different standpoints, regardless of the cultural heritage, whether personal, social or economic. It is the concept of 'palimpsest' that allows people to see the world from different perspectives through which new opportunities emerge. Within the ever-changing world, the need to resist blind uniformity, homogenization and conflict with diversity is essential. The past is around us. It is the decision of people to interpret identity as individuals, communities and as a nation with the purpose to make the past or history serve as a touchstone for future life.

A potential for design in the future lies in awareness and maintenance of our historic fabric and respect for the past. Within the stream of history, we are participating every moment in its production. Design is the bridge and integrator within which to create dialogue between people and heritage, to create balance between heritage and innovation and thus make decisions that bring us to a sense of belonging. This does not diminish modernization, and indeed, the rediscovery of heritage is completely reconcilable with modernizing events as demonstrated in this paper. We must celebrate the future world not because it is new or because it preserves the old, but because it is what we want.

END NOTES

1 – The Clock Tower on Star Ferry Pier in Victoria Harbor, Hong Kong was the site of energetic conservation demonstrations before its demolition in 2007.

2 – United Nations Educational, Scientific and Cultural Organization (UNESCO)
http://www.cuhk/ant/culturalheritage/index/htm

3 – Whitfield, T.W. Allan. 2005. Aesthetics as Pre-linguistic Knowledge: A Psychological Perspective. *Design Issues*, 21.1, 7.

4 – The famous Nail House in Chong Qing, China was a site of personal resistance to loss of heritage.

5 – Athavankar, Uday. 2002. Design in Search of Roots: An Indian Experience. *Design Issues*, 18.3, 43.

6 – Landschaftpark Duisburg-Nord, Germany preserved old industrial equipment for recreational use.

7 – Gas Work Park in Seattle, Heather MacIntosh, September 202. Preserving Cultural Landscapes. Retrieved March 30, 2007 from http://www.wwashington.edu/jillian/pix/gasworks5.jpg

8 – Highline in New York City, represented in a photo rendering of the proposed elevated park development, uses old infrastructure in a new way.

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AUTHOR NOTE

Janie Poon is currently a Design Manager for the Hong Kong fashion industry. She recently received a Master of Design in Strategies from The Hong Kong Polytechnic University. Given rapid change in Asia, her concern is with heritage preservation as it can be influenced by design in the context of modernization.

UNDERSTANDING DIAGRAMS: A POINTER TO THE DEVELOPMENT OF DIAGRAMMING SOFTWARE

KAMARAN FATHULLA

The University of Northampton
Visible Language 42.3
Fathulla, 265–284

Rhode Island School of Design
Providence, Rhode Island 02903

ABSTRACT The richness of diagrams is a characteristic reflected in their continuous use by humans over millennia across many applications and disciplines. Discussion of this richness is often expressed in one of two ways: either in terms of the constraints of the particular application and/or context within which diagrams are used, or through some meta and abstract formalism. Both approaches are grounded in traditional reductionist western scientific ways of understanding reality. The thinking behind such approaches has been instrumental in guiding the design and development of diagramming software. However, there is yet another level of richness of diagrams that could not be adequately accounted for by the constraints of the application or through any single formalism. Most real world diagrams often contain a mixed type of diagrams such as box and line, bar charts, surfaces, routes or shapes dotted around the drawing area. Each has its own distinct set of static and dynamic semantics. Both ways of discussing diagrams mentioned so far do not adequately capture this level of richness. The consequences of this inadequacy impact on the development of diagramming software. Existing diagramming software is either too specialized and therefore cumbersome and difficult to use, or too general, thus of little use in representing knowledge. In both cases the software becomes a hindrance to the user's activity and thinking rather than a help to it. In this paper a meta, non reductionist, framework for understanding diagrams based on symbolic and spatial mappings capable of accounting for this richness is proposed and discussed. The potential of the framework to guide the development of good diagramming software is demonstrated.

ON THE RICHNESS OF DIAGRAMS

The way people use diagrams, irrespective of the application, has been eloquently described by J. D. Watson, Nobel prize winner (1968), who discovered the structure of DNA: "…drawing and thinking are frequently so simultaneous that the graphic image appears almost an organic extension of the thinking process." Barkowsky and Freska (1997) argue that human interaction should be a fundamental approach to understanding maps. Godfrey (1998) acknowledges the richness of diagrams: "Drawing is not just a medium or a technique: it is a human activity with a rich and complicated history." Schön (1995) in the context of architectural drawing calls this the architect "holding a conversation with the drawing." Hetzeberger (1991) says that it must be one's own thoughts that determine a drawing and not the other way round. Norman (1990) argues for the need to move towards the point where the richness of human experience comes to the foreground and computing sits in the background. Bertin (1983) suggests similar viewpoints saying that a diagram "…is not 'drawn' once and for all; it is 'constructed' and 'reconstructed' until it reveals all the relationships constituted in the interplay of data…." "A graphic is never an end in itself, it is a moment in the process of decision making." In the context of their paper on creative design Neislon and Lee (1994) point out that "Design is a revolutionary process in which how a problem is defined in the mind of the designer changes dramatically over time." Schön (1991) characterizes this view of diagramming as the "reflective conversation with the materials" in his discussion of effective designs. Bishop (1994) states that a centuries held assumption that "a drawing-is a drawing-is a drawing" is progressively shown to be invalid. Gombrich (1966) adds to this view by saying that "to see the shape apart from its interpretation is not possible." This ability is referred to in Gombrich's discussion of Leonardo's creative process, he suggested that "…in searching for a new solution Leonardo projected new meanings into the forms he saw in his old discarded sketches."

The above serves to demonstrate the richness of diagrams in the context of human functioning. However, there is another level of richness (see next section) which transcends the human role and is about diagrams themselves.

Richness beyond actual uses of diagrams

Real world diagrams, regardless of their application, are quite complex. Even a simple box and line diagram (*figure 1*), can be messy because a number of mistakes have been crossed out; it can also have some rather crowded areas in which it is difficult to find space to place new shapes. The various boxes are labeled with letters, e.g., A, B, J, etc., for referencing purposes.

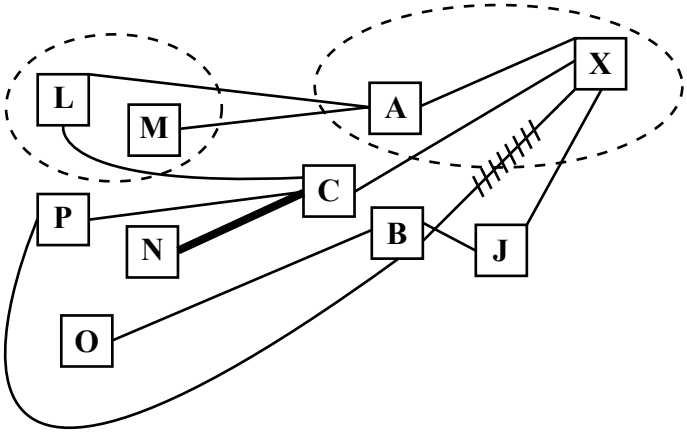


Figure 1 Box and line diagram.

A number of other characteristics of such diagrams are shown in Table 1 (*with reference to figure 1*).

Characteristics	**Diagram feature**
Consisting of visual elements each of which has some symbolic meaning	Boxes and lines, thick lines, circular curves
Expressing several different types of symbolic information	Items and relationships, also specific things like set membership or degree of influence
Containing a number of mixed visual styles to express these different types respectively	Boxes and arrows, circling (Boxes L & M), thickening (Line connecting boxes N & C), and looping (Line connecting boxes B & P)
Growing and changing rather than consideration of a diagram as a finished product	Not applicable
Editing involves replacement of parts that have already been drawn being replaced by others	Line between box B and X
Thinking, or part of it, is inherent in communication	Not applicable
Diagramming process is fluid and refers to active human processes when engaged with a diagram	Not applicable

Table 1 Semantics of real world diagrams

Others have found similar features to the above list; Neilson and Lee (1994) discuss an experiment in which such diagramming process is employed by an architect. I have found similarities between their observations and our list:

> *"changes to the drawing were not necessarily consistent with one another,"*
>
> *"the architect did not maintain a consistent interpretation of the drawing over time,"*
>
> *"the use of 'incomplete' drawings,"*
>
> *"the frequent wholesale reinterpretation of (parts of) drawings,"*
>
> *"common wide divergence in different reinterpretations of essentially different picture elements and relationships,"*

The previous sections served to illustrate that our understanding of diagrams should:

> *1. Evolve around human functioning*
>
> *2. Respect the richness of diagrams that transcends application constraints. Such richness is characterized by the distinctiveness of the various drawing styles expressed through distinct ways in which spatial and symbolic aspects are mapped.*

Having discussed the richness of diagrams the question now focuses on how existing ways or frameworks for understanding diagrams deal with the richness.

Existing ways of understanding diagrams

A number of frameworks for understanding diagrams are listed here to give the reader a flavor of the underlying approaches that drive the topic.

> *– Gombrich (1966) argues that "to see the shape apart from its interpretation is not possible." This ability is referred to in Gombrich's discussion of Leonardo's creative process "in searching for a new solution Leonardo projected new meanings into the forms he saw in his old discarded sketches."*

– Another definition given by Ittelson (1996) depicts diagrams as having no meaning without an interpreter and a communicative intent.

– Bertin (1983) describes diagrams in terms of the relationships between graphical marks.

– Peirce (1931) defines diagrams as signs that have predominantly iconic relations.

– Engelhardt (2002) sees diagrams in terms of cognitive structures.

– A recent definition in Knoespel (2001) considers diagrams as "…simple drawings or figures that we think with or through."

A summary of each definition and its corresponding emphasis is shown in Table 2.

Source	Emphasis
Gombrich	Symbolic structures
Ittelson	Symbolic structures
Bertin	Spatial structures
Peirce	Symbolic structures
Engelhardt	Symbolic structures
Knoespel	Symbolic structures

Table 2 Definitions of diagrams and their emphasis

Much of the discussion on the nature of diagrams seems to be influenced by the internal versus external debate. Proponents of the external camp see diagrams as a collection of spatial or visual elements independent of humans. Proponents of the internal camp see diagrams as a collection of symbolic elements. There is emerging dissatisfaction with the potential of these ways of understanding diagrams. Horn (2001) claims that our current ways of understanding diagrams is one of "confusion." Norman (2000) finds existing ways of understanding graphical representations to be unsatisfactory. Bishop (1994) adds to

this by questioning our existing ways of understanding diagrams arguing that the centuries held assumption that "a drawing-is a drawing-is a drawing" is progressively shown to be invalid. Kulpa (2003) argues that there is need for a serious study to help us better understand diagrams. A detailed discussion of the role and importance of these two aspects follows.

The importance of the spatial aspect

The spatial aspect is important because it is the aspect that provides the raw material for the creation and transformation of diagrams. Spatial aspect is also important because it forms a prerequisite for other aspects, such as the sensory, to function properly (Jobson et al., 2001). Four reasons are cited for why spatial is important, which all have to do with the fact that the user takes action with the diagram, rather than merely interpreting a displayed product. First, some actions involve only spatial manipulations and are subject only to spatial rules; for example changing a text font may require enlarging and re-positioning boxes in a flowchart (Maulsby et. al., 1989). Second, the user interface gestures with which the user creates the diagram are spatial in nature and must first be managed as such before being translated via the mapping into symbolic aspects. To implement a full set of spatial rules in the software enhances the efficiency and naturalness of drawing. Third, relying only on the symbolic and mapping, as in automated graph layout, leads to the removal of visual cues that are important to the meaning of the diagram (Basden, et. al., 1996). Fourth, having a full and exhaustive account of all spatial phenomena allows certain relaxation of the rules and reinterpretations. This is true in cases where the person diagramming may want to relax certain rules to aid his/her thinking processes. Spatial aspects could be facilitated by rule relaxation while keeping the symbolic meaning true and well formed.

Limitations of a purely spatial/visual framework for understanding diagrams

Kuipers (2000) questions the adequacy of discussing spatial aspects of diagrams in isolation from other human functioning aspects and proposes that a better way of addressing the issue of complex diagrams should acknowledge the many aspects of spatial knowledge that are not inherently visual. Programmers, for example, who use a simple single color, fixed pitch font terminal can get a mental image that aids comprehension from the appearance of the indenting in their code and the relative size of blocks of code.

One of the problems of a purely spatial account of diagrams impacts a diagram's well formed-ness. References to 'label,' 'name,' 'number,' etc. would seem to be symbolic phenomena rather than spatial. One way of making the necessary distinction would be to define all symbolic phenomena in purely spatial terms by the addition

of extra rules (e.g., "A label is a row of character-shapes that is placed near another shape") but this solution is too cumbersome and creates immense difficulties particularly in mixed diagrams. Numbers are sometimes used to label items in a list (for example, a bullet list in a multimedia presentation), in such a way that they indicate the order in the list. If an item were to be moved up the list, then we would expect not only that the numbers accompanying the items would be moved with the item (a spatial operation), but that some items would be renumbered (an operation that cannot be accounted for by spatial rules).

A second problem is the rigidity of applying the rules of what constitutes well-formedness. Human designers often relax the rules. Neilson and Lee (1994) include numerous examples of this in their observations of how an architect designs the layout for a kitchen. One of these is that the architect sometimes draws only part of the object to represent the whole; the rectangular outline of a cooker would be drawn with only two lines, in an L shape. Many of the diagrams would be considered ill-formed by the normal rules of the spatial layout of physical objects, yet to the knowledgeable human user of the diagram they are well-formed. Similar criticisms were made by Goel (1992).

Third, a purely spatial perspective on well formed-ness cannot account for what might be called 'doodling.' Basden et al (1996) call it 'tentative action' and give the following example. The user of the Istar toolkit, that employs boxes and arrows as a visual knowledge representation language, would 'pick up' a box and wiggle it about for a time before setting it back in its original position. The spatial result of such actions is often null, so that from the spatial perspective alone, the action itself has zero effect. But, to the user, it was a significant action because it helped him think about the concept that was represented by the box. A definition of well formed-ness based solely on spatial concepts would not be able to account for such important elements of the usability of drawing software.

Some diagrams that seem spatially ill-formed are in fact well formed to the user. For example, Figure 2 shows a box and arrows diagram produced by the Istar visual knowledge representation toolkit (Basden and Brown, 1996). Istar has a facility to hide most of the diagram except those parts connected to a selected box, directly or indirectly. The diagram shows some dangling lines.

A fundamental spatial rule of well formed-ness in a box and arrows diagram is that all arrows must have their ends terminate on boxes, this suggests the diagram is not well formed from a spatial perspective. However, such a diagram was well formed in the user's eyes and found to be useful, because the dangling arrows told them what else the visible boxes connected to. A useful definition of well-formedness such as we wish to implement in software should therefore allow such temporary breaking of the rules of spatial well-formedness,

within the overall context of a well-formed diagram. However, it does require that the definition of this fuller notion of well-formedness includes knowledge that would enable spatial well-formedness to be recovered.

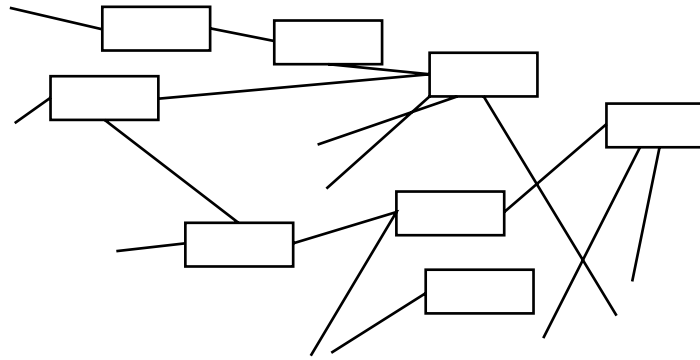


Figure 2 Istar Diagram from Basden and Brown (1996) box and line diagram.

Taylor et al (1984) says that spatial arrangements do not have any inherent significance of their own. Wood (1993) argues that we recognize differences between diagrams not purely based on spatial differences but because they are "structured differently as systems" and because they are "manifestly different landscapes." The point raised by Wood seems to suggest that there is something more to a diagram than just its spatial relations and constraints and that this leads to meaning by bringing in structural differences.

The importance of the symbolic aspect

The importance of the Symbolic aspects is that it gives precision and clears any ambiguity that may be found in diagrams. This is true because many types of diagrams make use of similar spatial phenomena, but what distinguishes them from each other is their Symbolic aspect. When diagrams are partially created from the Spatial aspect alone, their description makes no sense, but such diagrams are useful and important for the person drawing them precisely because of their Symbolic aspect.

Symbolic aspect also allows us to deal with mixed diagrams where the same Spatial aspect of such diagrams could have more than one meaning depending on their use. The London Underground Map is one such case where it is composed of circle and lines. This diagram could express the relationships between the stations or it could express the route taken to go from one place to another. Diagrams may sometimes be ill-structured, where the rules are relaxed such as dangling lines in a box and line diagram. We are able to cope with these features because their well-formedness is still valid through Symbolic aspects.

There may be instances where Spatial aspects are not needed, but there is a purpose behind their absence. An example of such a case is where some terrain is virtually flat such as marsh lands, flood plains, deltas; in this case there is no need to draw contour lines symbolically. However, the blank spatial feature still conveys symbolic meaning relevant to the type of the diagram. There is a need for drawing tools to support the draw-first, interpret-later approach in diagrammatic knowledge acquisition (Cheng, 1996). This seems to suggest the need for the software tool to allow the user to draw, in a spatial sense, first and then interpret symbolic aspects. The Symbolic aspect is also important because not every meaning of a diagram is spatially expressed. Some of the meaning (symbolic) is found in the activity of diagramming. Most architects, whose use of diagrams is crucial to their professional work, find it hard to think without a pencil in their hand (Lawson, 1994).

Limitations of a purely symbolic framework for understanding diagrams

However, by recognizing the importance of Symbolic aspects there is a temptation to consider it as the aspect that is sufficient to account for the nature of diagrams. There are a number of problems with this view. First, from a general point of view, Symbolic aspects alone would not allow us to distinguish diagrams from other constructs made by humans that are used to convey information—what is symbolic about a book, a web page, a letter, for example. Second, guiding our thinking of what Symbolic aspects ought to be about would be based on our existing knowledge of the variety of diagram types in use and this would inhibit us from developing new types of diagrams. Yet, in reality we find that people are very creative and able to always produce new types of diagrams. This suggests that Symbolic aspects alone are not sufficient. This suggests that we cannot in advance anticipate what Symbolic aspects cover because this is about human agency and the potential for creative expression of meaning. Finally, some useful diagramming activities (Spatial aspect) carries no symbolic meaning such as cleaning up and tidying activities people often deploy in complex messy diagrams. The effect of Symbolic aspect alone would not facilitate the recognition of such activities because they are of a different nature characterized by the kinematic aspect.

The need for a different approach

Focus on spatial or geometric representations helps with interpretation, but it largely ignores the human processes of creation and interpretation, though it is often employed in their service, and it excludes any consideration of symbolic meaning. It treats the spatial phenomena as static entities that can be combined by special logics, rather than as flowing, growing things. When understanding diagrams

is motivated by cognitive or psychological perspectives then it can in principle handle mixed diagrams, but in practice rarely does so, as it has no basis for understanding the differences in the mixture. It considers only the interpreter of diagrams, and ignores the creator, it assumes that diagrams are static, rather than growing, and it has no place to consider the purpose of the diagram. It might employ geometric concepts, but does not understand the relationships between them. Finally, when focus is on structure (especially syntactic and lexical), this ignores the generation or growing of diagrams and it does not give much attention to which spatial or geometric phenomena can support symbolic meaning. There is often difficulty in dealing with mixed diagrams, because they assume a particular type of semantics and seem unable to provide any basis for software support. The narrow focus of most of these approaches means that they can address certain problems, but cannot integrate them with consideration for other problems. When faced with theories or solutions relevant to the situation with which this paper started, the response is often "So what!" and reject both funding applications and access to academic literature.

The approach taken in this paper differs from existing ways in that it recognizes the importance and need for both the Symbolic and Spatial aspects in working out a good way to understand diagrams capable of handling both construction and interpretation tasks. This recognition, even though it has philosophical underpinnings (Fathulla, 2006), nevertheless agrees with our intuitive understanding of diagrams. Diagrams that are used to communicate some purpose or meaning do so through distinct spatial elements, properties, constraints and relationships. The approach advocated in this paper is based on the Mapping between Symbolic and Spatial aspects, SySpM. The term aspect refers to a constellation of meaning, rich and diverse and as such it includes all phenomena that matter when discussing reality; in the case of diagrams these include elements, properties, constraints, operations and relationships.

The SySpM Framework

The central thrust of this framework is: Separating symbolic from spatial but allowing for their mapping. The framework is based on the notion that Symbolic aspects are distinct and separate from Spatial aspects and are irreducible to it. From this framework individual SySpM's can be constructed. The term "a SySpM" is used to denote a distinct (particular) collection of Symbolic and Spatial aspects and a distinct Mapping between the two collections. Synonymous with this term are drawing styles or types of diagrams. Table 3 shows eight such SySpMs (Fathulla, 2006).

We grouped the symbolic and spatial terms into primary and secondary lists. The former includes symbolic and spatial terms that

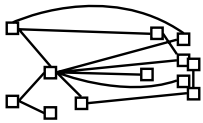
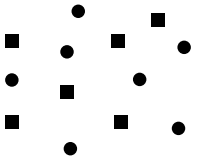
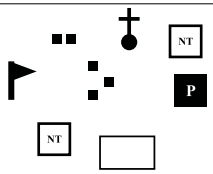
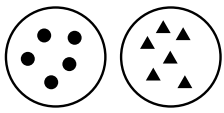
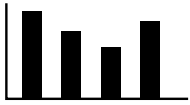
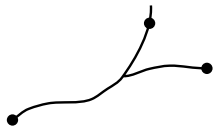
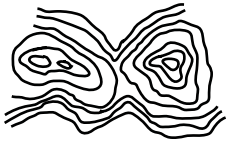
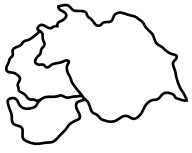
No.	The SySpM	Mapping	Example diagram
1	Boxes and Lines	Item mapped onto box, relationship mapped onto line	
2	Communicating Similarity	A collection of items mapped onto a collection of shapes	
3	Map of Objects	Item iocation mapped onto icon position	
4	Set Membership	A shape inside a loop mapped onto member of a set	
5	Bar Charts	Magnitude mapped onto length of a bar	
6	Route Maps	Route mapped onto curvilinear line	
7	Contour Maps	The set of location with the same quantitative value mapped onto closed continuous curve	
8	Surface Coverage	Region mapped onto area	

Table 3 SySpM's developed in Fathulla (2006).

are used in the simplest or basic form of the SySpM. This category of symbolic and spatial is also in all instances of diagrams of the relevant SySpM. The latter includes terms that are used in complex diagrams of the relevant SySpM and it also includes things that have to do with the relationships or interaction between the various symbolic things of the relevant SySpM. Development of each SySpM also includes a list of spatial features that do not map onto any Symbolic aspect, these are known as redundant Spatial features**.** These could then become available for other SySpM's thus forming mixed diagrams or list constraints, i.e., why they occur and list events or changes relevant to the SySpM under consideration. Special features of a SySpM use redundant spatial features to bring in secondary spatial features rather than another SySpM as mixed diagrams. An example of this in a Box and Arrow SySpM is when lines are allowed to cross other lines. This happens when one line is given a kink or a gap to indicate clearly that one is passing over or under the other rather than connecting to it, e.g., electronic circuits. Sub types are diagrams in which the original and simple SySpM is constrained or complicated because of specific needs usually associated with a type of application. This is achieved by bringing in an extra symbolic constraint that, owing to mapping, also gives a different spatial feel to the diagram. There are at least three different ways symbolic sub types can be depicted in a Box and Arrow SySpM: networks, lists, and trees. For each SySpM there might be special cases that do not 'fit' well. Many spatial applications involve several of such special cases such as holes, discontinuity and other irregularities. We need to identify these and explain the problems they generate, that is, what constraints they break, either spatial (as here) or symbolic.

A SySpM could contain features that are outside the range of its base symbolic types. This recognizes that each SySpM will be able to express only a subset of the symbol level, not all of it. To express the whole extensive range of things at the symbolic level requires several different SySpM's. Within this context two types of mixed-ness are identified. One is when several SySpM's are present in a diagram, but none dominates the overall meaning of the diagram. An example of this is the diagram depicting the fate of Napoleon's army during its march on Moscow (*see figure 3*).

This type of mixed-ness is referred to as "True mixed diagrams." The other type is referred to as "Augmented diagrams." This type of mixed-ness has one SySpM occupying a primary importance while other SySpMs are added in and have secondary importance. This type of mixed-ness occurs when redundant spatial features of a SySpM are used to bring in symbolic aspects from other SySpMs. For example, in a Box and Arrow SySpM thickness of line could be used to bring in quantitative value from Bar Chart SySpM.

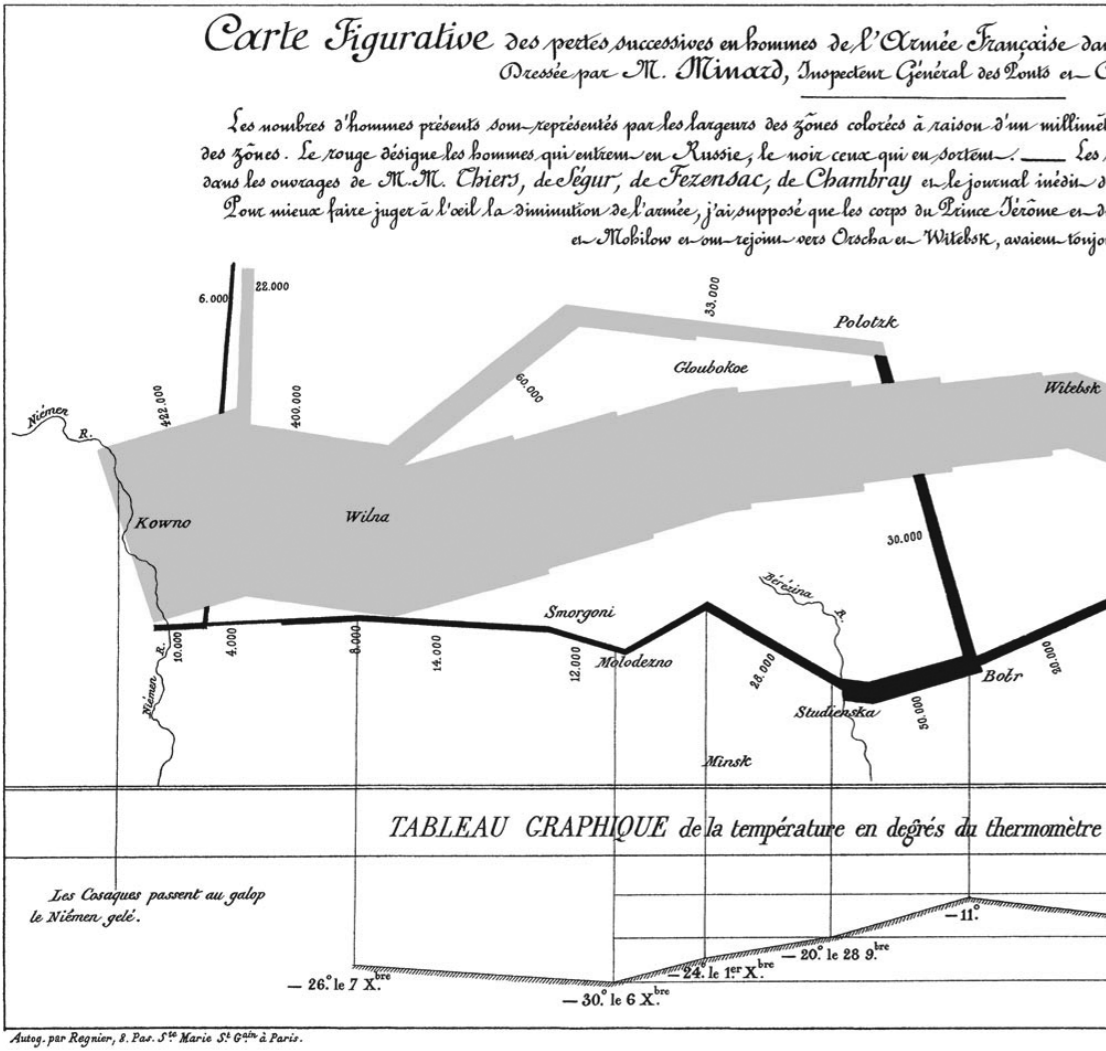
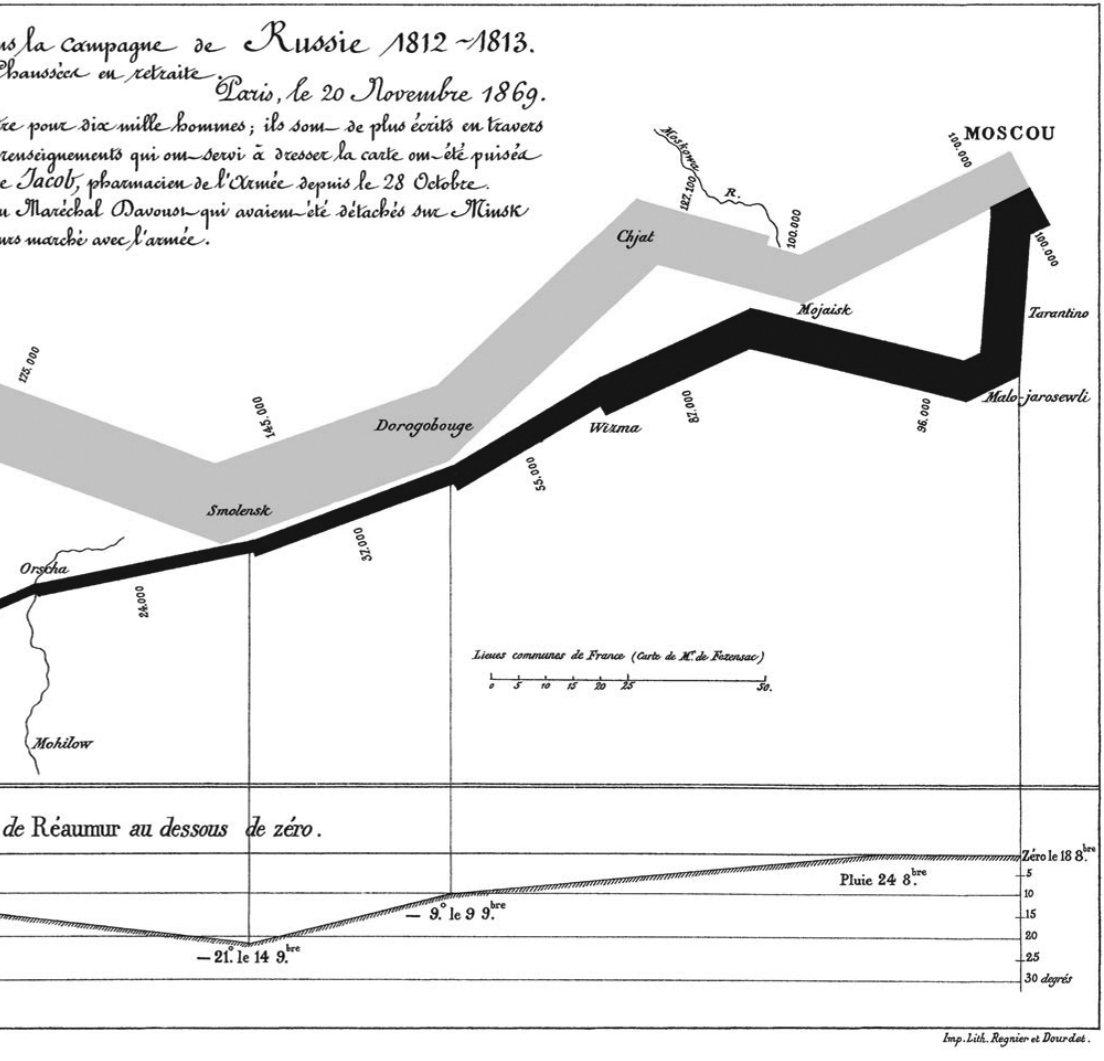


Figure 3 Charles Joseph Minard's graphical representation of the story of Napoleon's advance and retreat into Russia in 1812. Source: "Collection Ecole des ponts" avec la cote ENPC du ou des documents.


Russie 1812 ~1813.
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Imp. Lith. Regnier et Dourdet.

Current drawing software tools

Drawing software is used to generate diagrams. But it is all too easy for the user to produce a diagram that is ill-formed. Myers (1991), for example, draws our attention to the fact that in using a generic drawing package (e.g. MacDraw or Claris Draw) to create a box and arrow diagram, the user might move a box without moving its arrows, leaving them dangling. Extra work is needed to correct such mistakes. Damm et al (2000), Edmonds and Moran (1997), Serrano (1995), Weible and Buttenfield (1992), Ryall et al (1996) have all discussed limitations of drawing software. Computational systems are often developed based on psychological studies with the aim of automating the generation of diagrams (Zhang, 1997). This aspect of computational approaches makes them less likely to support the characteristics of diagram richness as outlined at the start of this paper. Computational approaches tend to apply rules of well-formedness in a rigid way thus making them less suitable to support such features. Cheng and Cupit (2001) also add that existing drawing packages seldom support the activity of marking the significance of a distance between two points. This suggests the limitation of computational approaches to account for the problem of variety of types of symbolic information found in most real world diagrams. In general automatic generation of diagrams bypasses most of the characteristics of diagram richness. Computational approaches place a great deal of significance on the issue of efficiency. This emphasis leads to the generated diagram missing most or some of the meaningful spatial and visual features that were of importance to the diagrammer. Based on work carried out in Fathulla (2006) and Fathulla and Basden (2007), we argue that the difficulties people experience with diagramming software tools point to an underlying issue of how we understand diagrams. A vision of how better diagramming tools could be developed based on the framework of SySpM is presented.

SySpM: A framework for designing diagramming software

The author believes that the SySpM concept can help in the design of software that will aid users, because it offers the designer a principled guide for constructing software. Each module is built with a purpose in mind to support a particular type of SySpM, with sub-modules to handle the Spatial, the Symbolic and the Mapping between them. If these can be 'plugged in' then the user has immediate access to different SySpM's, and thus a support is provided for a variety of ways of thinking. Drawing actions that are not applicable in any SySpM are not meaningful and therefore automatically forbidden by the software. The definition of objects, activities, relationships and constraints in both symbolic and spatial terms helps in the design of the data structures to be implemented. So that the interface does not "get in the way of the user's thinking" (Norman, 1990), Basden et al (1996)

developed principles of proximal user interface that may be invoked in its design. But these must be instantiated by the specific requirements of the software; for example the principle of graded effort implies distinguishing frequent from infrequent operations. A well designed SySpM can provide such information. The linkage between various SySpM's via redundant spatial features, thus forming mixed diagrams, provides users with continuity of the diagramming activity that is essential, especially when such activity aids the thinking processes.

Feasibility of implementing SySpM in software is brought about through recognizing the need to work out three distinct data structures for each SySpM. Each data structure will implement the features worked out thus far for each SySpM. Fluidity of the drawing process is seen as a central issue in diagramming when used as an aid to thinking. We will demonstrate this quality of SySpM to draw a line of varying width. Such lines are common in route maps. To draw this line with the various widths and angles using existing software packages would be time consuming and often frustrating involving several interruptions to ensure the continuity of the line, the various widths and changes in direction. These interruptions occur because such software recognizes diagrams as graphical shape manipulation. However, building drawing software which has knowledge of the different symbolic meanings, namely routes or quantitative values would enable such drawing to take place with a minimum degree of interruption. The user would have to instruct the software regarding which SySpM's to activate, either during the diagramming activity or right at the start of the process.

The three distinct and yet integrated aspects of the SySpM framework allow for software to be designed such that data structures can be implemented to support each SySpM. The way software could achieve this is by developing a data structure for each graphical piece. Such data structures would hold for each SySpM, not only spatial information such as position, size, shape, etc., but also which SySpM's relate to its several parts. For example, a rectangle has a top, bottom, right, left, inside and four corners. In Bar Chart, the top and bottom 'belong' to the Bar Chart SySpM but the right and left are unused and may be used for another SySpM. Then, whichever part the mouse is over, the software finds from this data structure which SySpM is the one to supply the relevant rules to guide the visual/spatial and symbolic aspects of its modification. An early version of this kind of user interface has been implemented in Basden et al (1996), but only for the Box and Arrow SySpM.

However, it might be argued by some that construction of software based on the SySpM would add yet more complexity in what is already too complex, and thus exacerbate problems of maintenance. This perception is wrong. In many cases, software is designed on the basis of too simple a view of real world needs and then has facilities bolted

on in a way that is alien to its underlying architecture so that usability is impaired and maintenance problems are exacerbated. For example, in box and arrow software, the constraint that lines must always attach to boxes can be implemented as a purely spatial constraint, but when it is discovered that users require the ability to show part diagrams with what appear to be dangling lines, the existing data structures cannot easily accommodate the desired facility. In real life situations there seems to be a 'requisite variety' (Ashby, 1956) that we cannot escape; a high quality SySpM analysis would highlight what this variety is, so that the architecture can be designed, right from the start, to accommodate the necessary facilities. An early prototype version of a diagramming software, called Istar, (Basden et al., 1996), capturing a limited scope of the above proposal, has already been developed.

CONCLUSION

This paper investigates the difficulties faced by people using existing diagramming software tools. It argues that diagrams produced by people express richness that is rarely captured fully by these tools. The root causes of the problems are linked to our understanding of diagrams. A proposed framework for a better understanding of diagrams is outlined and its potential for developing better and more intuitive diagramming tools are discussed. The work carried out here is part of an ongoing research that aims to develop drawing software based on the framework of SySpM.

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AUTHOR NOTE

Kamaran Fathulla is a senior lecturer in information systems at the University of Northampton, United Kingdom. Kamaran has a master degree in User Interface Design and a PhD in Understanding Diagrams. She is a member of the IASTED Technical Committee on Human-Computer Interaction for the term 2007-2010. The research presented here is underpinned in the philosophical work of the Dutch philosopher Herman Dooyeweed. Kamaran is the chief editor of a newly established electronic journal aimed at exploring the application of Dooyeweed's philosophy in various domains of human life.

THE NEW WAY OF MAKING FONTS WITH DTL FONT MASTER

Nikola Djurek

University of Zagreb
Visible Language 42.2
Djurek, 285–300

Rhode Island School of Design
Providence, Rhode Island 02903

ABSTRACT Software for professional font production appearing recently, *DTL Font Master*, is like no other program of its kind in its configuration and functions. This article is about the program, its new and improved features in type design and production, through the eyes of a day-to-day user, a type designer and coauthor of the program. Emphasis is placed on the structure of a suite of modules and their utility.

INTRODUCTION

Excellent design is just a part of good typography. The other part is production, the number of actions that ensure proper function of a typeface. Font production technology is as important as the creative process of designing letters. A beautiful font is of no use if it doesn't function properly. That is why special professional font production software is needed. One appeared recently, *DTL Font Master v. 2.5*, and it is completely different from any other font production tools known today. It was developed for the Dutch Type Library, a font foundry that produces digital typefaces since the 1980s. As the foundry grew and font production became more complex, the requirement for a special font software also developed. Programming started in the second half of the 1990s, it developed, improved, changed appearance through time and now version 2.5 is available to everyone (Dutch Type Library, 2007). The software was developed in collaboration with URW++, a Hamburg based company, one of the most experienced companies on technical font production. The *DTL Font Master* team consisted of experts in the field of font production and design: Gu Jun, Hartmut Schwarz, Axel Stoltenberg, Dr. Jurgen Willrodt, Peter Rosenfeld, Frank E. Blokland and Nikola Djurek, author of this article.

DTL Font Master is comprised of several modules, or Masters, which is a completely new configuration for this kind of software (*figure 1*). Each module performs one of the key operations in producing high quality fonts, such as: data management, editing functionality, digitizing, tracing and kerning, interpolating fonts, testing, correcting contours, generating, etc. The modular structure of *DTL Font Master* underlines the differentiation between type design and font production and is specifically suited for batch production. Batch functions enable you to process large quantities of data at once and are controlled by simple text files; there is no need for any scripting. Because of the modular system *DTL Font Master* is very versatile for users and for programmers. Each utility can be obtained separately and functions independently of the other modules; users can define their own set depending on their production methods. Also, the technical functionality can be enhanced without effecting other modules. This guarantees a stable environment for font production that is always up to date. The user interface of the modules follows the standards of Mac OS and Windows, but can be changed according to one's preference, for example, the display of anchor and control points can be changed to small, medium and large. It is also important to say that all files generated by the *DTL Font Master* modules are platform-independent. This makes it possible to centralize font production files on a server and to work on these from Macs and PCs.

In this article I will present each part of the *DTL Font Master* software, concentrating on new, improved features that are not typical

for other existing font production programs.

About the Modules

DTL Trace Master

First of the seven *DTL FontMaster* modules, necessary for turning a sketch into something more than a sketch, is *DTL Trace Master*. The module for autotracing scanned data is suited for tracing letters and logotypes. That means, for instance, that extreme points will be placed perfectly. It supports scanners directly through the Twin drivers, a standard for the most manufacturers. It is possible, with this module, to scan and directly convert analog data into high quality digital contours.

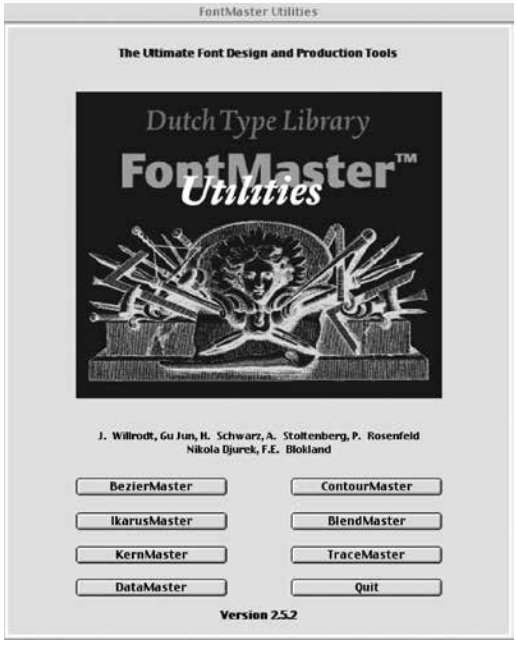


Figure 1 The DTL Font Master opening window, where you choose the module you wish to use (from DTL FontMaster 2.5.2, screen shot 2007)

It supports IK, BE, EPS, TIFF and several other outline description formats (Dutch Type Library 2004). There is even a possibility to convert scanned data directly into TrueType font format. *DTL TraceMaster* is used to convert TIFF data into BE format. Because the accuracy is exceptional, it is a good alternative for manually digitizing contours (*figure 2*). The relation between the size of the scanned (TIFF) model and the output resolution by *DTL TraceMaster* is simple: 1 centimetre is converted into 1000 units. The quality of the output depends on the resolution and size of the original model. When the outlines are ready for the editing, an editor is needed.

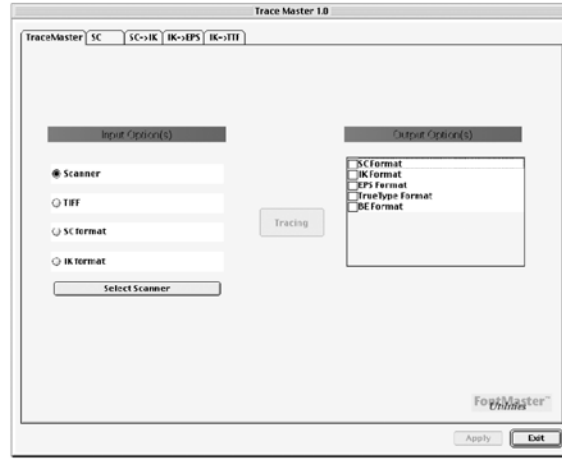


Figure 2 The main dialog of DTL TraceMaster showing input and output options, (from DTL TraceMaster pdf manual [2004], screen shot 2007)

Bezier Master

DTL Bezier Master is an editor for outlines in bezier format and is intended for drawing and managing character sets (*figure 3*). It has many properties making it unique. For example, the option to check bezier points with the arrow keys and the option to load the same font into the foreground and the background (Dutch Type Library, 2004). Increasingly refined corrections can be made to the letter because changes from the foreground are simultaneously shown in the background. For example, after optimization of the font data in the *DTL Contour Master* it is possible to compare the original and the new version in the *DTL Bezier Master* by opening one font in the foreground and selecting the other in the background. Another important element is Font Administration tool that handles and organizes the font database and manages code pages clearly (*figure 4*). In the Font Adminstration window the different code pages that are supported by the character set in the database can be shown beside the Unicode and the Character Numbers. This tool is very important for the production of large Unicode based fonts such as OpenType. OpenType font glyph sets use Unicode encoding which allow broad international support, as well as support for typographic glyph variants. Additionally, OpenType fonts may contain digital signatures, which allows operating systems and browsing applications to identify the source and integrity of font files, including embedded font files obtained in web documents, before using them. Also, font developers can encode embedding restrictions in OpenType fonts and these restrictions cannot be altered in a font signed by the developer (Microsoft Corporation, 2007). The database of the Font Administration tool can consist of more than 65,000 characters. It is possible to copy and paste between the code

pages. Pasted characters will be placed in the database automatically under the appropriate number. Newly (re)placed characters are saved automatically and can't be undone.

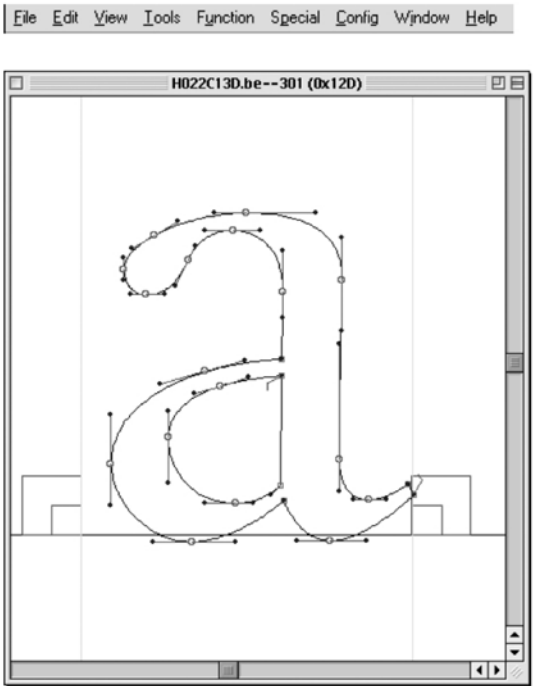


Figure 3 (left) Character Edit window of the DTL BezierMaster where actual designing takes place (below) and menus that are available while this window is active (above) (from DTL FontMaster 2.5.2, screen shot 2007)

Figure 4 (right) Font Administration window inside the DTL Bezier Master module with dierent code pages shown (from DTL FontMaster 2.5.2 - DTL BezierMaster, screen shot 2007)

An important tool inside *DTL Bezier Master* is also the Metrics Editor (*figure 5*). It adjusts the positions and widths of the characters. The Metrics Window can be resized to take full advantage of the screen resolution. The changes made in the Metrics Editor are saved automatically. In order to aid the type designer in the design of smooth and tangentially continous outlines, four different type of points are available in *DTL Bezier Master*: Start points, only one start point for each contour is allowed; Control points, off curve points, also called Bezier Control Points (BCP); Anchor points, also called corner points: these points are on curve points, marking the end or beginning of a straight line or a Bezier curve and Smooth Anchor points, these points are on curve points, marking the end or beginning of a straight line or a Bezier curve.

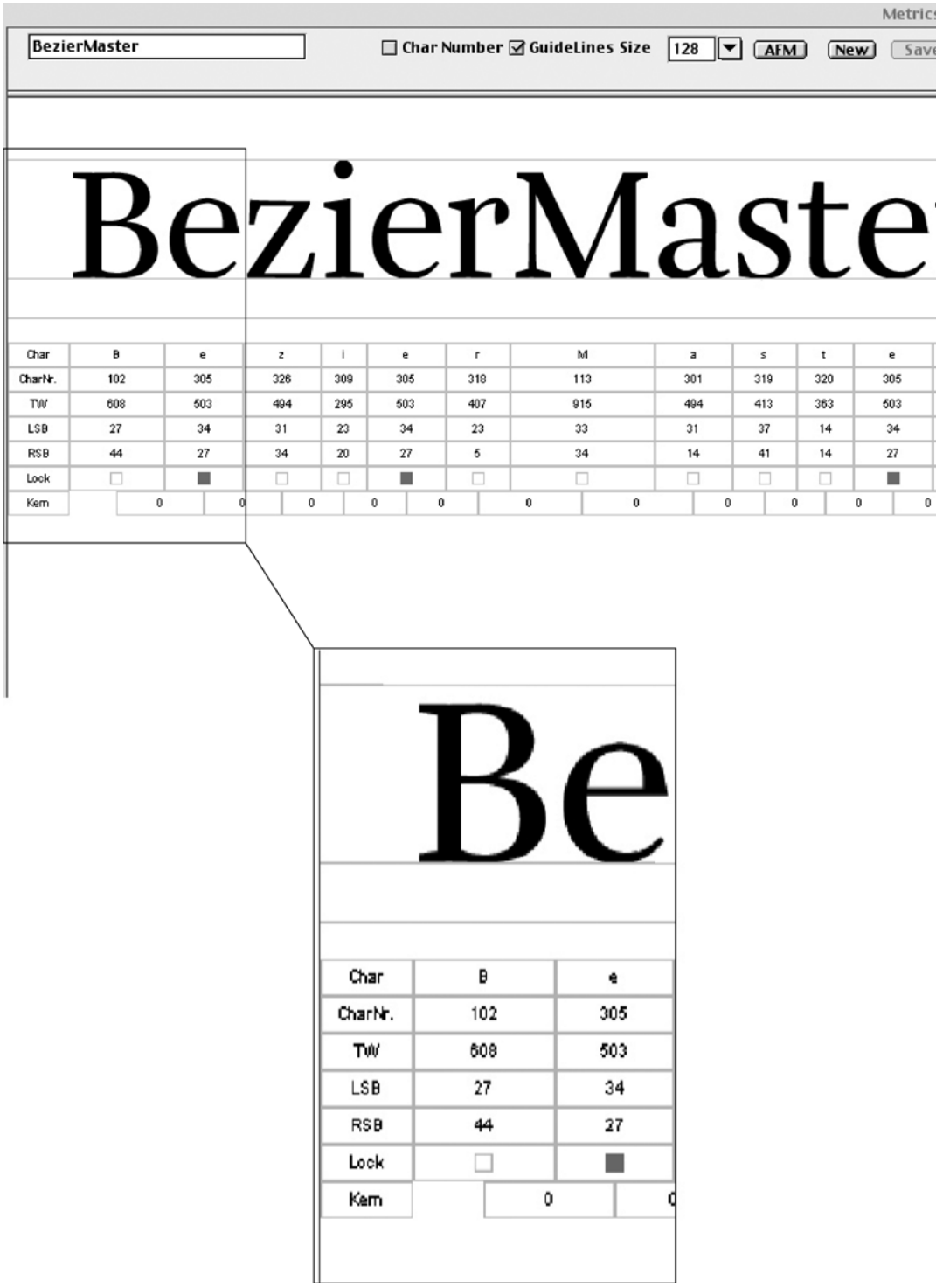
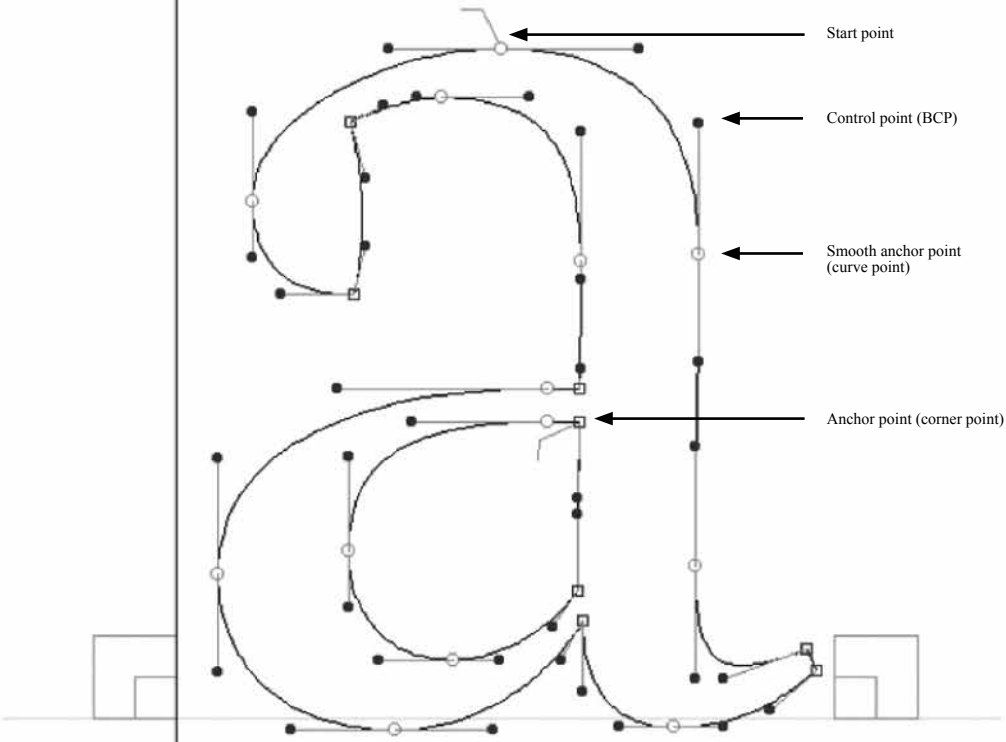


Figure 5 Metrics Editor window inside the DTL Bezier Master module (from DTL FontMaster 2.5.2 - DTL BezierMaster. screen shot 2007)


Start point
Control point (BCP)
Smooth anchor point
(curve point)
Anchor point (corner point)

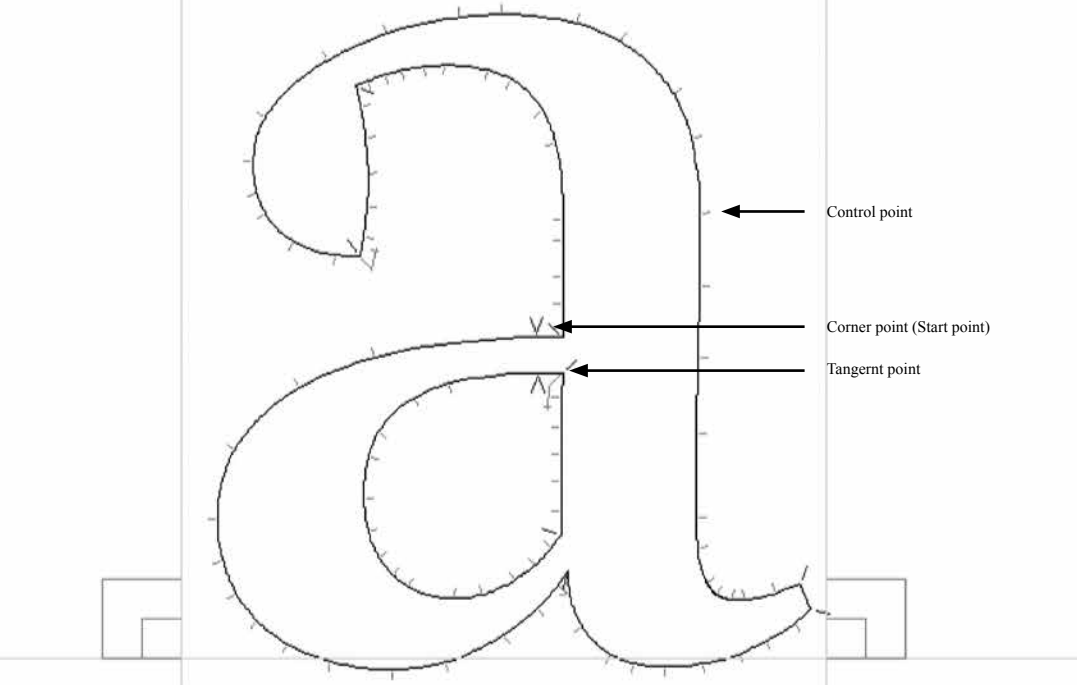

Control point
Corner point (Start point)
Tangernt point

Figure 6 (left) The differences between Bezier outlines in DTL Bezier Master and Ikarus outlines in DTL Ikarus Master (from DTL FontMaster 2.5.2 - DTL BezierMaster and DTL IkarusMaster, screen shots 2007)

Ikarus Master

DTL Ikarus Master is an editor for the IK (Ikarus) format. Most of the functions match those *DTL Bezier Master* offers for BE format. Also the IK data can be loaded directly into the background of the *DTL Bezier Master*. Actually, BE format has been developed by URW and it is derived from the Ikarus format. There are few differences between them. The way that IK format describes contours differs completely from the bezier curves in the BE format. Every point lies exactly on the outline, while in BE format, control points are outside outline (*figure 6*). *DTL Ikarus Master* is not normally used for drawing characters directly on screen, for that it is better to choose *DTL Bezier Master*. But for editing characters that are hand digitized, it is ideal for using with a digitizing board. The Ikarus format was for a long time the standard for digitizing fonts, and still a lot of data is in this format. This was the first professional font production system, and it remains relevant because of the conversion of the IK data into TrueType, PostScript or OpenType with *DTL Data Master*. It is used by specialized font production houses around the world. These demanding users appreciate high quality digital data with a flexible system, simplicity and speed that supports a font conversion into other formats. Ikarus was the source for many inventions, such as hinting, interpolation, auto tracing, auto kerning, etc

Figure 7 DTL ContourMaster corrects stem widths and serif lengths (from DTL FontMaster 2.5.2 - DTL ContourMaster. screen shot 2007)

Contour Master

The first module used by the Dutch Type Library was *DTL Contour Master*. It can be used to test and correct all kinds of errors in contours, such as open contours, overlapping or double contours, double points, missing extreme points. Also, things like bar and line widths can be tested (*figure 7*). *DTL ContourMaster* tests and corrects the IK and BE formats. The BE (Bezier) is derived from the Ikarus format. The latter makes a description of contours at extremely high resolution possible. It can automatically correct the contours, according to the chosen options. A program like this is necessary, especially for large quantities of characters that form several code pages in a TrueType or OpenType font. Corrections made by the *DTL Data Master* are irreversible. To protect your original data it is not possible to overwrite the 'master' file (*figure 8*).

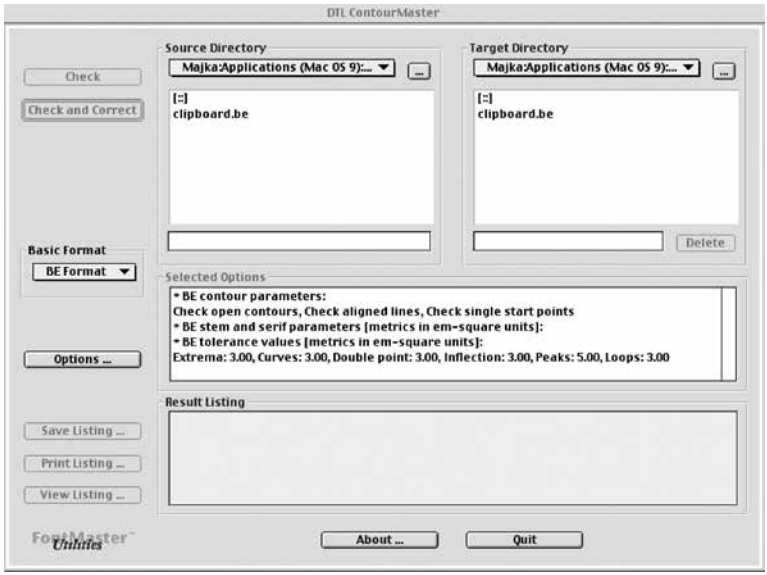


Figure 8 Starting dialog of DTL ContourMaster that has two major functions: to select one or more source fonts and to select one or more options for checking and correcting the source fonts (from DTL FontMaster 2.5.2 - DTL ContourMaster. screen shot 2007)

Kern Master

DTL Kern Master is a module for automatic creation of kerning pairs for BE and IK databases. This program is specially developed for OpenType production: it is possible to generate kerning for a complete BE and IK database, including Cyrillic, Greek, East European, etc. with one command. Because of that, in most cases, the kerning for the different scripts is stored in a single file. All the different files can be simply edited with a text editor. It is a fact that there are many

combinations that can not be optimized without kerning, especially with Cyrillic, Greek and East European characters. Using very sophisticated algorithms *DTL Kern Master* enables perfect optimization of spacing (*figure 9*). The quality of kerning generated with this program is extremely high, but it is always possible to make changes manually in the *DTL Bezier Master* or *DTL Ikarus Master* Metrics Window (*figure 10*). Any changes made will be saved automatically to the original metrics file. Group kerning can be done here as well. In *DTL Kern Master* the glyphs are converted first to extremely high resolution bitmaps before sophisticated algorithms are used to calculate the kerning. Complete BE and IK font databases can be supplied with kerning pairs. There is basically no limit to the number of kerning pairs, so very large databases that support multiple scripts can be used in combination with extensive kerning pair definitions. The actual calculation is a matter of seconds, depending on the speed of the computer unit (DutchType Library, 2007). *DTL Kern Master* does not work with font formats like PostScript Type 1, TrueType or OpenType directly. Fonts have to be converted to the BE or IK format in *DTL Data Master* first, before using *DTL Kern Master*. After processing the kerning pairs *DTL Kern Master* will show a listing that can be printed, saved and viewed (*figure 11*).

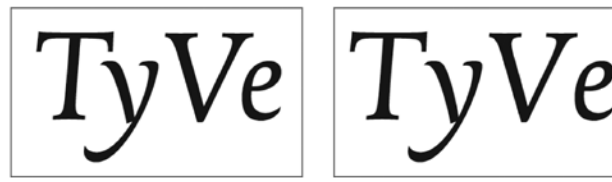


Figure 9 Two versions of the same typeface, with and without kerning pairs calculated by DTL KernMaster (from http://www.fonttools.org/, DTL KernMaster pdf manual (2004), screen shot 2007)

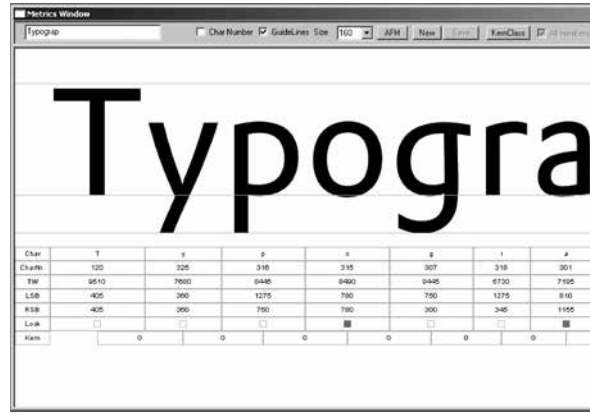


Figure 10 It is possible to check and alter the kerning in the Metrics Editor of both DTL Bezier- and IkarusMaster (from DTL KernMaster screen shot 2007)

```
DTL KernMaster 2.00.009A : Mar-25-2004 12:00:00
Batch processing is being started.
* kerning class file is "eMac 80GB:Applications (Mac OS 9):Dutch Type
Library:DTL FontMaster 2.00.009A:kernmaster.cla"
* kerning pair file is "eMac 80GB:Applications (Mac OS 9):Dutch Type
Library:DTL FontMaster 2.00.009A:kernmaster.krn"
* character layout file is "eMac 80GB:Applications (Mac OS 9):Dutch Type
Library:DTL FontMaster 2.00.009A:beeditor.cha"
* encoding key is "ANNumLat1"
+ kerning calculation ist being started
+ input: "eMac 80GB:Desktop Folder:AFM_Output:D_19_13T.BE"
+ output: "eMac 80GB:Desktop Folder:AFM_Output:D_19_13T.afm"
- output: "eMac 80GB:Desktop Folder:AFM_Output:D_19_13T.afm"
- input: "eMac 80GB:Desktop Folder:AFM_Output:D_19_13T.BE"
- kerning calculation has been finished
```

Figure 11 The listing of the kerning process in the DTL KernMaster that can be viewed, printed and saved (from DTL FontMaster 2.5.2, screen shot 2007)

Blend Master

DTL Blend Master is a module for interpolating fonts (*figure 12*). Normally, a Medium is calculated from the Regular and Bold variants of a typeface, that together form the extremes. From a mathematical point of view interpolating is not an especially complicated technique, but in font production it is not easy at all. This program checks and corrects contours of the extremes so that interpolation proceeds in a faultless manner (Dutch Type Library, 2004). It uses intelligent routines which make the number of points and the direction of the contours equal without changing the form of the glyphs. The interpolation requires only a few parameters. The interpolation factor can be independently defined for x-factor and y-factor. Normally the range for blending is between 0 and 100 percent. It is possible to process multiple files from two different folders with one command; in that case it is important that the two folders contain the same number of files. If characters fail to blend, an Encapsulated PostScript file showing the problem(s) can be generated. It is possible to import this EPS in *DTL BezierMaster* and make the necessary changes in the contours by hand.

Data Master

The module for managing, converting and generating database and font formats is called *DTL Data Master.* It converts font formats for Mac OS and Windows into BE (Bezier) and IK (Ikarus) formats that are used internally by the *DTL Font Master* utilities and vice versa.

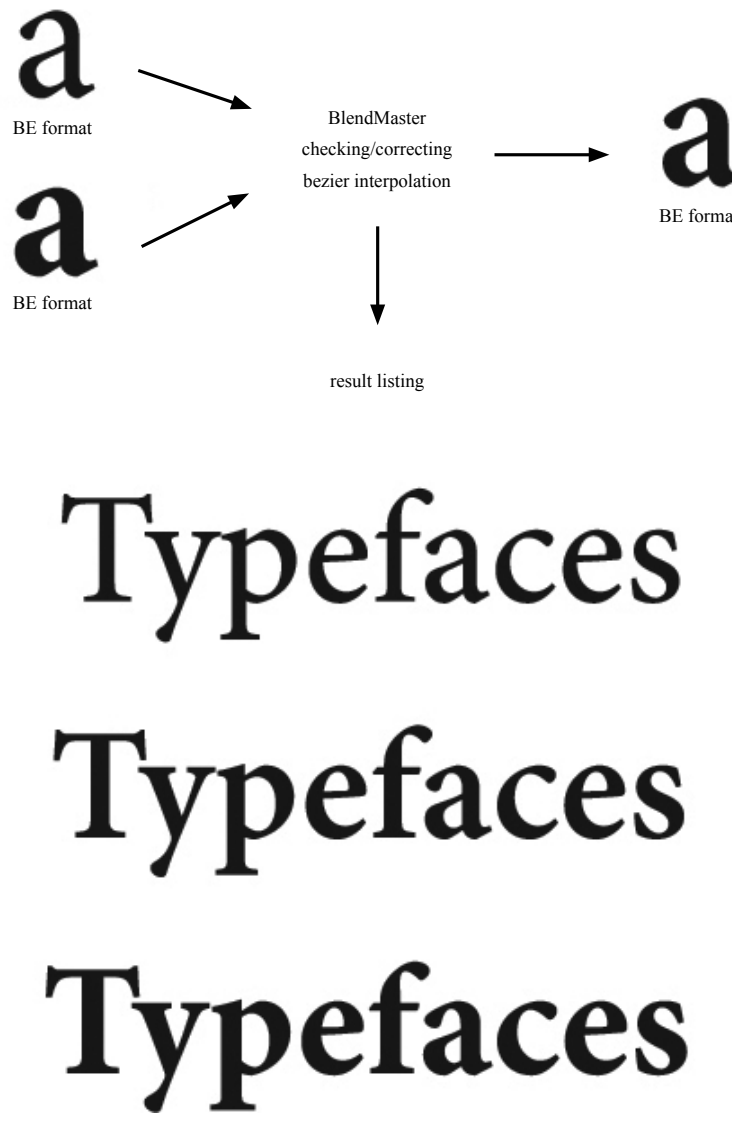


Figure 12 Interpolation process in DTL Blend Master and examples; the regular version (top) and bold version (bottom) of Minion typeface were blended to create medium weight (center) (based on Dutch Type Library [2004] Font Master Utilities manual)

In addition, it can create OpenType fonts according to the Adobe standard, which underlines the up-to-date status of *DTL Font Master*. All the meticulous work needed for the production of OpenType fonts is done automatically by the program. The approach is to provide a simple way to generate OpenType fonts that are also suitable for non-experts.

CONCLUSION

In conclusion, the modular structure of *DTL Font Master* as presented supports the stages of font production.

1) Design stage—Sketching on paper, resulting in manual digitizing (*IkarusMaster*) and/or auto tracing (*Trace-Master*); sketching/drawing on screen, directly in a font/glyph editor (*BezierMaster*/*IkarusMaster*), or using a vector graphics program like *Adobe Illustrator* in between.

2) Editing stage—Enhancing (aesthetically and technically) the design (*BezierMaster/IkarusMaster*); enhancing the glyph set, from a basic character set to multiple code page support (*BezierMaster/IkarusMaster*); *s*pacing (*BezierMaster/IkarusMaster*); kerning (*KernMaster/BezierMaster*).

3) Data management stage—Database building/enhancing/merging (*BezierMaster/IkarusMaster*); consistency checking (*ContourMaster*); technical quality control (*ContourMaster*).

4) Font generation stage—Producing different formats for different platforms (*DataMaster*).

5) Format enhancement stage—Delta hinting (Visual TrueType - a professional level tool for graphically instructing TrueType and OpenType fonts); adding OpenType features (*DataMaster*/Visual OpenType Layout Tool - a Microsoft tool providing graphical user interface to add OpenType layout tables to fonts with TrueType outlines) (Blokland, 2006).

There are a few shortcomings of this software, for example, *DTL FontMaster* is not one-hundred percent compatible with Macintosh OS X system yet. It is compatible with Windows and older Macintosh systems, but with Mac OS X some functions don't work. When digitalizing fonts with *IkarusMaster* you need to have a *Wacom* or similar, specially made digitalizer which adds an extra cost to your font production. Also, the autokerning function in *KernMaster* is not yet perfect, so manual adjustments and control over kerning pairs is still required, because it can create some unusual kerning pairs. It is also important to say that this software is professional and not so user-friendly for beginners. The module configuration is great for professionals because it gives them more control over the process, but is rather confusing for beginners. So, if you are planning to make your first font, *DTL FontMaster* may not be the best choice for you. These are the so-called, downsides, which are minimal when we

consider all advantages that *DTL FontMaster* offers. The separation of work stages, which makes managing the font production process more convenient, also supports various functions and customization of interfaces which are time saving. This and all previously mentioned features and qualities make *DTL Font Master* the most sophisticated font production software available, at least for the time being.[1] The following things are being worked on at this time: adapting the modules for Mac OS X; enhancing OpenType layout feature generation, batch functionality and command file support.

END NOTES

1 – You can download *DTL Font Master Light 2.5.4*, for Windows and Mac, from the web site. The light versions of *DTL Bezier-* and *Ikarus Master* are fully functional and have only one restriction: not more than 256 glyphs can be stored per database. The light version of *Contour Master* makes a complete testing of multiple font databases possible, automatic improvement is only enabled in the full version. Of *DTL Kern Master* and *Trace Master* only demo versions are available for free. The light and demo versions of *DTL FontMaster* run under *Mac OS 8.6* and 9.x, *Mac OS X Classic* mode, *Windows 95/98, Me, NT, 2000, XP* and *Vista* (Dutch Type Library, 2007).

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AUTHOR NOTE

With a diverse background in civil engineering, graphic design and visual communication, Nikola received a master degree at Royal Academy of Art, department of Type and Media, The Hague, Netherlands in 2005. Since that time he teaches three typographic courses at the University of Zagreb, School of Design. A country delegate for Croatia with AtypI (Association Typographique Internationale), he is currently a PhD student in the Faculty of Graphic Arts, University of Zagreb. His research focus is finding the aesthetic parameters of typography in relation to the Croatian language.

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