

Grammar based design tools: Issues of representation and interaction

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Designing With Vision Workshop
The Open University, 8 June 2010
<http://design.open.ac.uk/DV/>

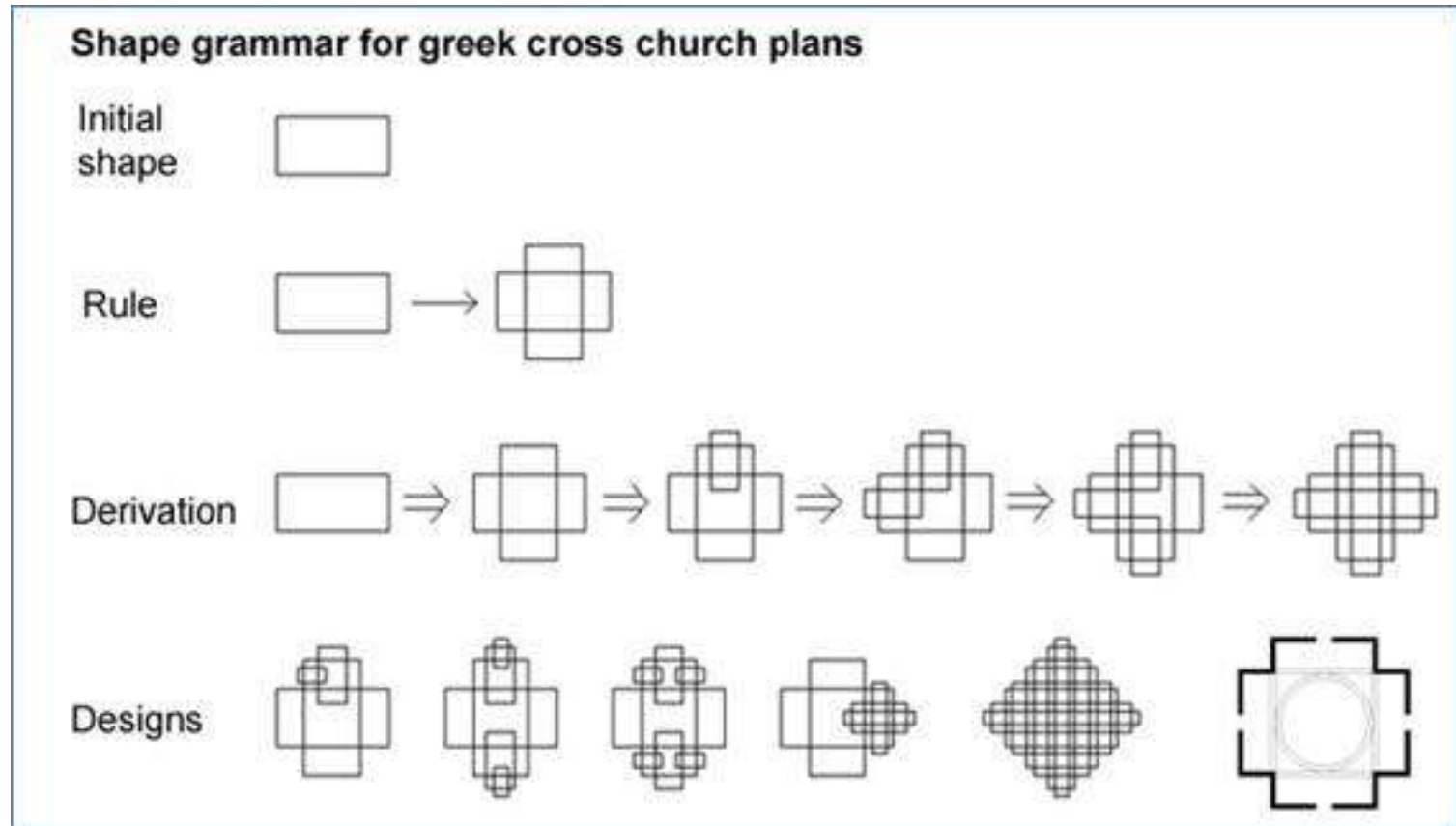


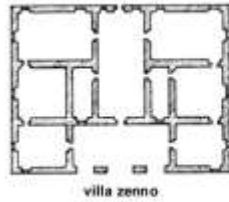
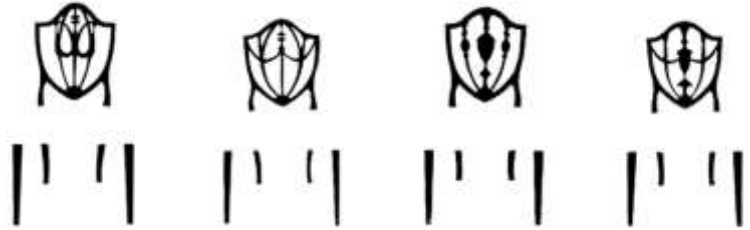
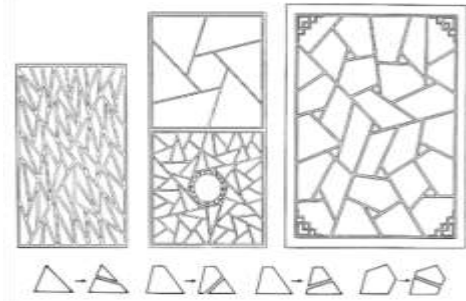
Challenge

We want conceptual design tools that support designers' ways of thinking and working and enhance creativity, e.g. offering design alternatives difficult or not possible without the use of such tools.

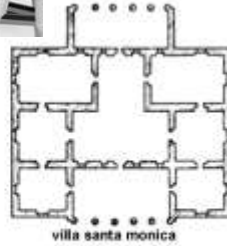


Shape grammars

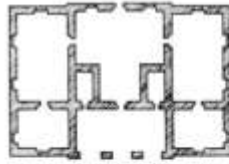




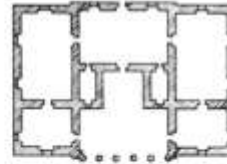
villa zenno



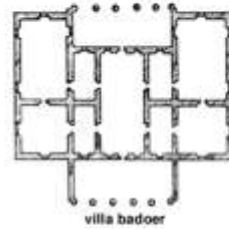
villa santa monica



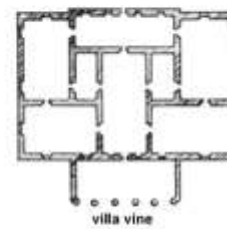
villa sarraceno



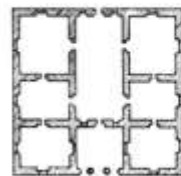
villa sepulveda



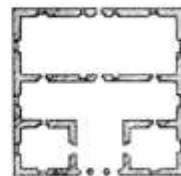
villa badoer



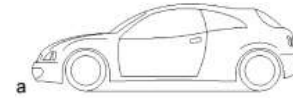
villa vine



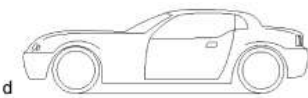
villa angarano



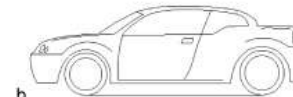
villa hollywood



a



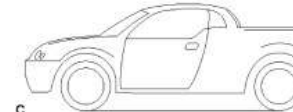
d



b



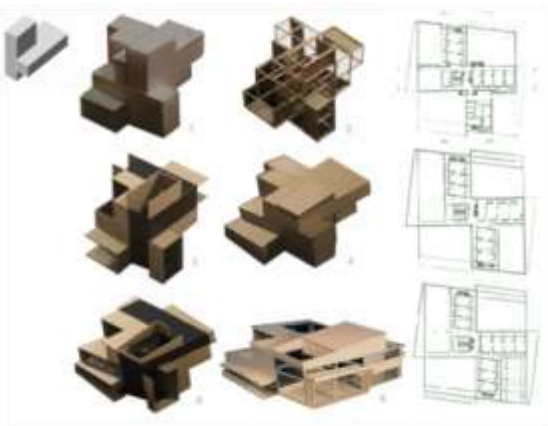
e



c



f





Grammar applications

- Analysis
 - Grammar construction from a corpus of designs
- Synthesis
 - New grammars of design styles
- Transformation
 - From one design style to another
 - Change of design brief
 - Hybrid, crossover designs

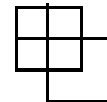


Emergence

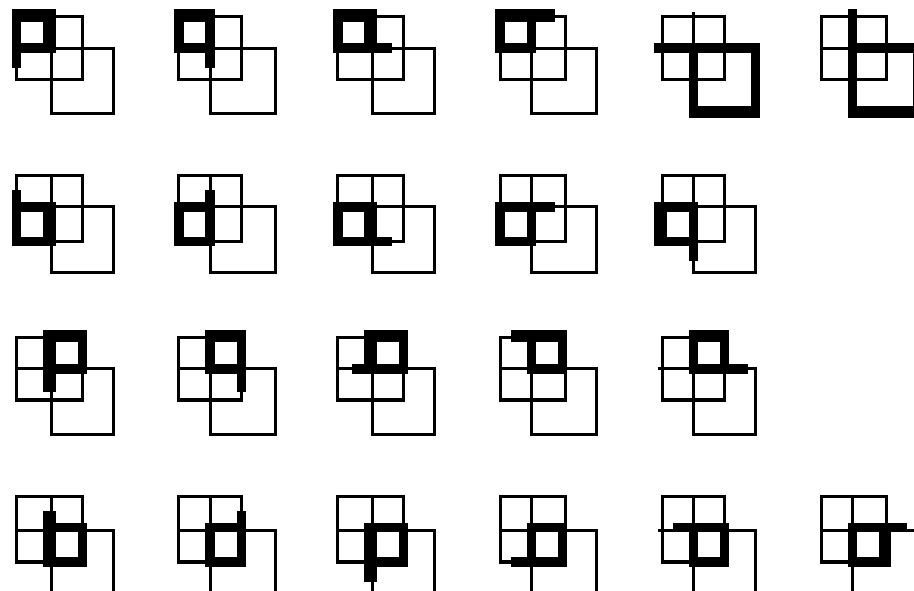
A: 4 maximal lines



S: 8 maximal lines



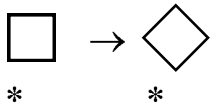
$\tau(A) \leq S$



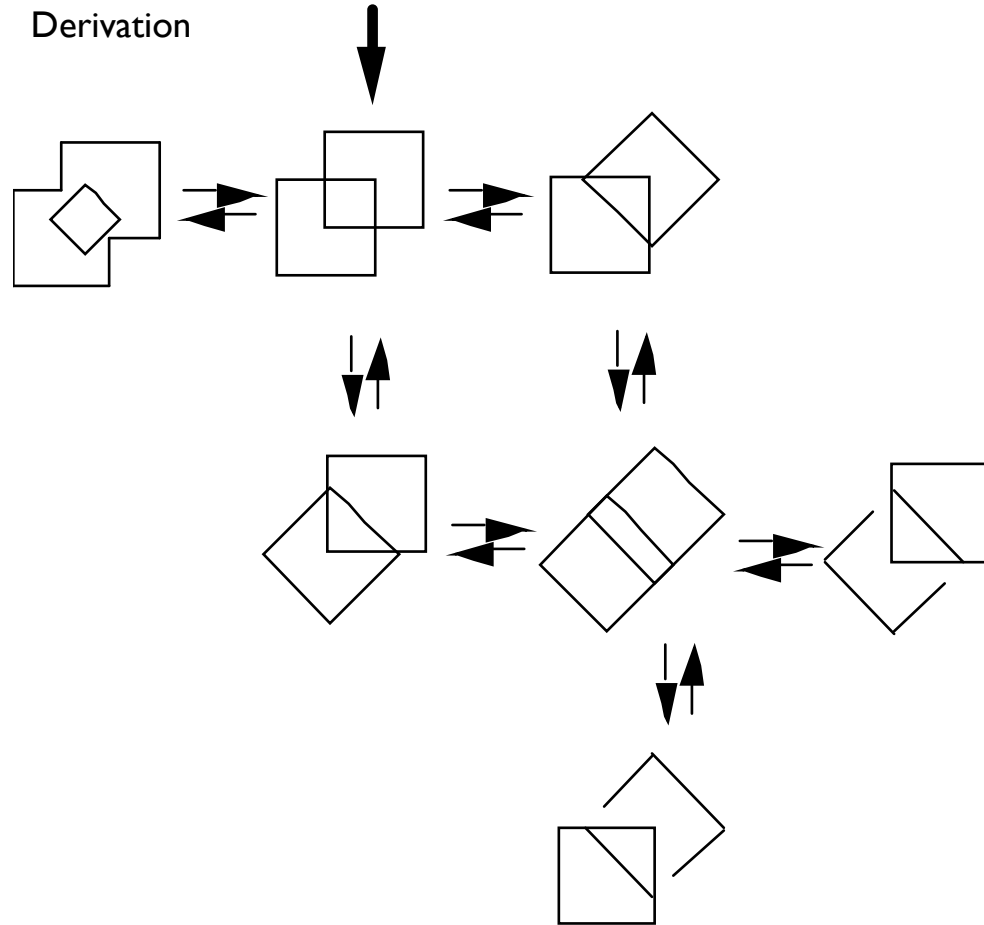


Unexpected results

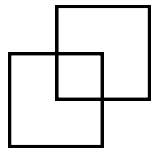
Rule



Derivation



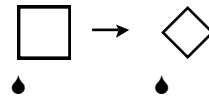
Initial shape



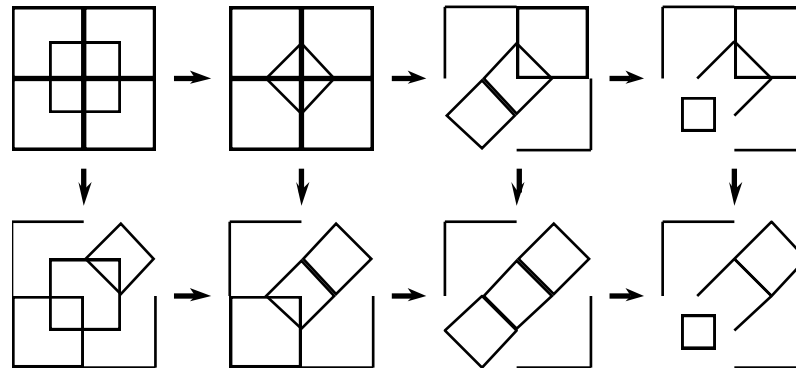


Emergent forms

Rule R

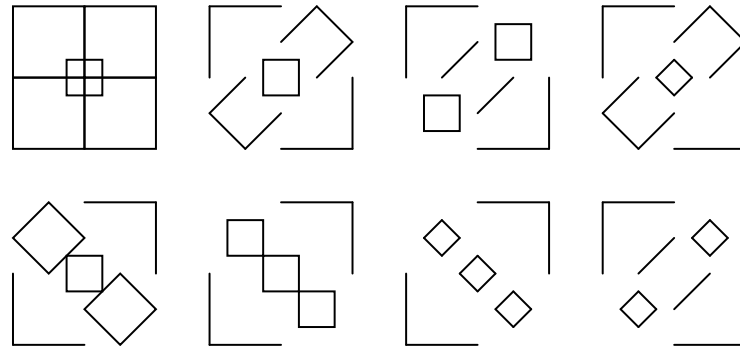


Initial shape S



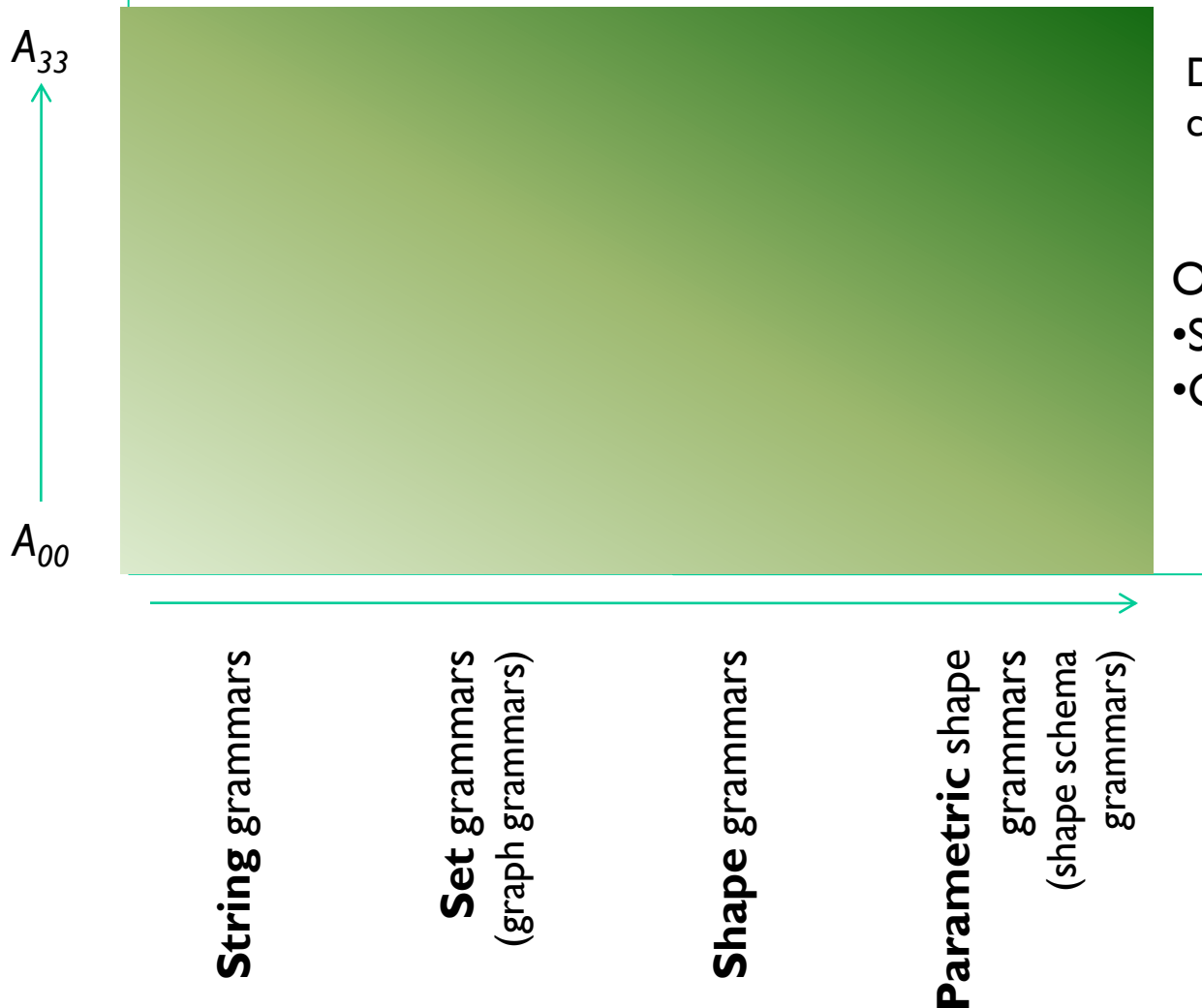
derivation

emergent forms





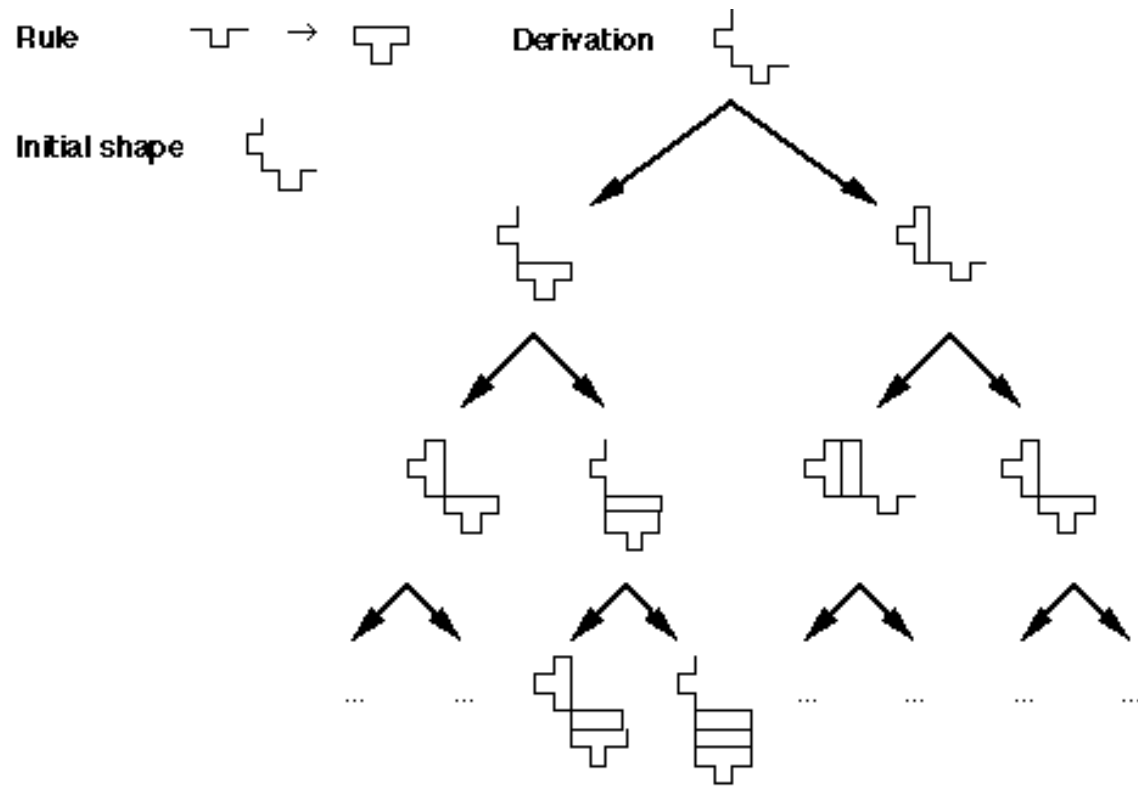
Grammar computational complexity



Darker areas indicate more computational complexity

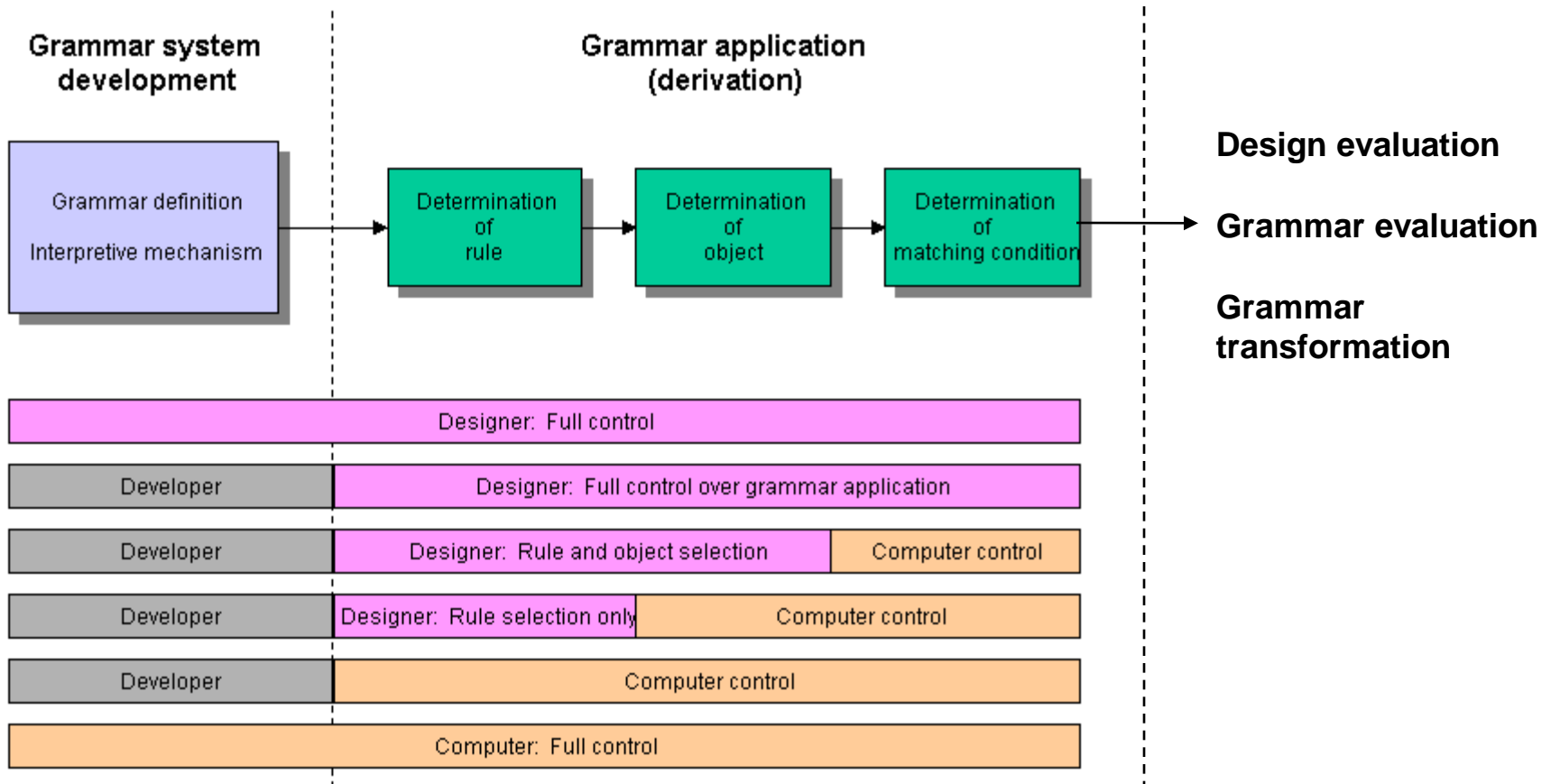
Other factors:

- Symbolic/semantic information
- Composite representations





Grammar use & interaction





Issues for computer implementation

- Maximal element representations create huge computational issues (e.g. combinatorial explosion)
- Designer interaction with such systems is a challenge
 - e.g. how to present all possibilities to the designer



Common implementation restrictions

- ‘Toy’ systems, e.g. proof of concept
- Single design application, hard coded
- Representation restrictions, e.g. set grammars, raster representations
- Design restrictions, e.g. orthogonal designs only

Do these restrictions keep us from moving forward?



File Edit Format Search Eval

Query	Rule 5
<pre>/* "shapegrammar.pro" Consulted. */ yes ?- initialize. yes ?- start. initial shape file: initial3.dba rules file: rules5.dba /* Consulting "initial3.dba" */ /* "initial3.dba" Consulted. */ /* Consulting "rules5.dba" */ /* "rules5.dba" Consulted. */ yes ?- redraw. yes ?- go. Enter rule #: 5 Enter rule point 1: Dig = (24,48) Found Enter rule point 2: Dig = (48,48) Found Enter rule point 3: Dig = (49,24) Found Pick shape point 1: Dig = (101,150) Found Pick shape point 2: Dig = (200,150) Found Pick shape point 3:</pre>	
	Design



GEdit

Rules Help 11:31:36

Current Shape

1 x (1/12)

Memex

Possibilities...

abcd

Alternatives

Abstract Steve Wu

Gen-designs software do

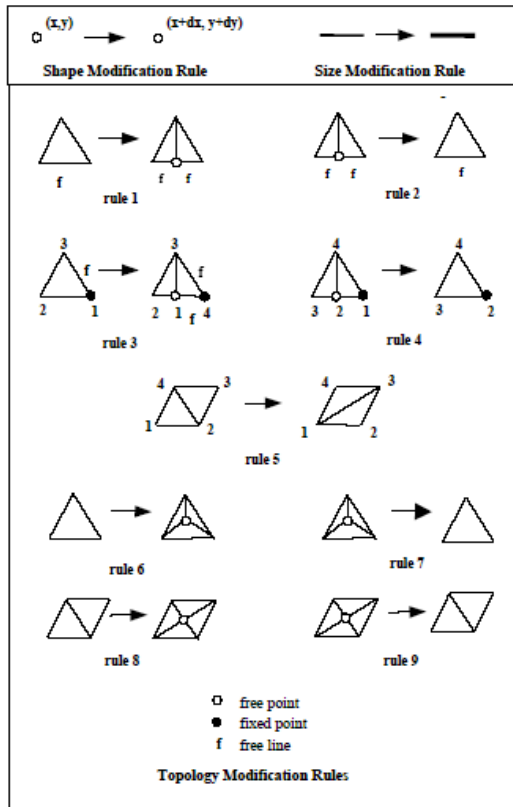
Total number of transformations 2

Possible

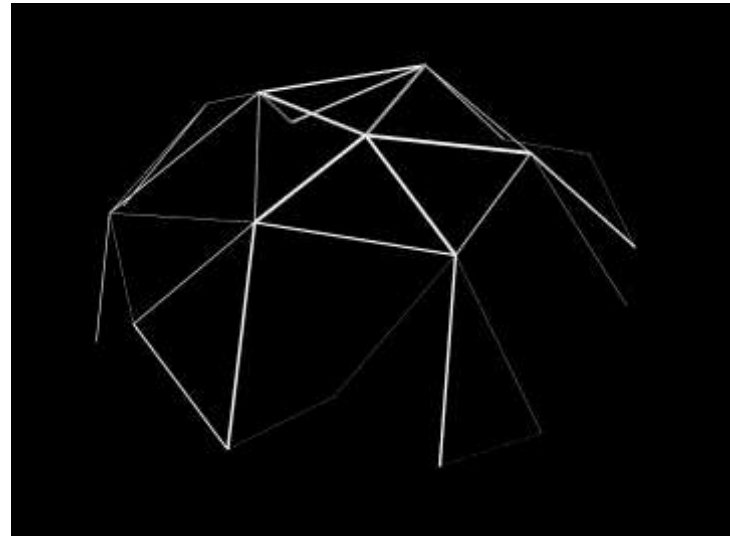
15



EifForm



Planar truss grammar



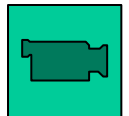
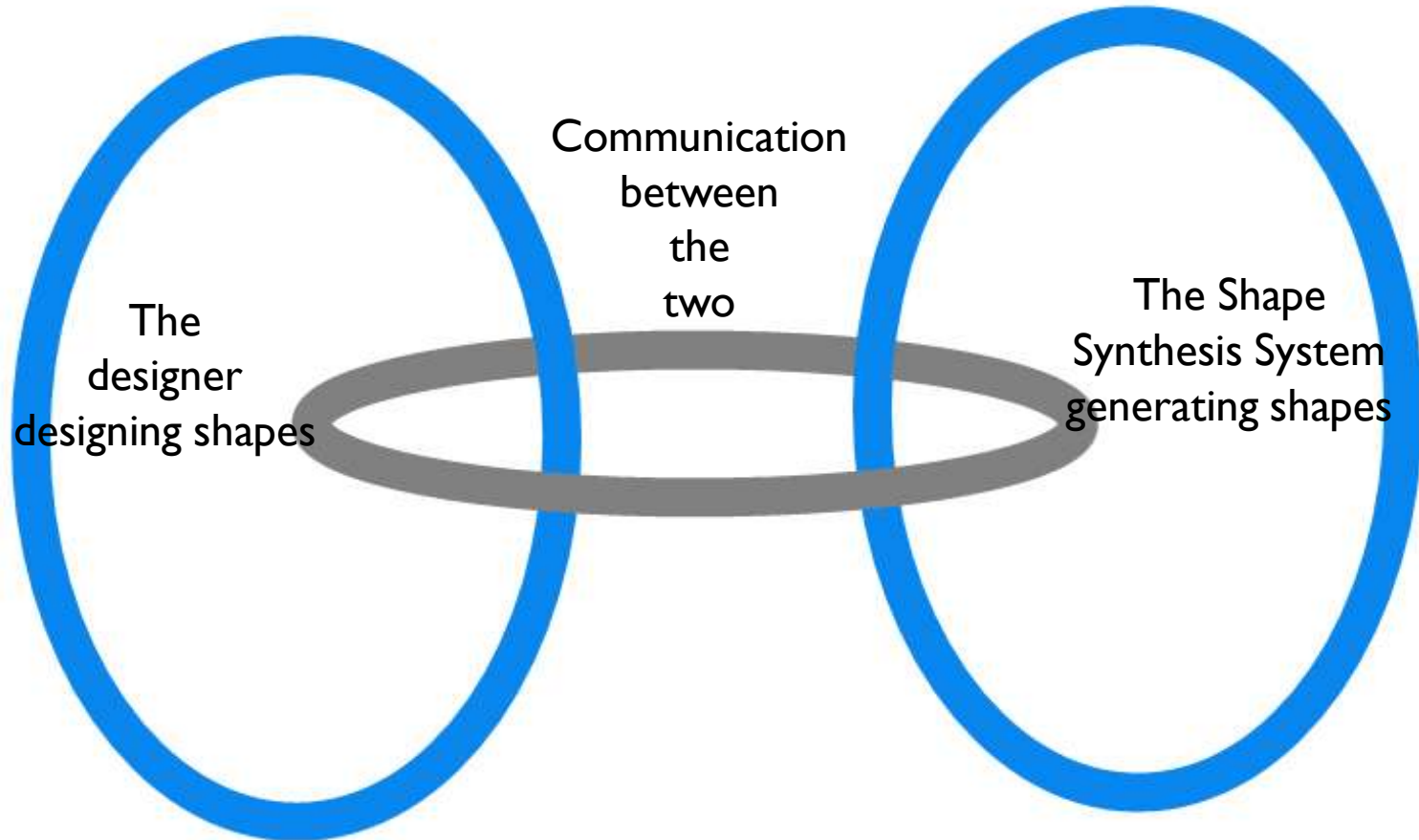
Dome



Canopy/landscape



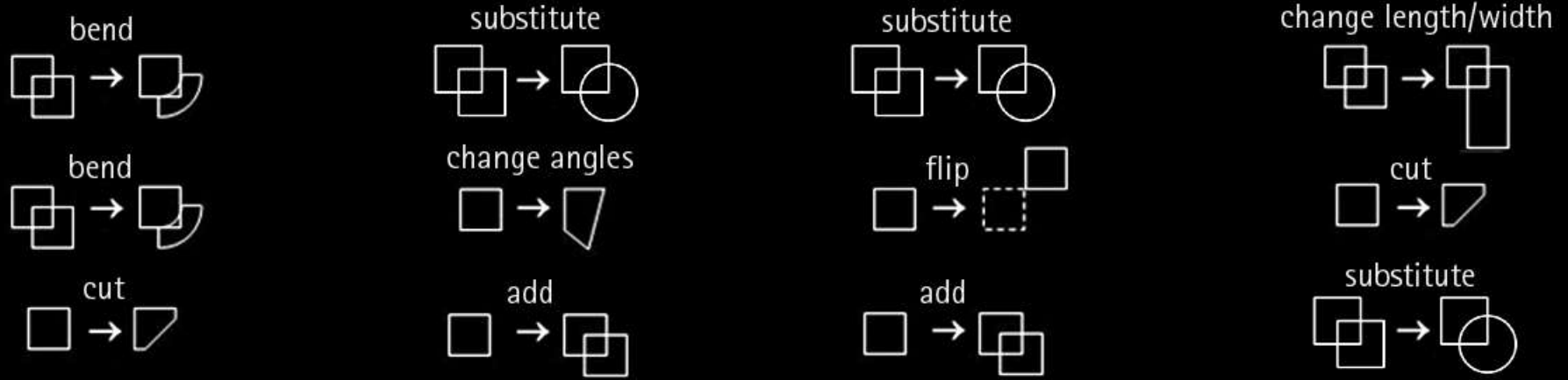
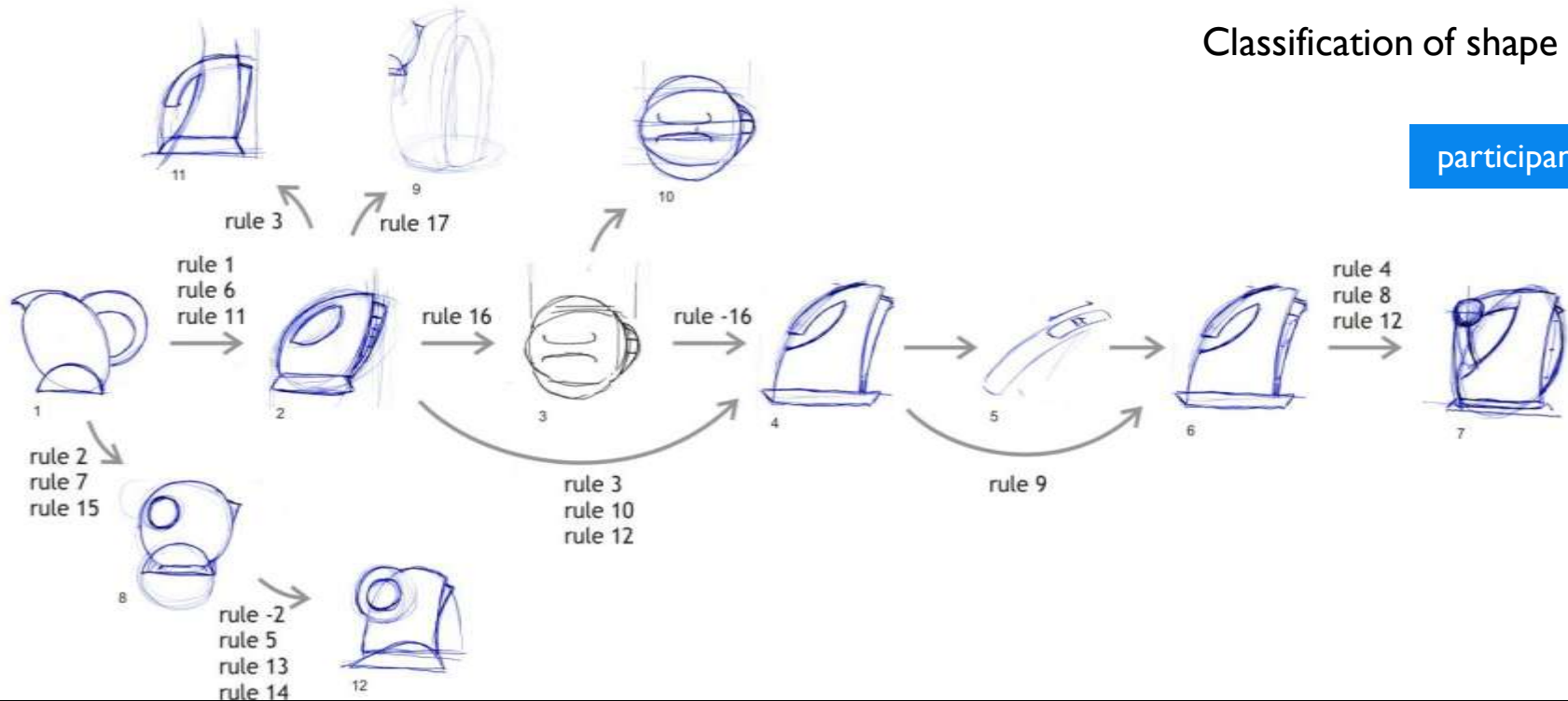
DSSG project overview
... we anticipate three intertwined cycles

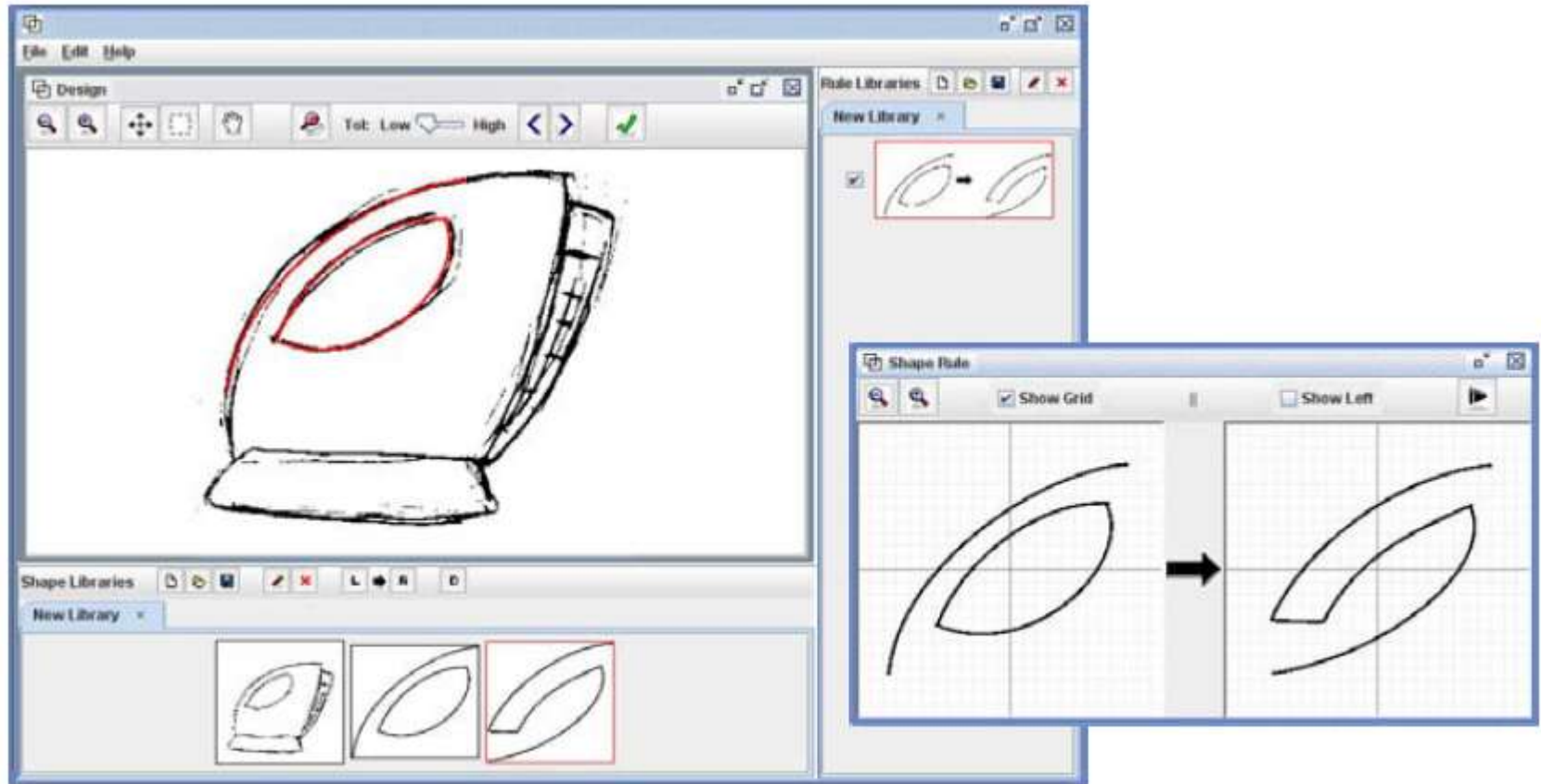




Classification of shape rules

participant I



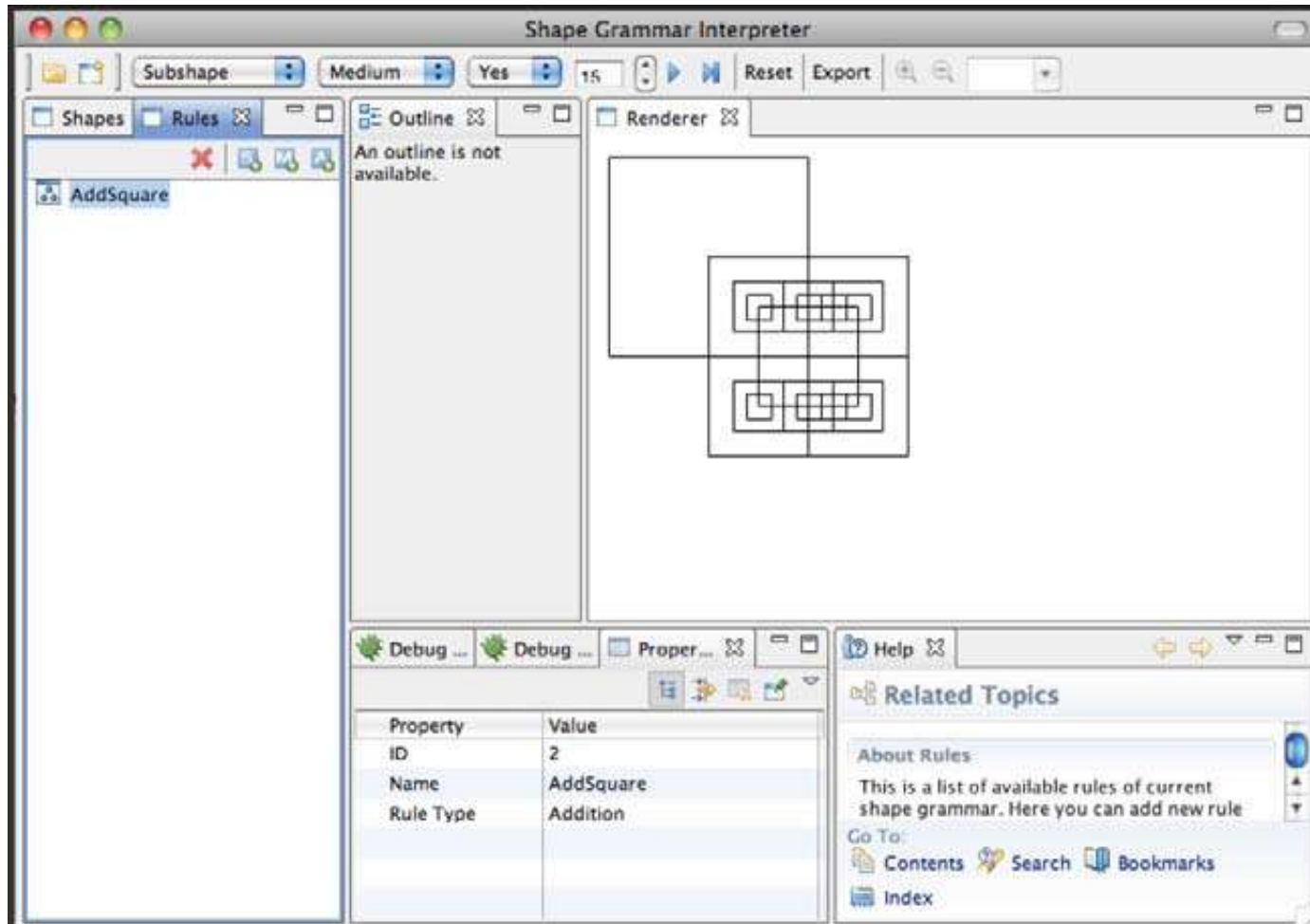


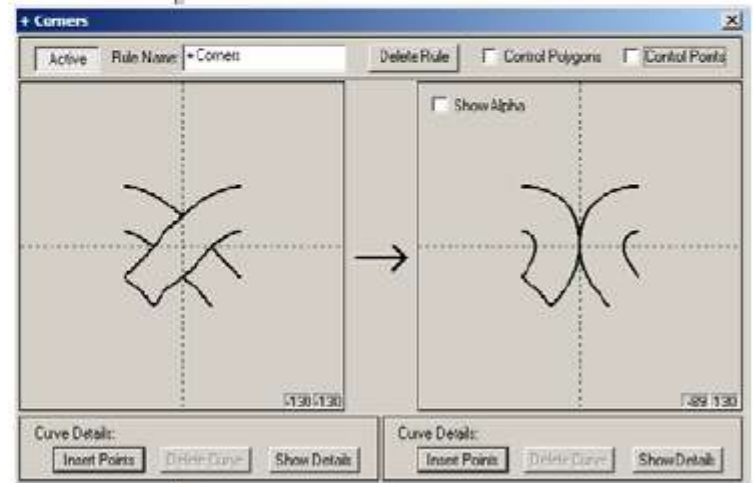
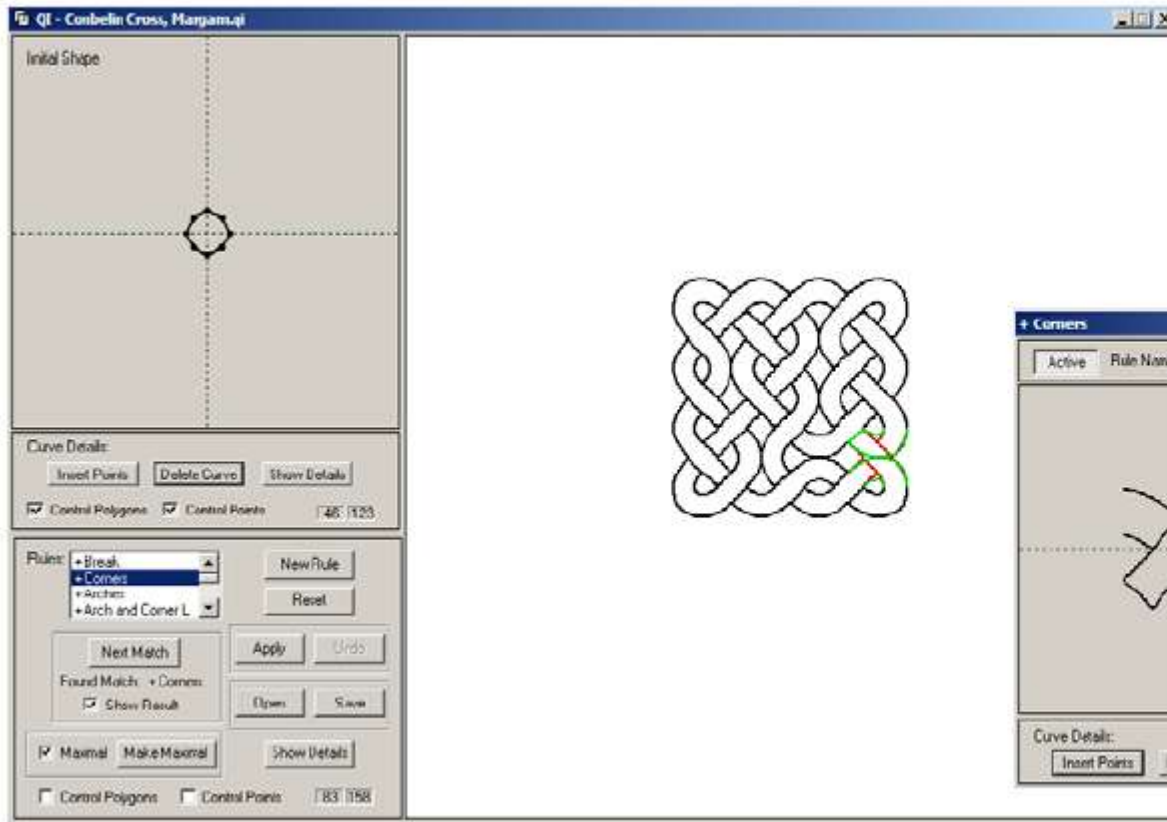


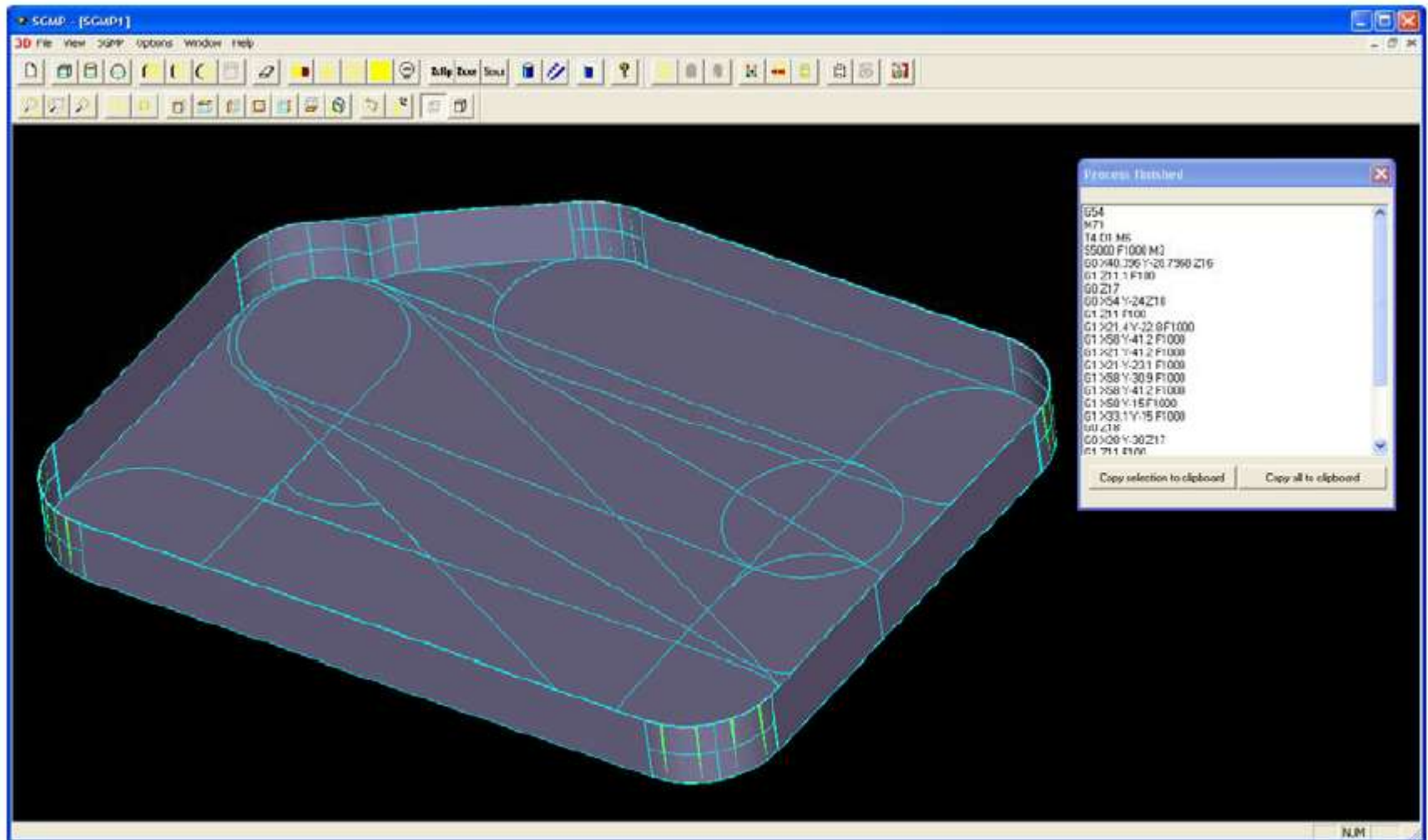
Recent grammar implementations

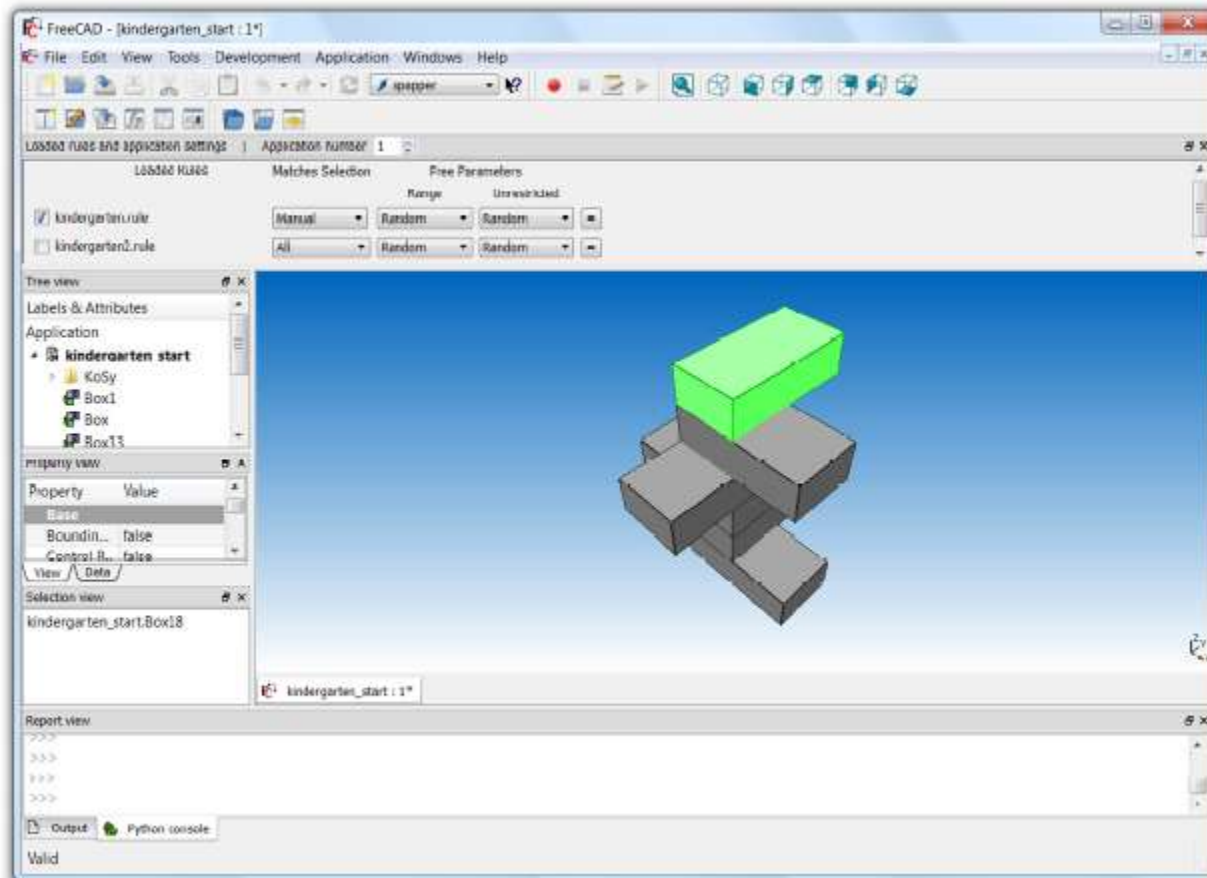
To be demonstrated at DCC 2010, 11 July

1. Grammar development environment
2. General interpreter for rectilinear forms
3. 3D parameterised primitives
4. Curved shapes
5. Machining planning
6. Subshape detection w/computer vision
7. Mass customised housing











So, while there is ongoing research activity looking at issues of representation, interaction and use, how close are we to having truly useful grammar based design aids?