Analysis of role of design in furniture production and market by applying ANP

Majid Azizi

Professor, Department of Wood and Paper Science and Technology, Faculty of Natural Resources, College of Agriculture and Natural Resources, University of Tehran

Gholamreza Mehdikhanloo

M.S. Graduate, Department of Wood and Paper Science and Technology, Faculty of Natural Resources, College of Agriculture and Natural Resources, University of Tehran

Introduction

The furniture industry in the world has been ranked first in the light industry due to job creation and early returns in the last two decades.

The furniture industry currently accounts for 2 percent of global trade, and this is growing.

Iran's share of global furniture trade is only 0.02 percent.

The value of furniture design in the furniture industry has been around 180 billion dollars over the past decade, with G7 countries having a share of 60% and 20% of developed countries and 20% of the rest of the developed countries.

The furniture and peripheral industries account for 10% of employment in Iran and it has a special role and is one of the early returns industries.

The necessity of doing research

-Lack of innovation and creativity in design
-Copying the works
-Increase in supply amount
-Competition is very seriously
-Distinctive design having the similar raw material and machineries is advantage

Literature review

-Ratnasingam and Lorass (2003) proposed criteria of designing as one of the factors influencing sustainability of Asia's wooden furniture industry future.

-Gazo(2005) presented importance of design in furniture industry of Malaysia and its role in attaining growth and higher added value.

- Swann & Birke (2005) showed that creativity and design influence R&D. As inputs, creativity and design play an important role in the innovation and performance of a business.

- A study by Gemser and Leenders (2001) on Dutch companies showed that design integration in the development projects of new product has a significant positive impact on the company performance (profit, turnover, sales, and exports).

Research Design/Methodology

The analytic network process (ANP)

- **ANP is most suitable technique for our study**
- **ANP provides a broad framework for decision making in complicated environments.**
- **ANP extends dependence and feedback and generalization of the super-matrix approach. It allows interactions and feedback within clusters (inner dependence) and between clusters (outer dependence).**

The ANP is a coupling of two parts

- **Control hierarchy**
- **Network of influences among the elements and clusters**

- **The network varies from criterion to criterion and a super-matrix of limiting influence is computed for each control criterion.**

- **Finally, each of these super-matrices is weighted by the priority of its control criterion and the results are synthesized through addition for all the control criteria.**

To determine how to study the role of design and provide appropriate solutions,

Reviewing the internal and external resources,

Interviewing the producers and academicians,

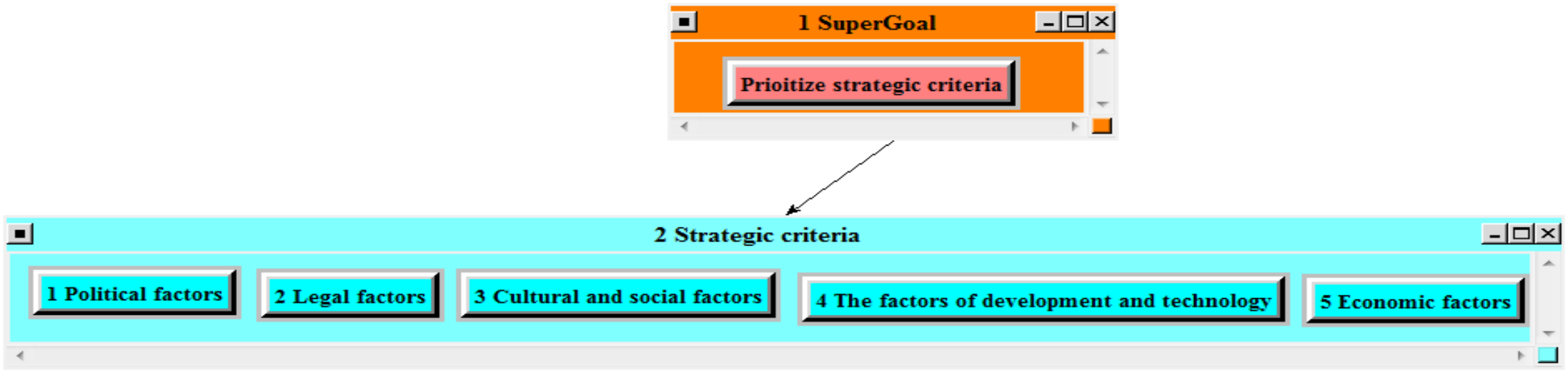
Describing the work and demands of the researcher,

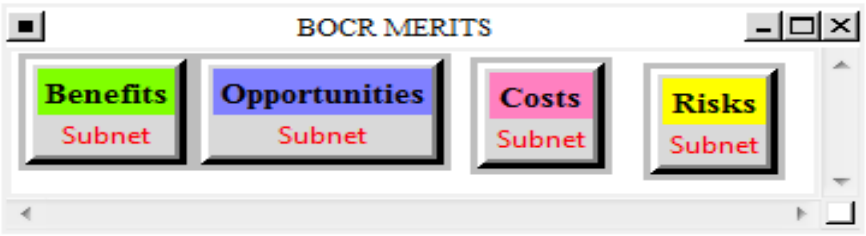
A comprehensive list of effective criteria was developed to enable us to understand all the important criteria on decision making in relation to the role of design.

To do this, the views of more than 40 furniture industry experts were used.

Finally, 296 sub-criteria in 31 intermediate criteria were identified and in five general groups or control criteria were designed.

Overall structure of decision making





The Alternatives

There are four potential alternatives for role of design:

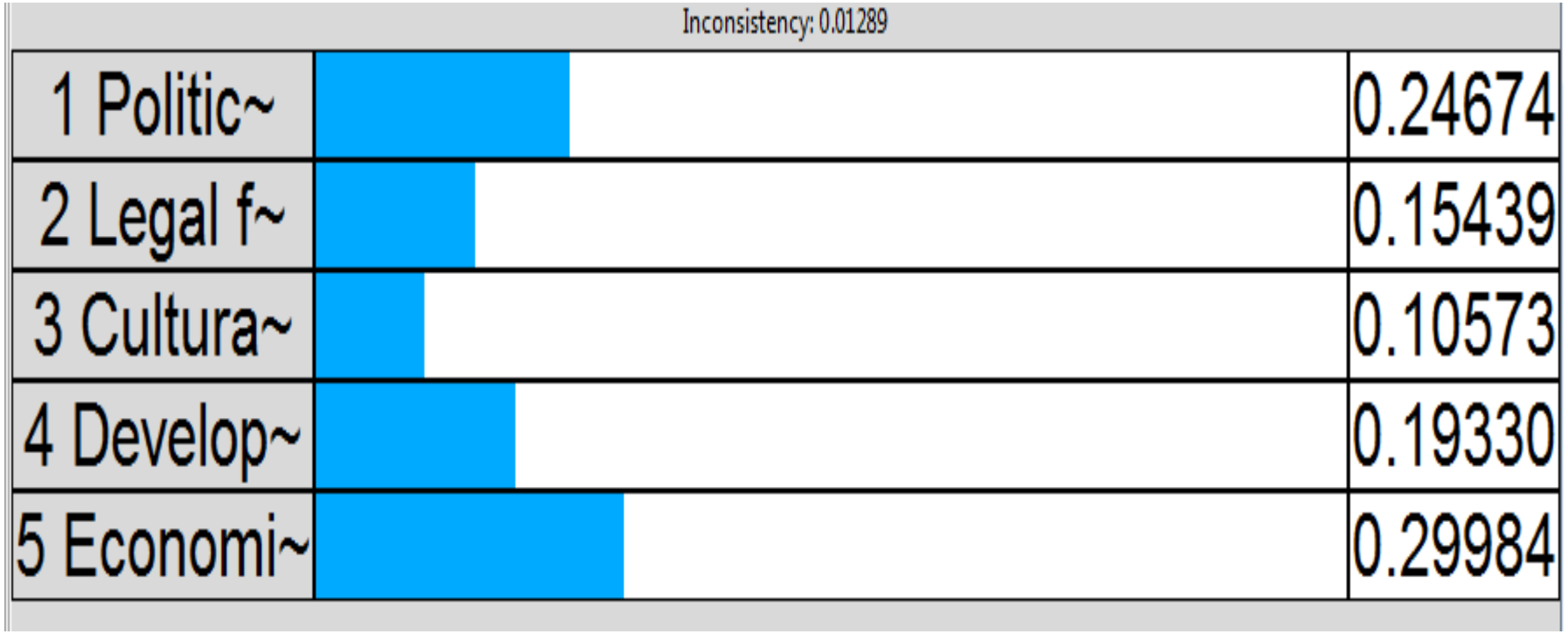
- **Using fashion design in furniture production (S1),**
- **Using engineering design in furniture production (S2),**
- **Using a combination of fashion and engineering designs in furniture production (S3),**
- **Applying leading countries' design capability with an outsourcing approach in furniture production (S4).**

Strategic criteria

In this research the merits of benefits, costs, opportunities, and risks are weighted by five general factors, liable to one of the following broad categories:

- **Development and technological**
- **Cultural &social**
- **Economic**
- **Politic**
- **Legal**

Strategic criteria



The economic criteria (0.299) has the highest priority

For selecting the most appropriate alternatives, the best approach is to categorize the criteria into favorable and unfavorable categories.

- **The decision maker considers the favorable criteria as benefits and the unfavorable criteria as costs.**
- **The possible events are also divided into opportunities and risks criteria, depending whether they are considered to be positive or negative (Saaty, 2001a).**

Prioritizing BOCR

Rating of the model to obtain BOCR weighing values very high (1), high (0.51), medium (0.252), low (0.124), very low (0.065)

	Benefits	Costs	Opportunities	Risks
Economic(0.299)	Very high	medium	Very high	high
Politic(0.246)	high	high	Very high	high
Legal(0.154)	Very high	high	high	high
Cultural &social(0.105)	high	low	high	medium
Development and technological(0.193)	high	medium	high	high
Overall priorities	0.313	0.146	0.332	0.207

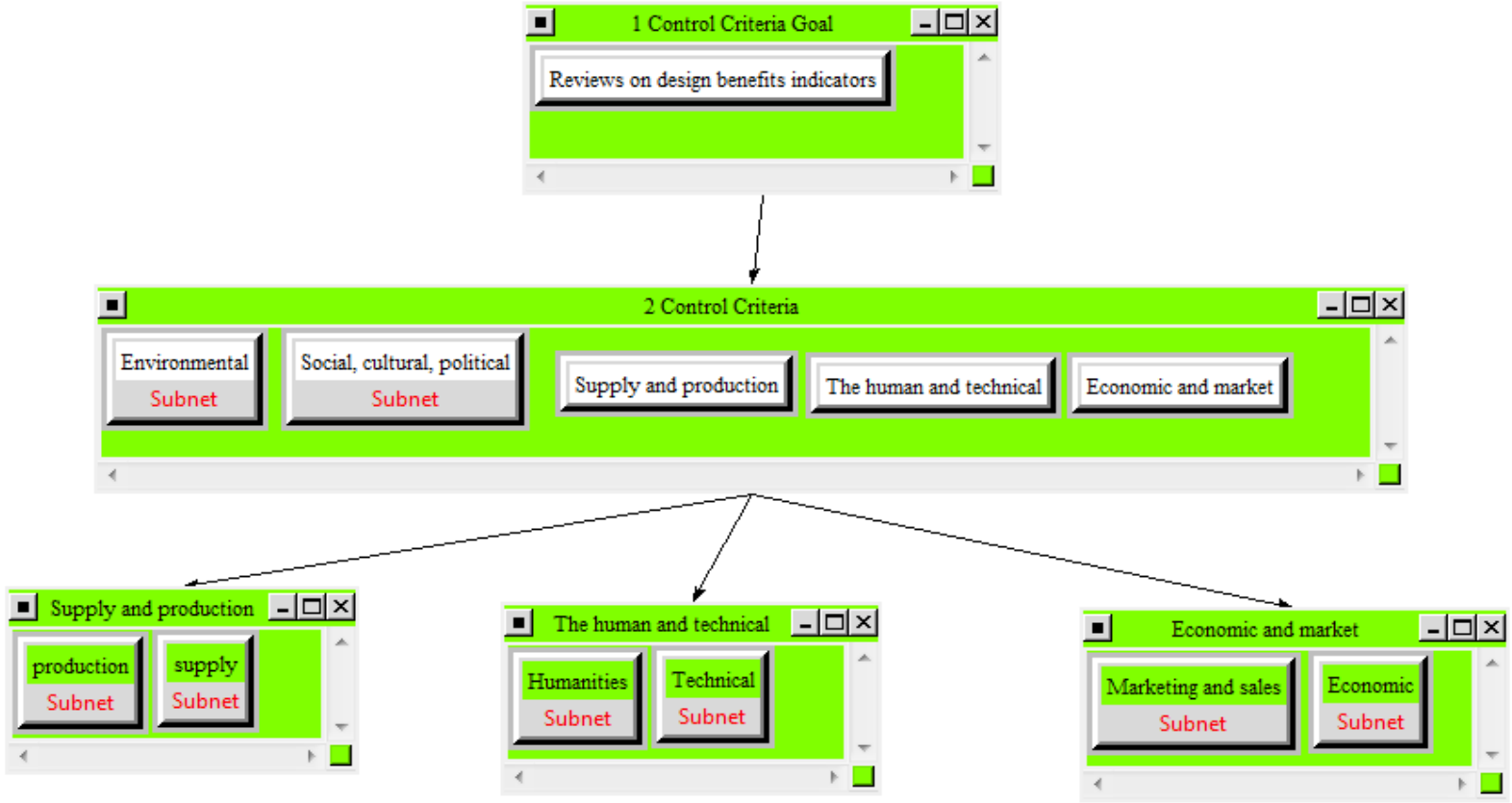
Opportunities has obtained the highest priority with weighting value 0.332

Control criteria network

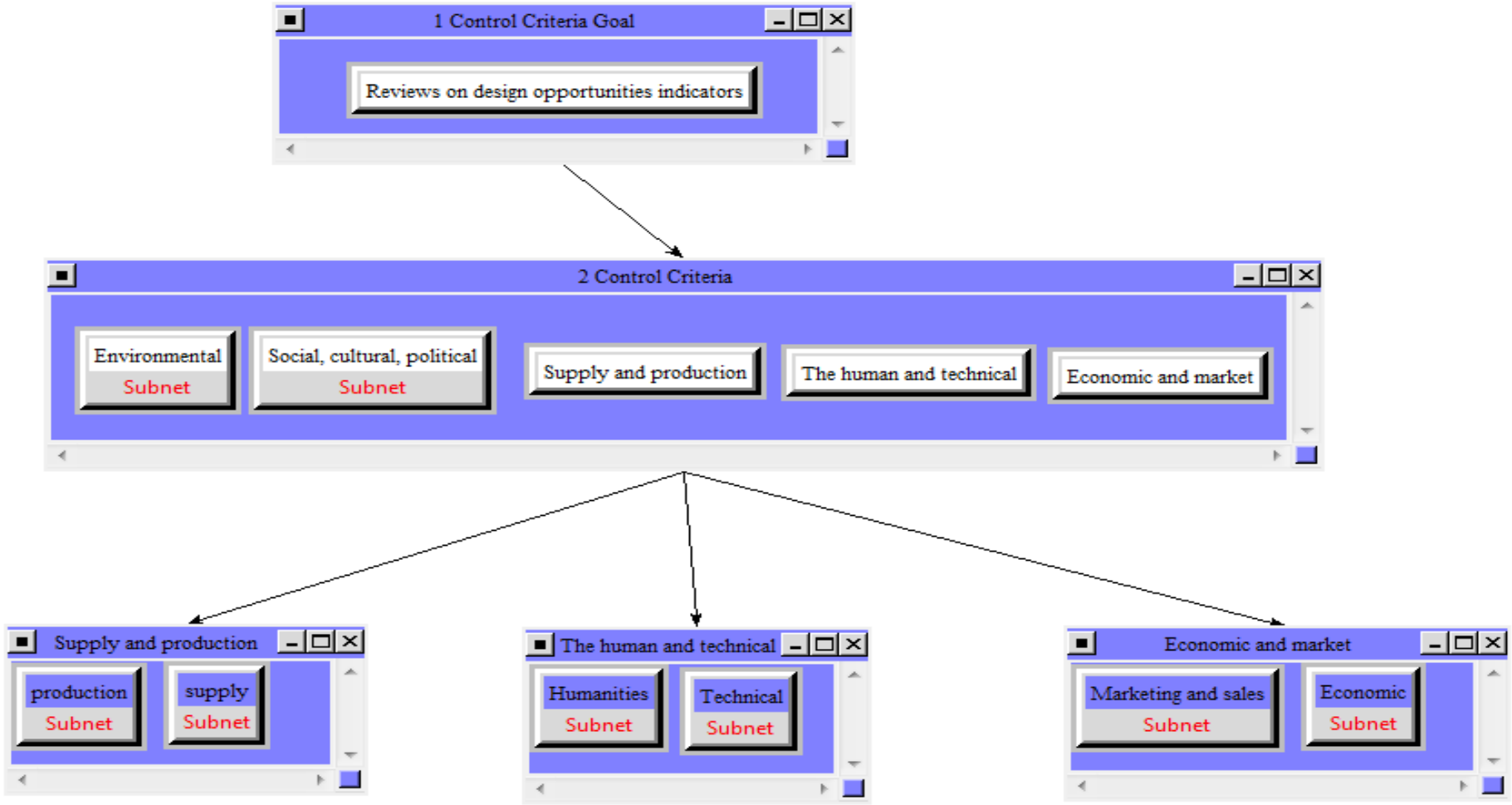
Network of control criteria under benefits, costs, opportunities and risks are as follows:

- **Economic and marketing**
- **The man force and technical**
- **Supply and production**
- **Social, cultural & political**
- **Environmental**

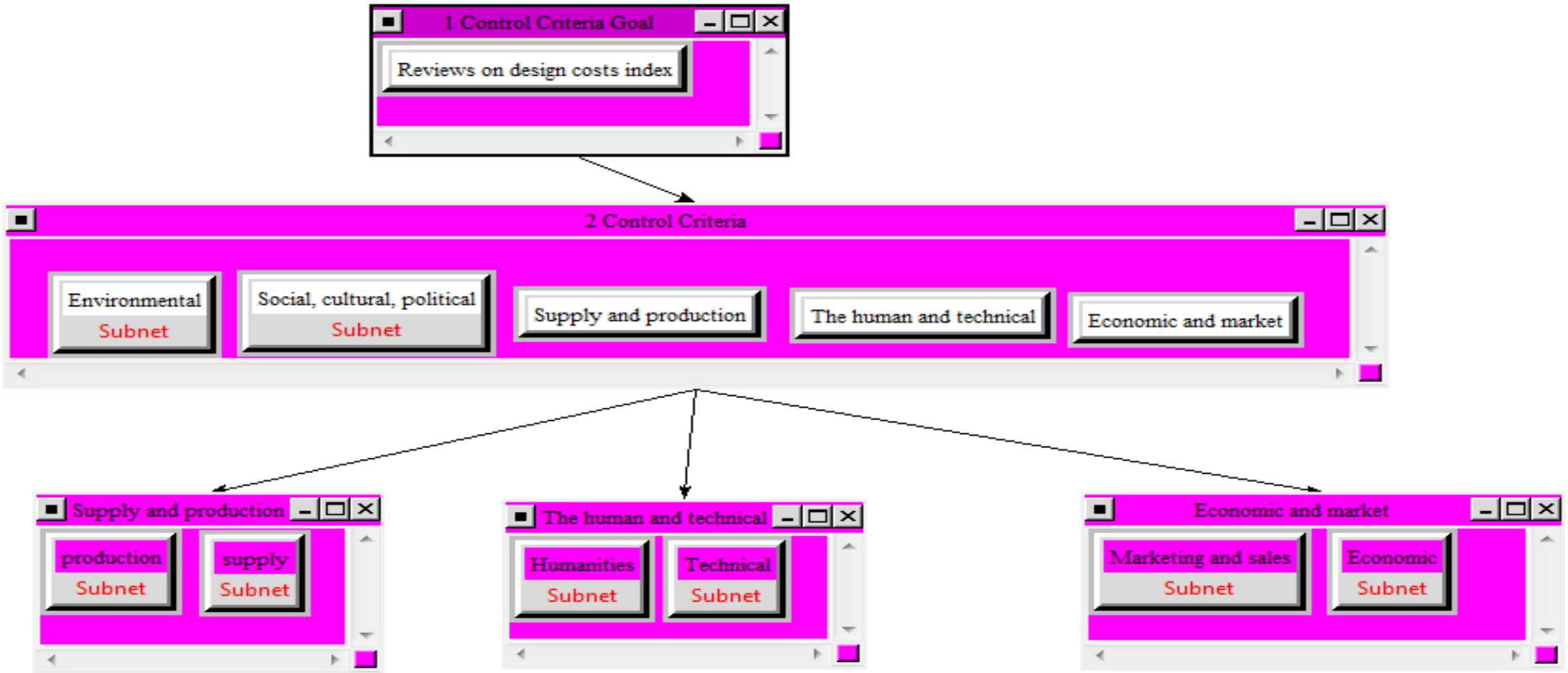
Control criteria network under benefits



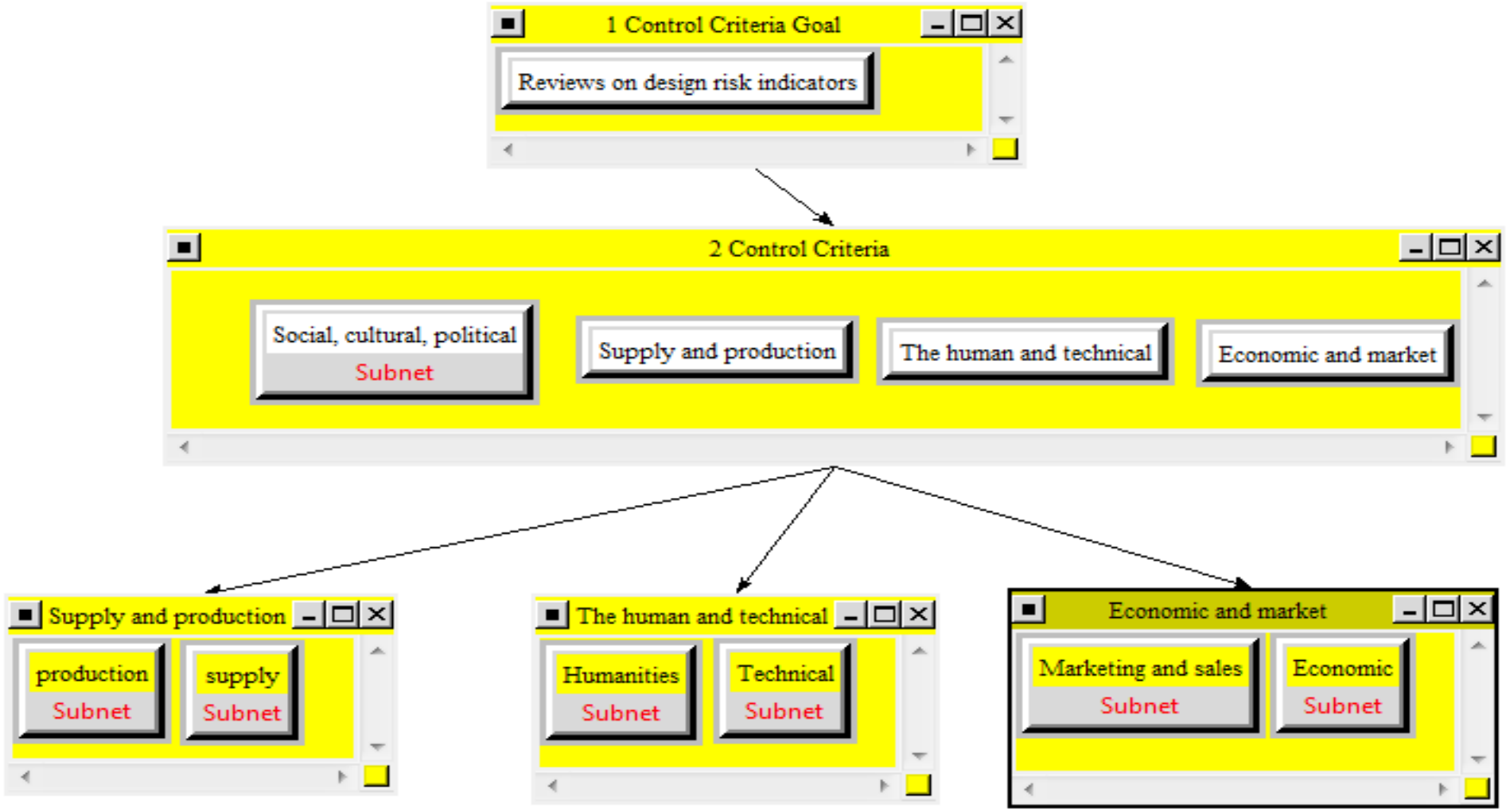
Control criteria network under opportunities



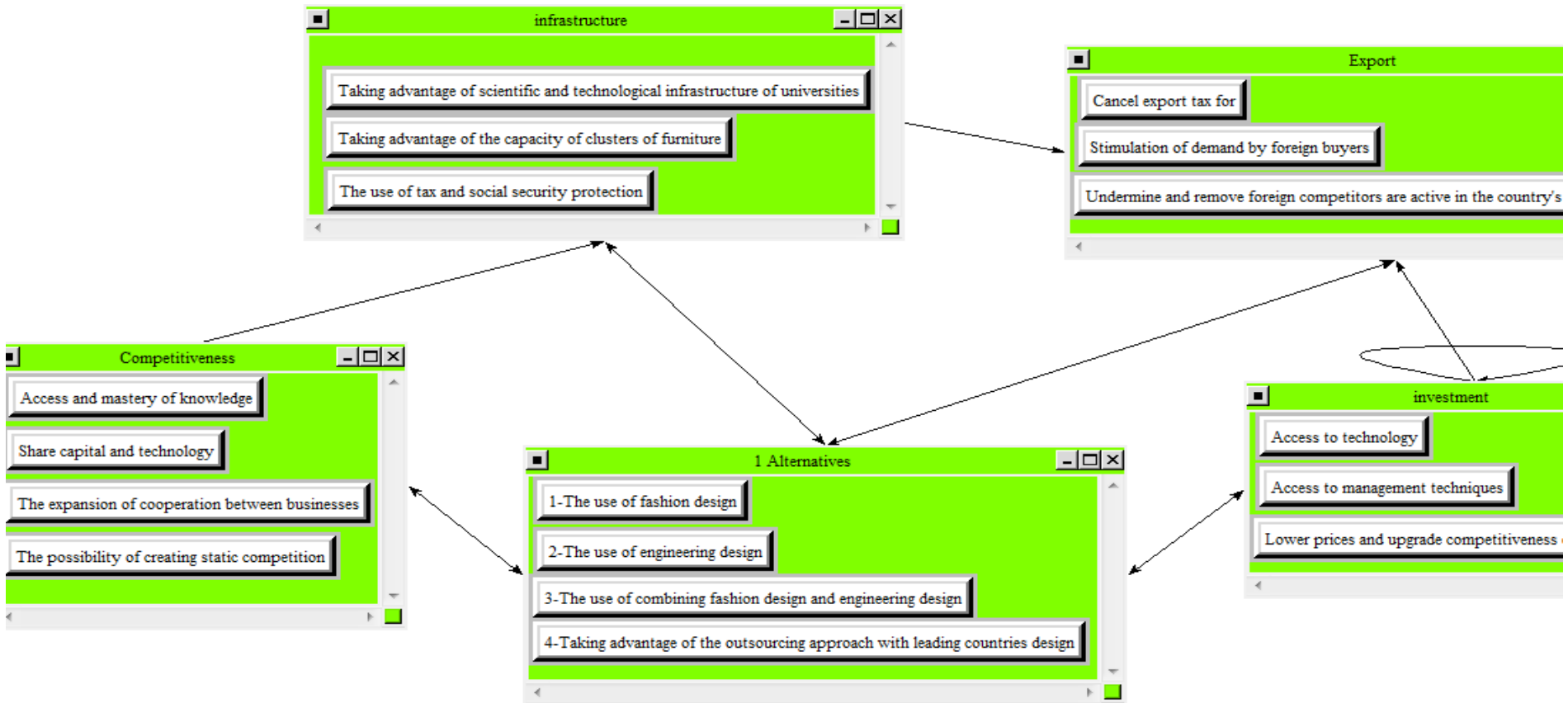
Control criteria network under costs



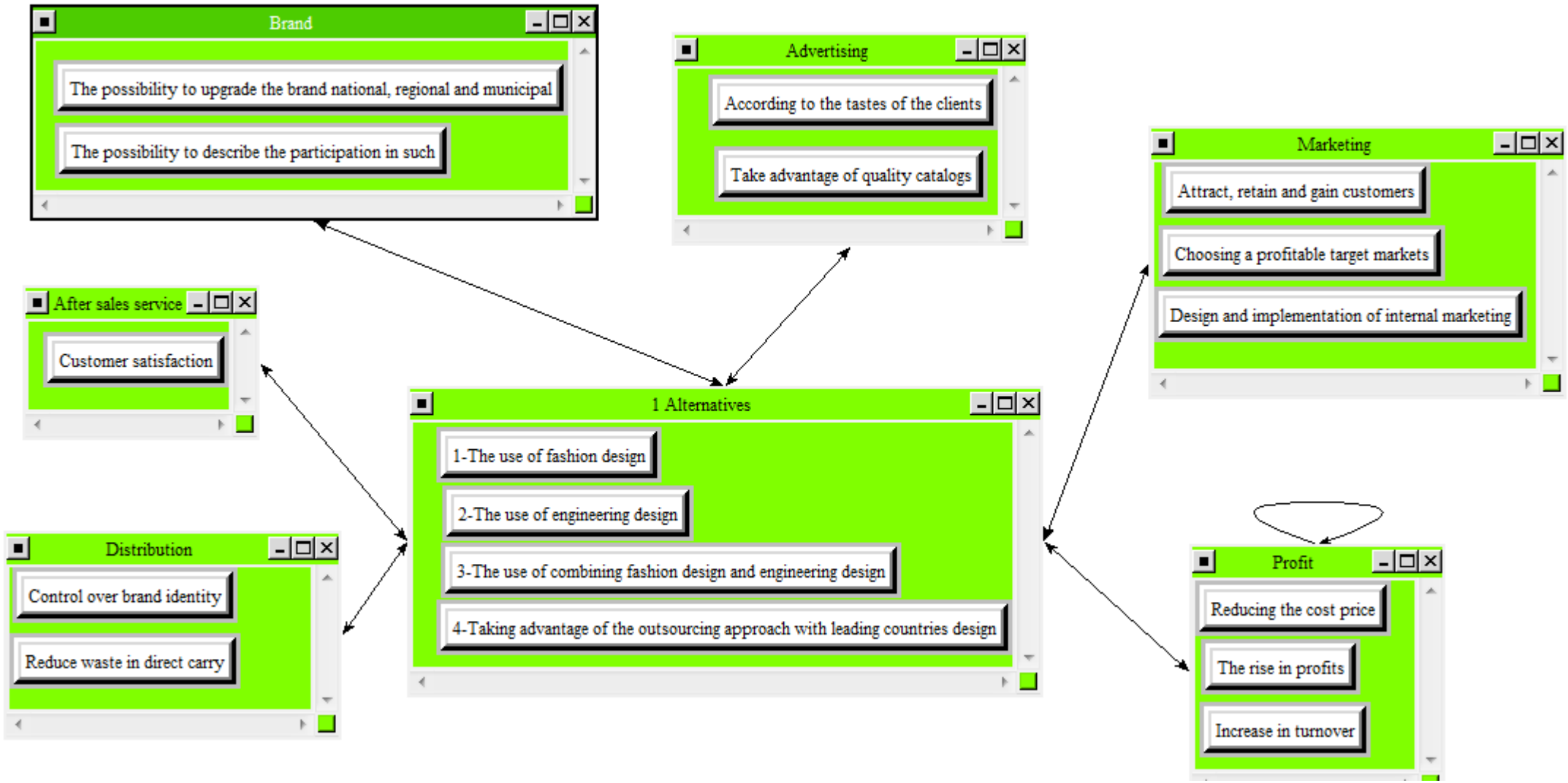
Control criteria network under risks



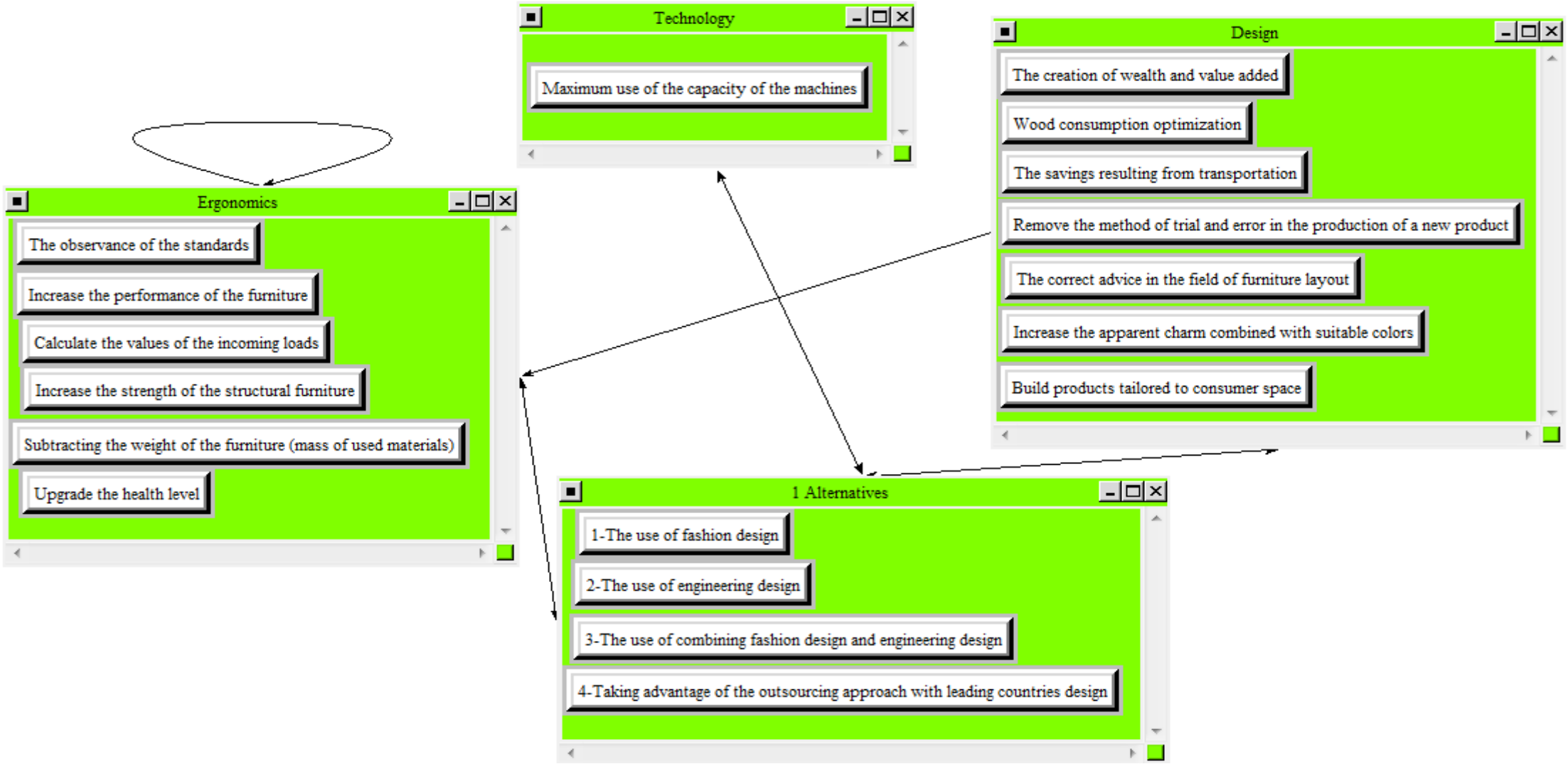
Sub network under benefits/ economics



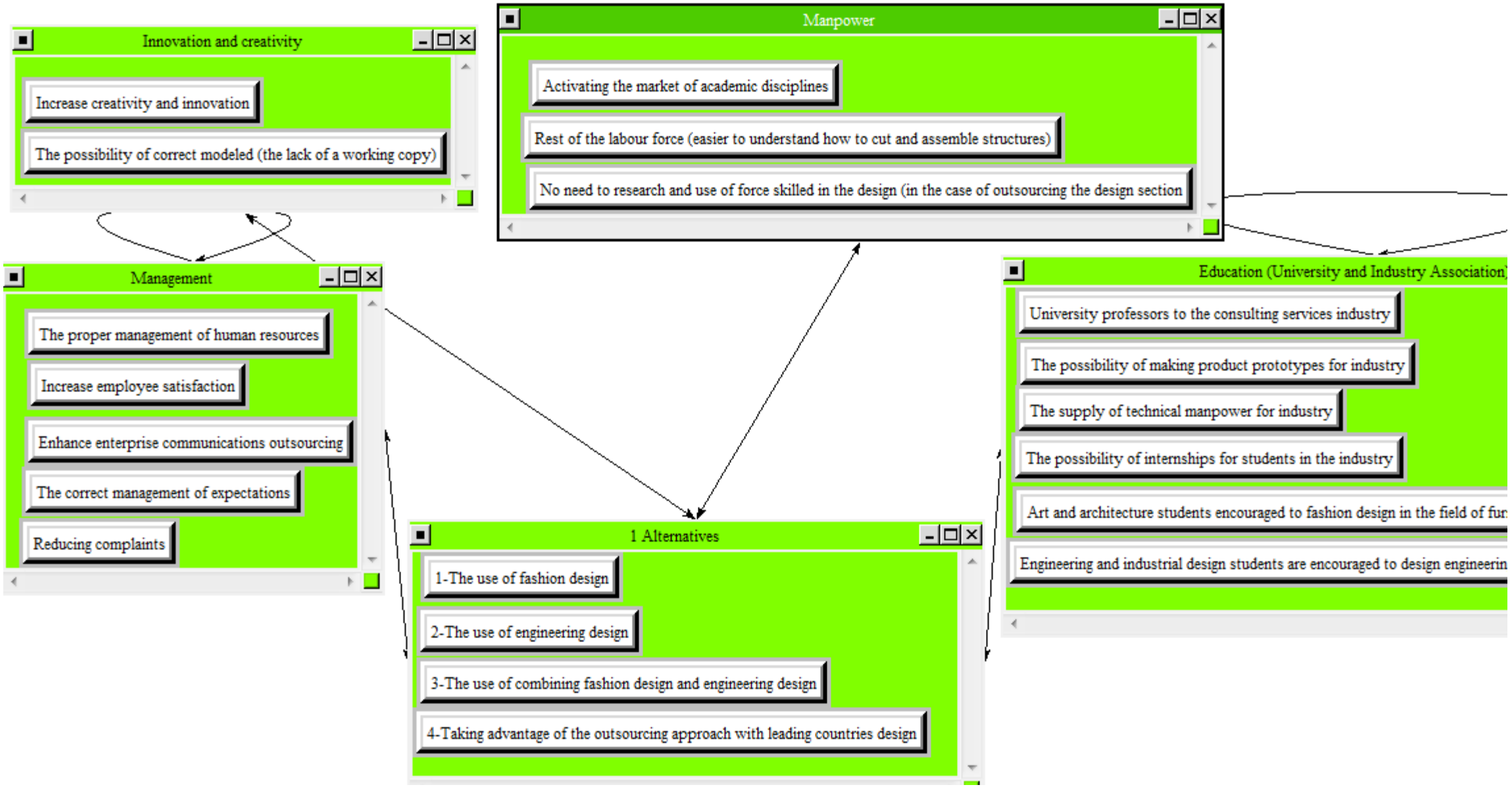
Sub network under benefits/ marketing



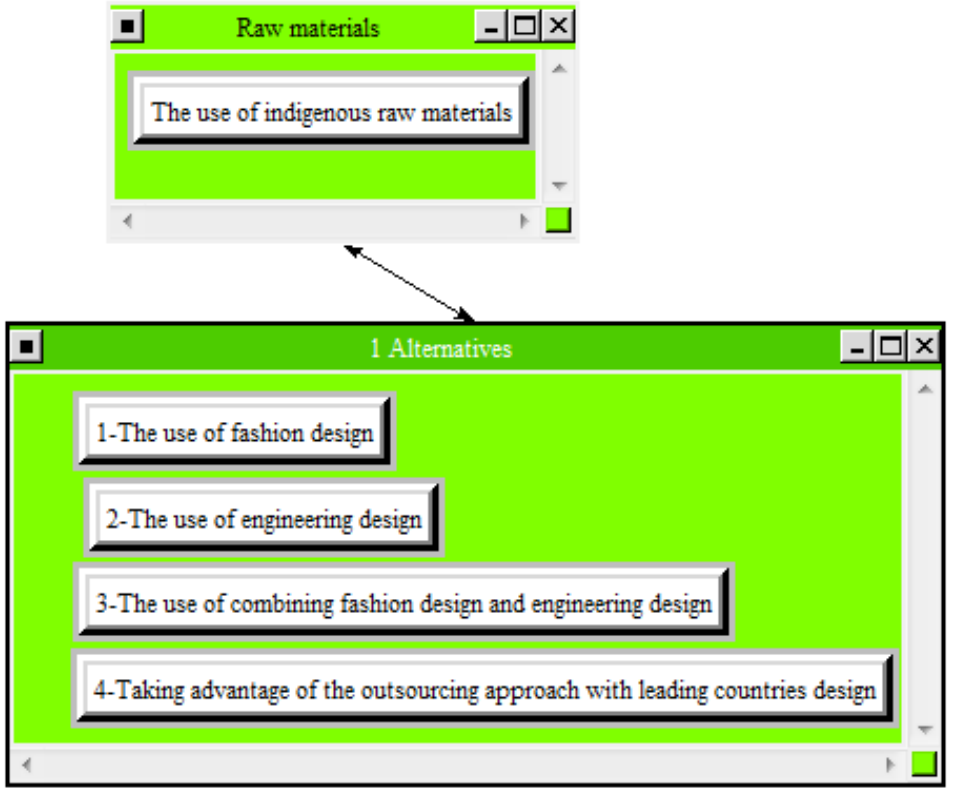
Sub network under benefits/ technical



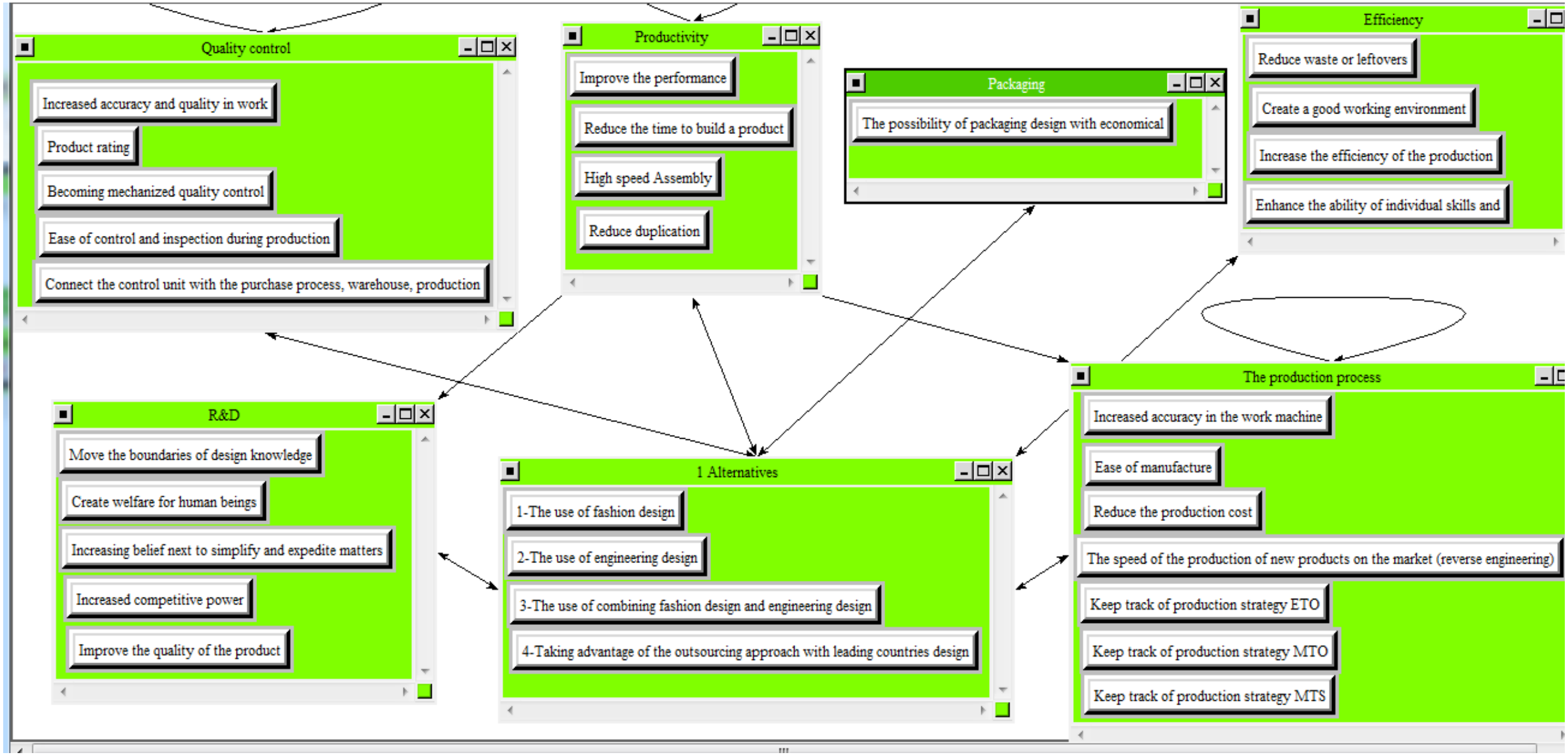
Sub network under benefits/ man force



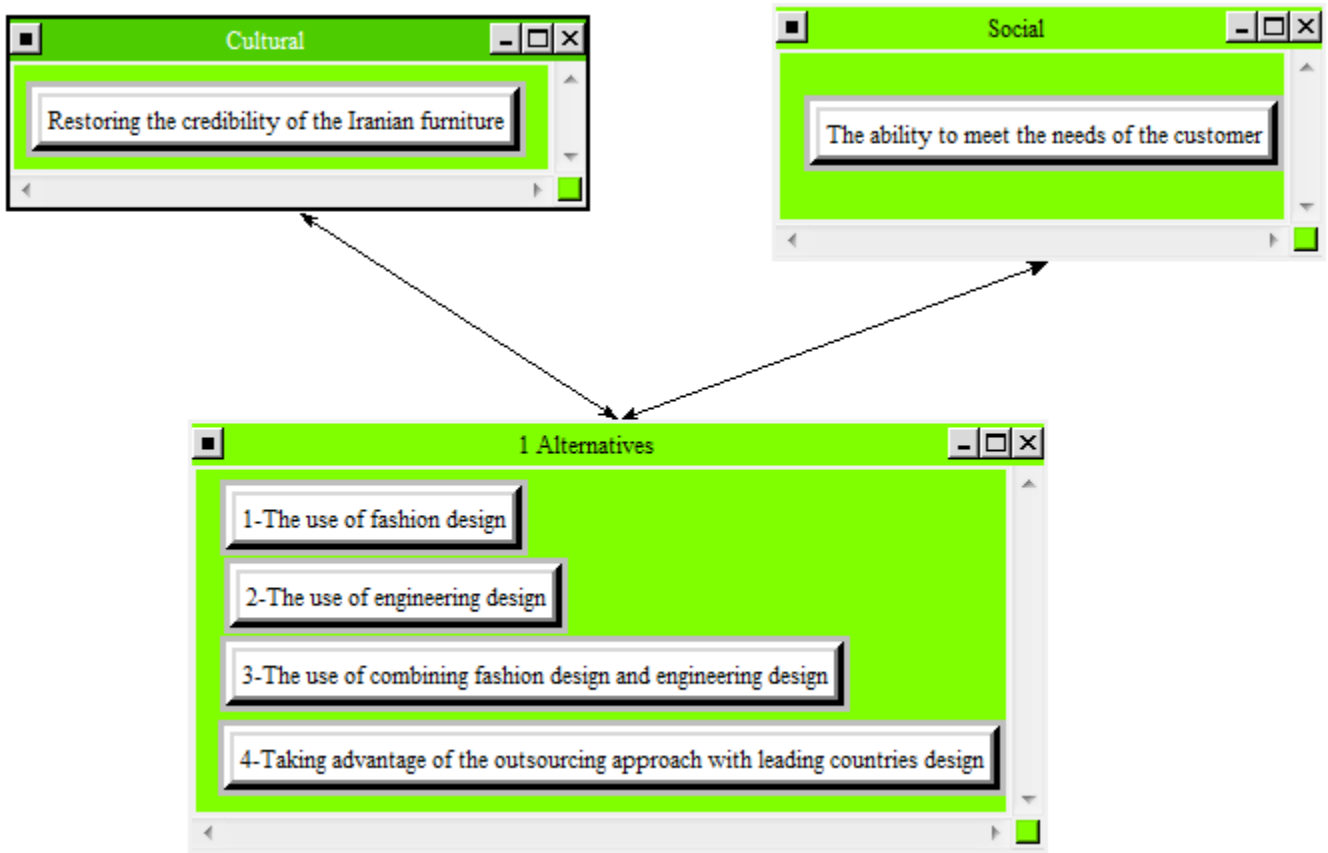
Sub network under benefits/ supply



Sub network under benefits/ production

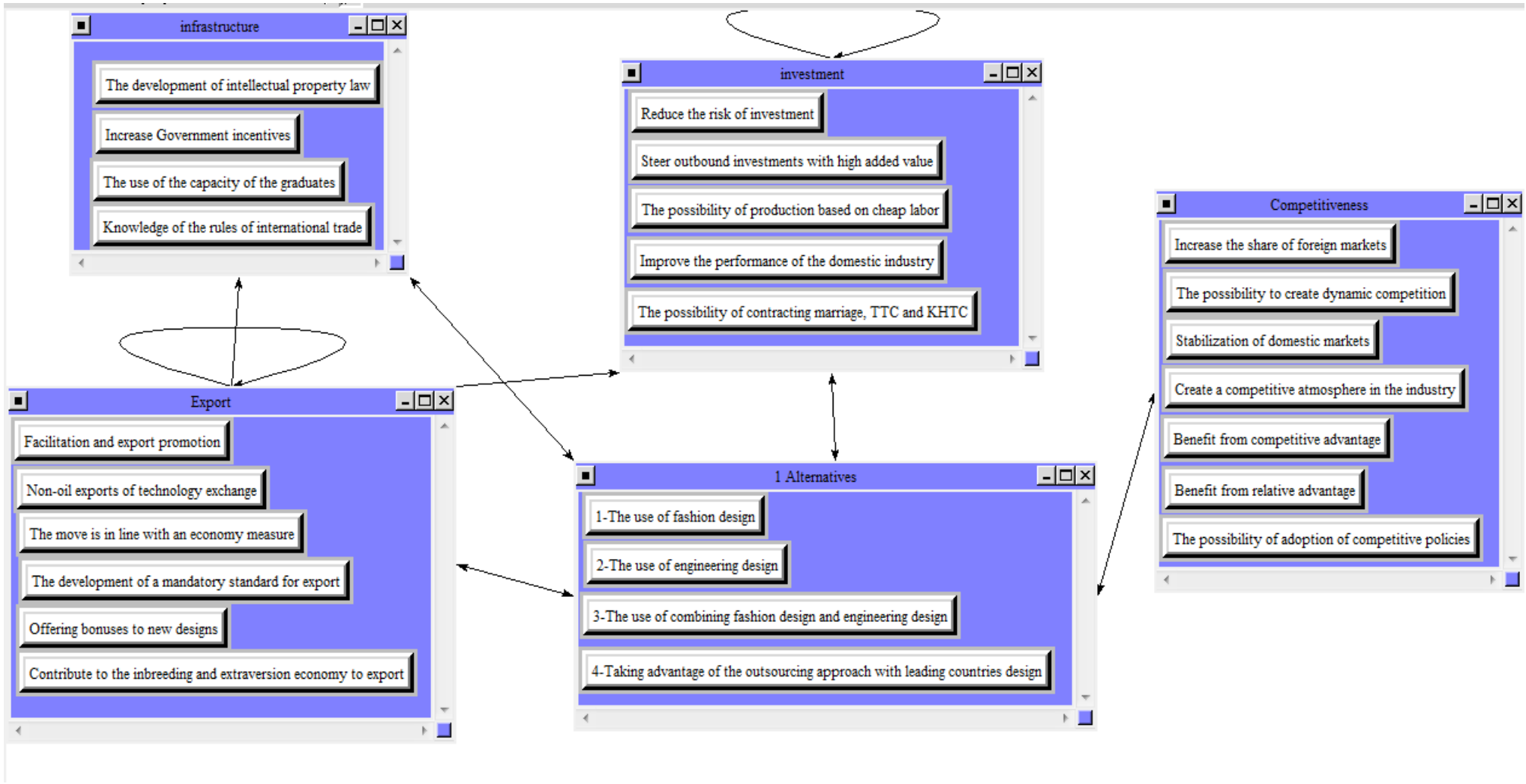


Sub network under benefits/ social cultural & politic

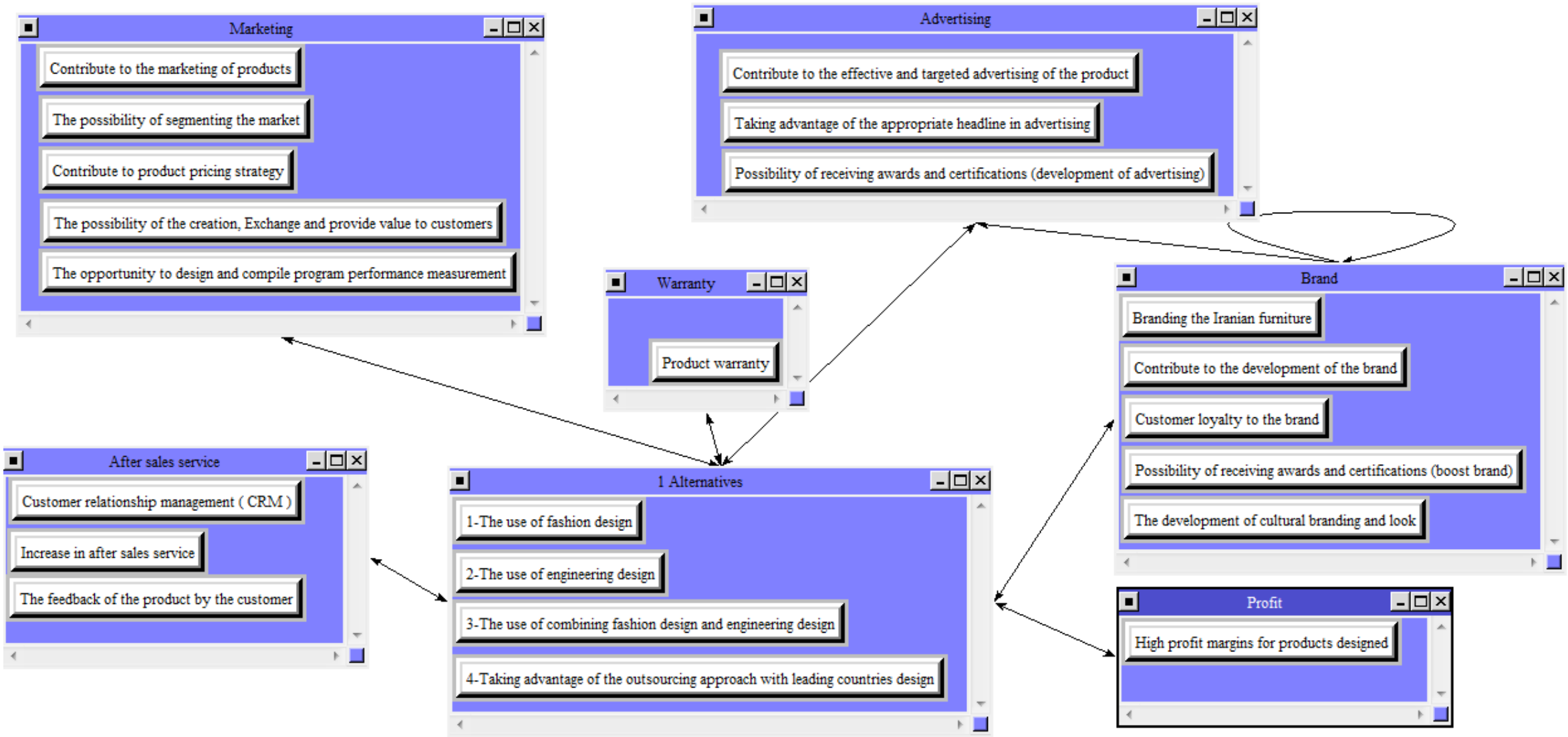


Sub network under benefits/ environmental

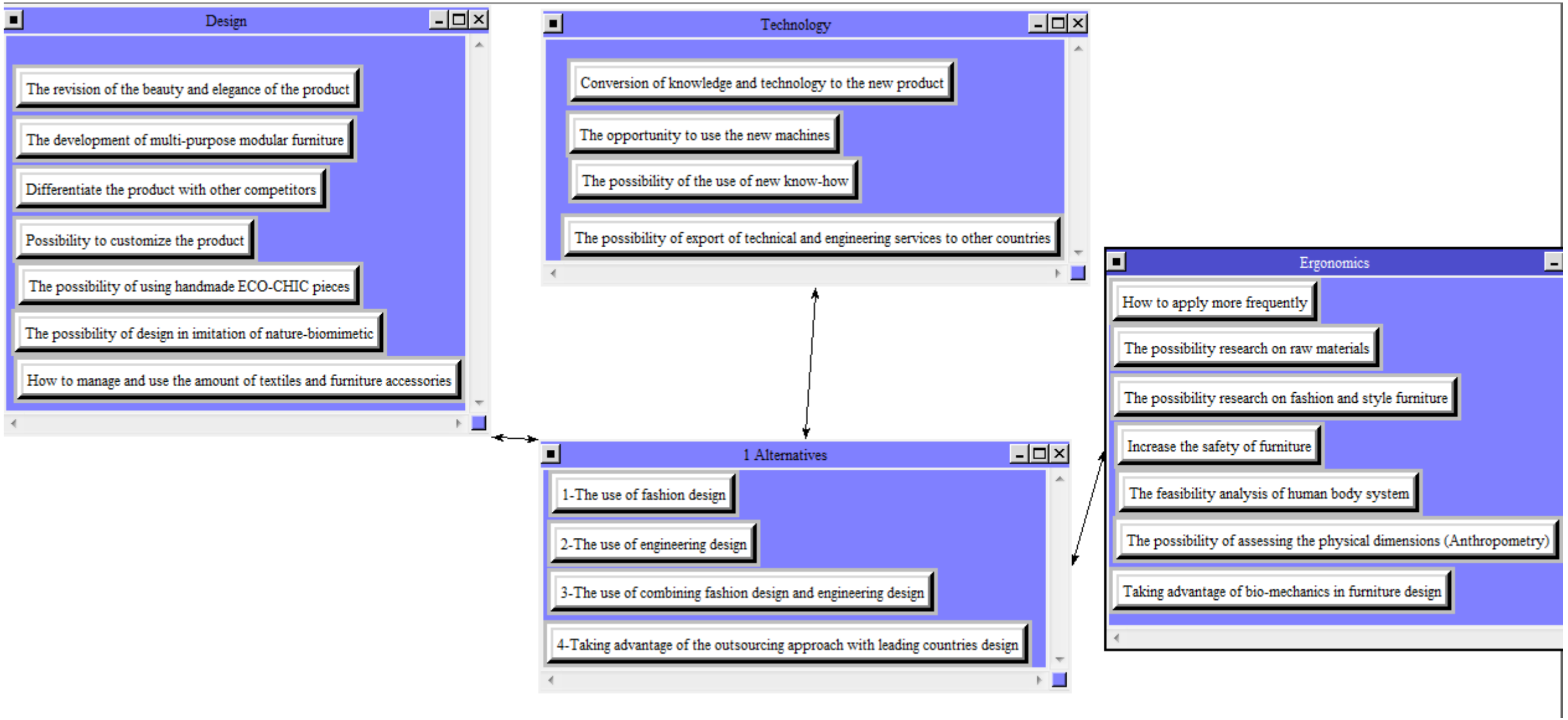
Sub network under opportunities/ economics



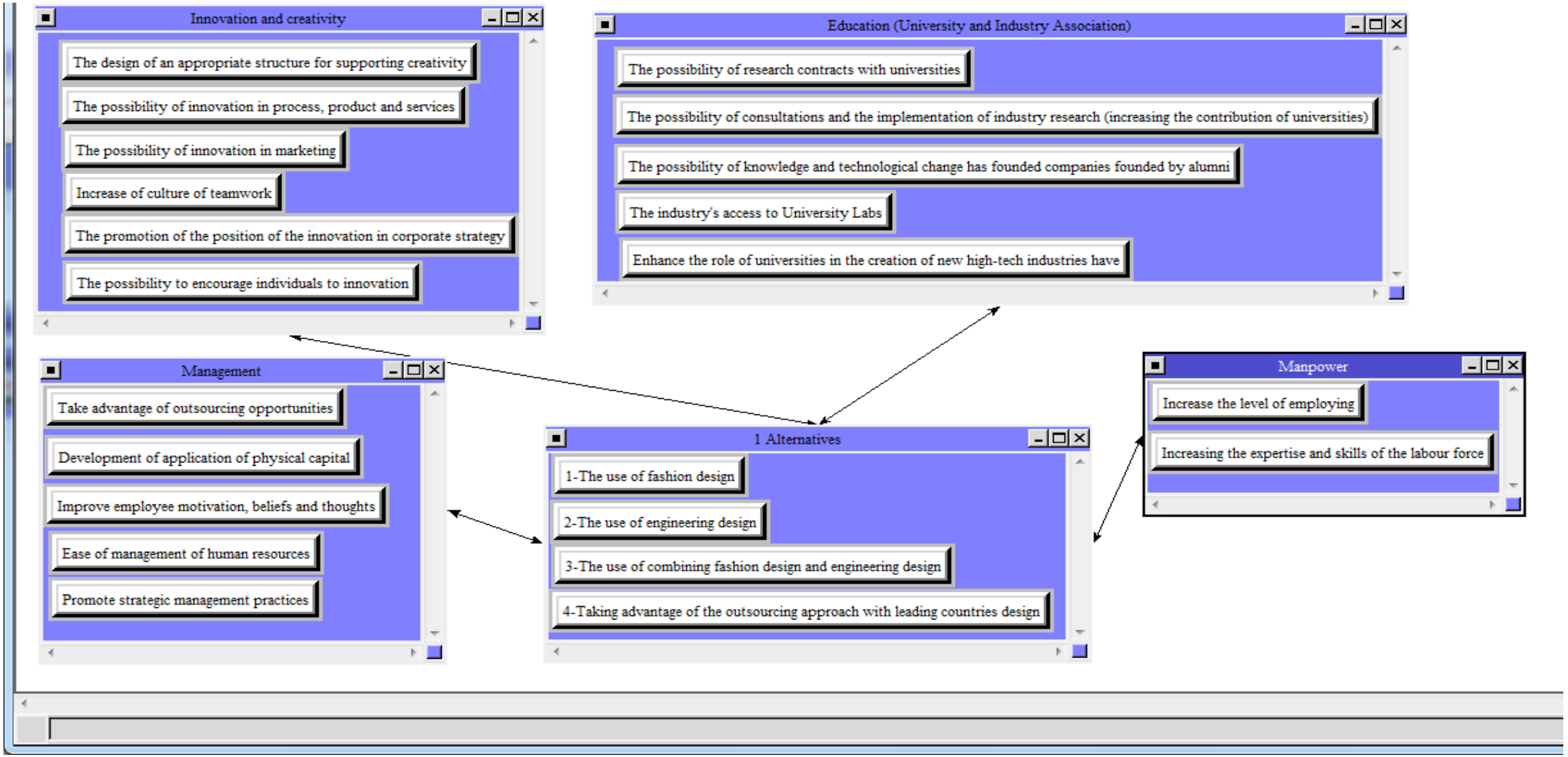
Sub network under opportunities/ marketing



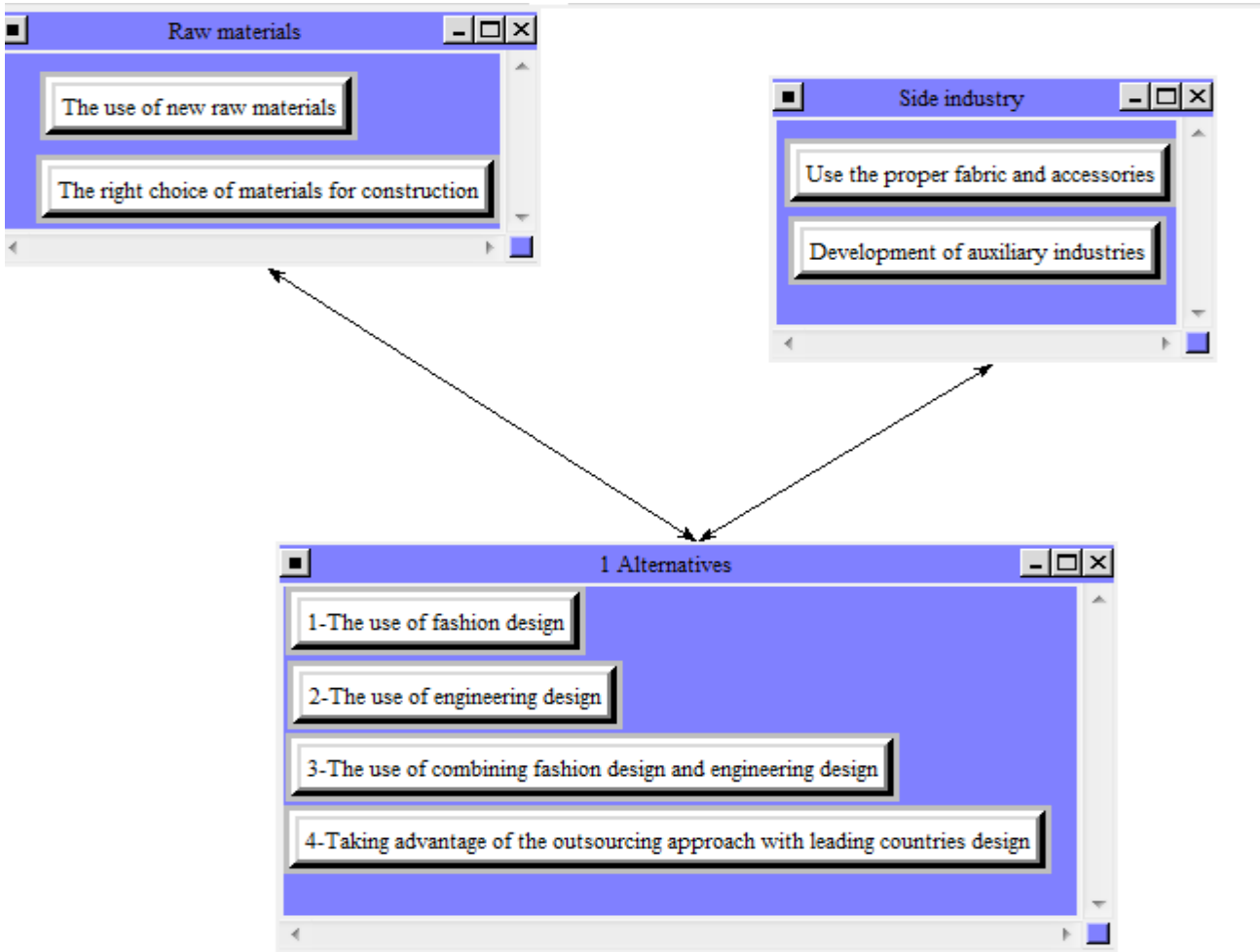
Sub network under opportunities/ technical



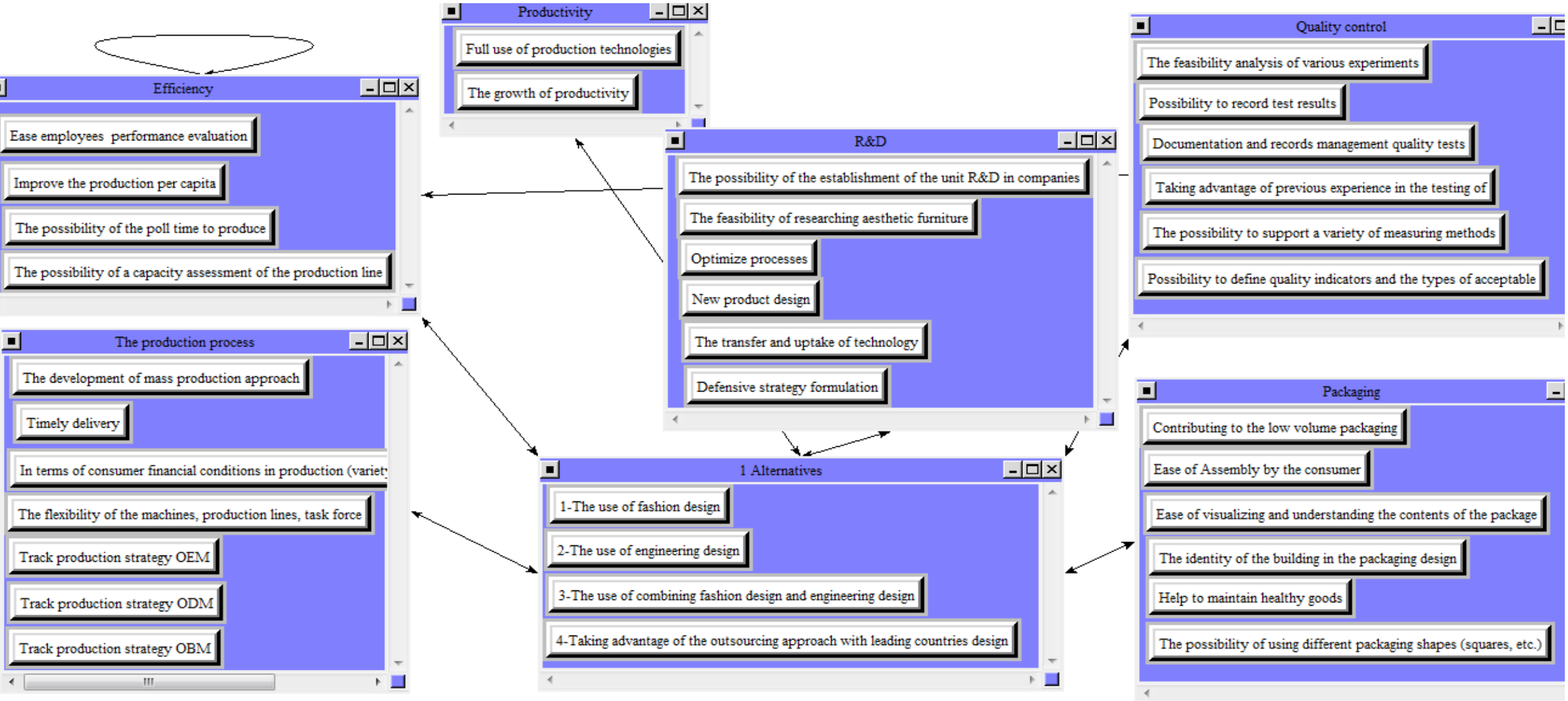
Sub network under opportunities/ man force



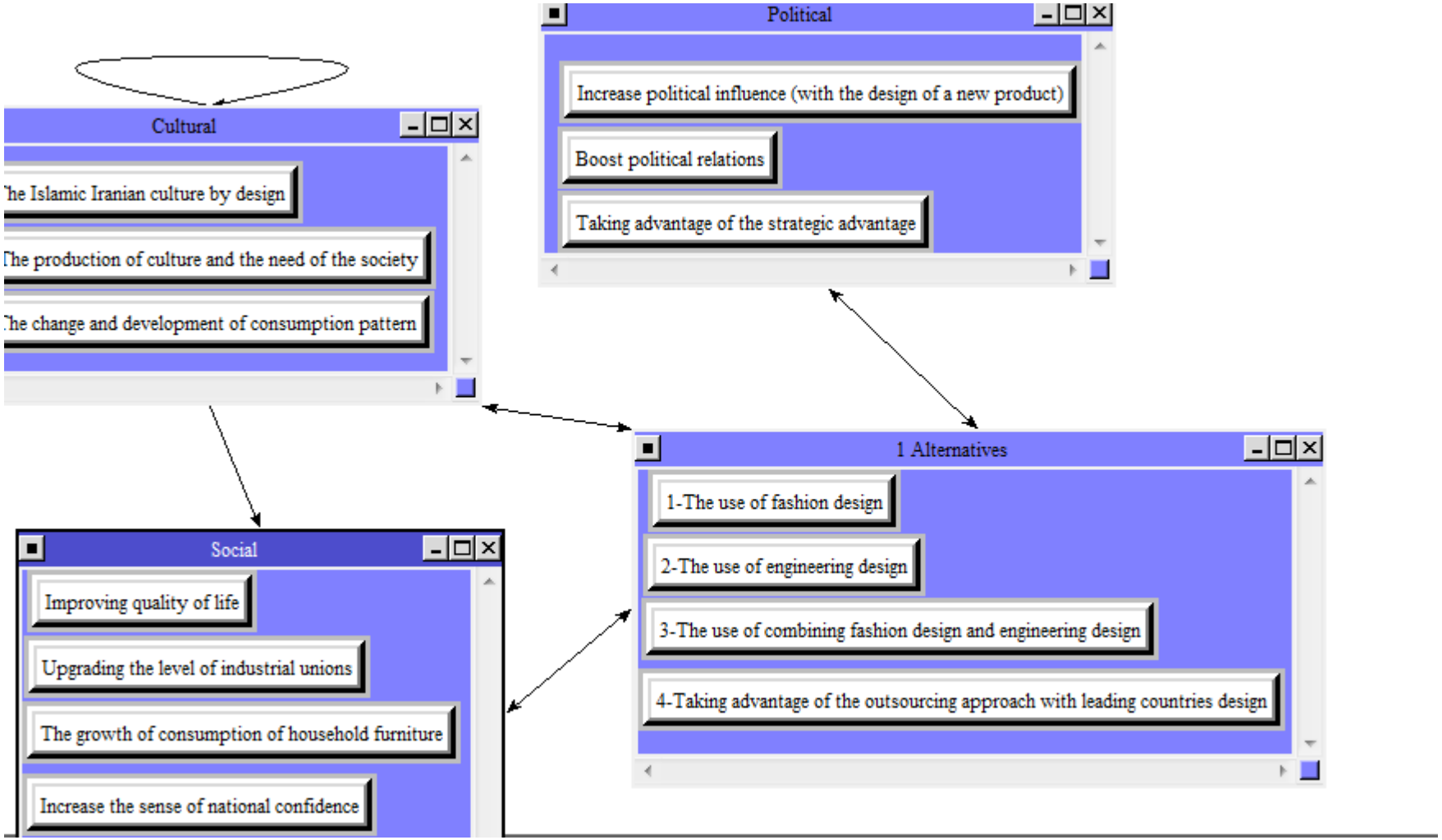
Sub network under opportunities/ supply



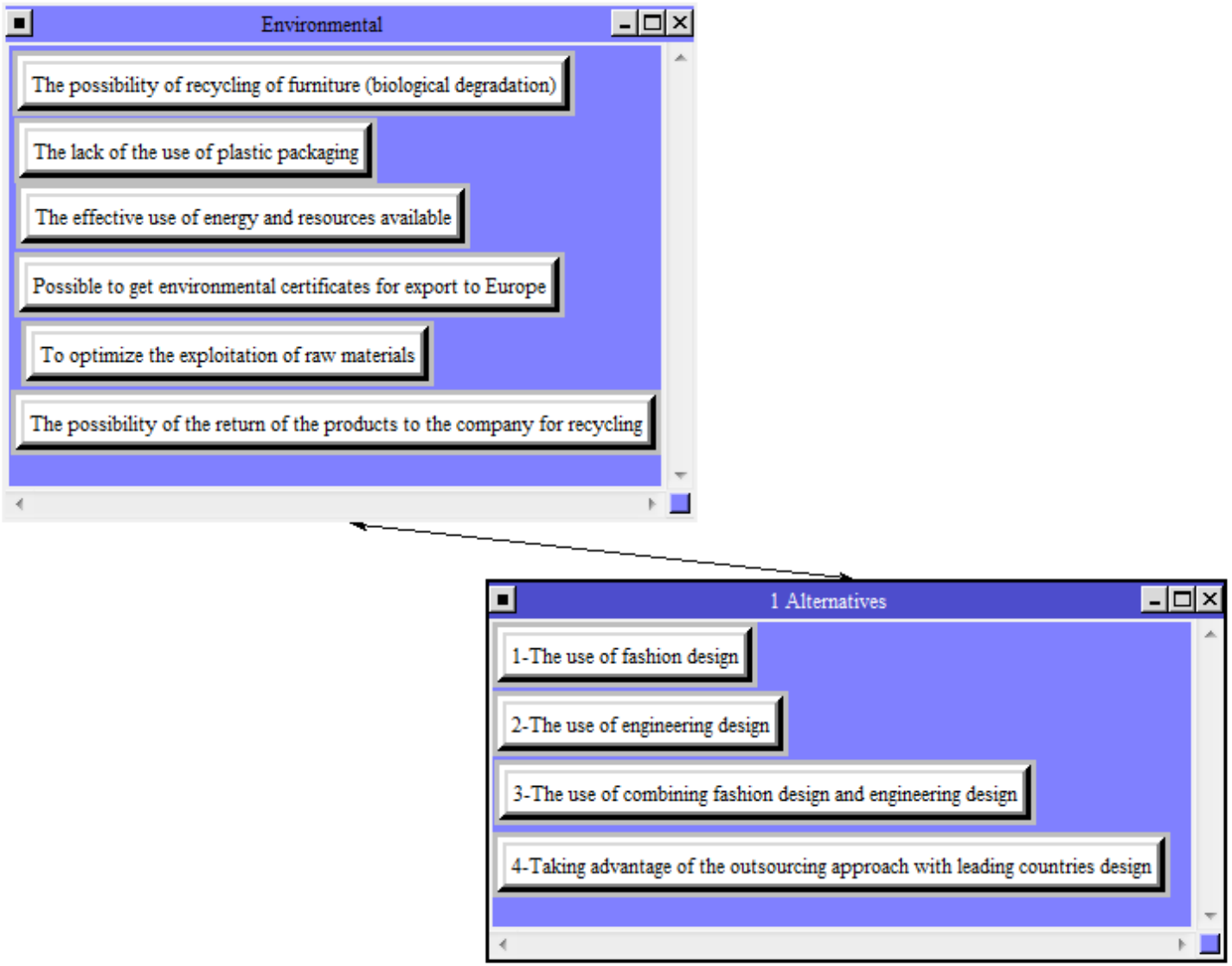
Sub network under opportunities/ production



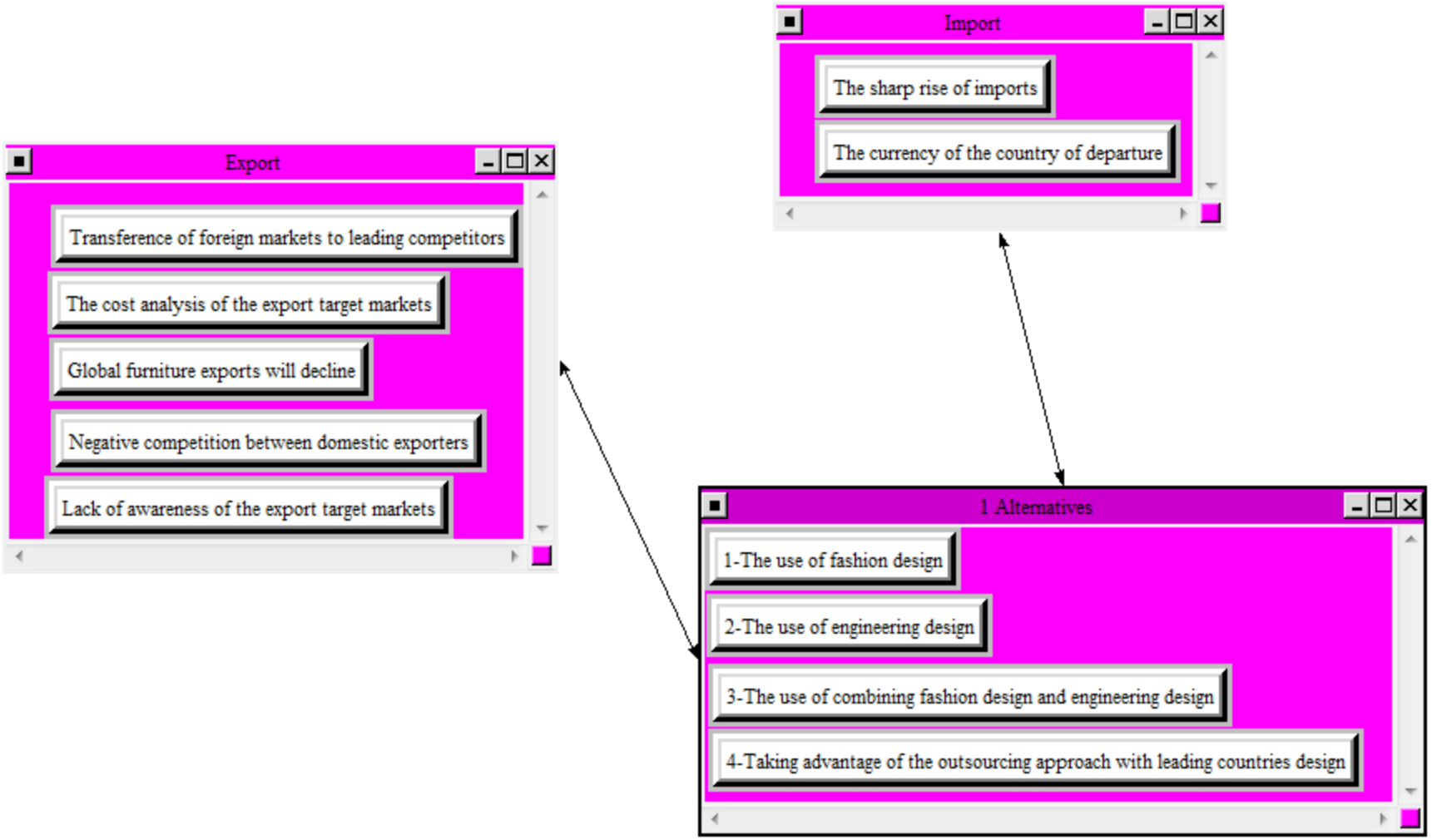
Sub network under opportunities/ social cultural & politic



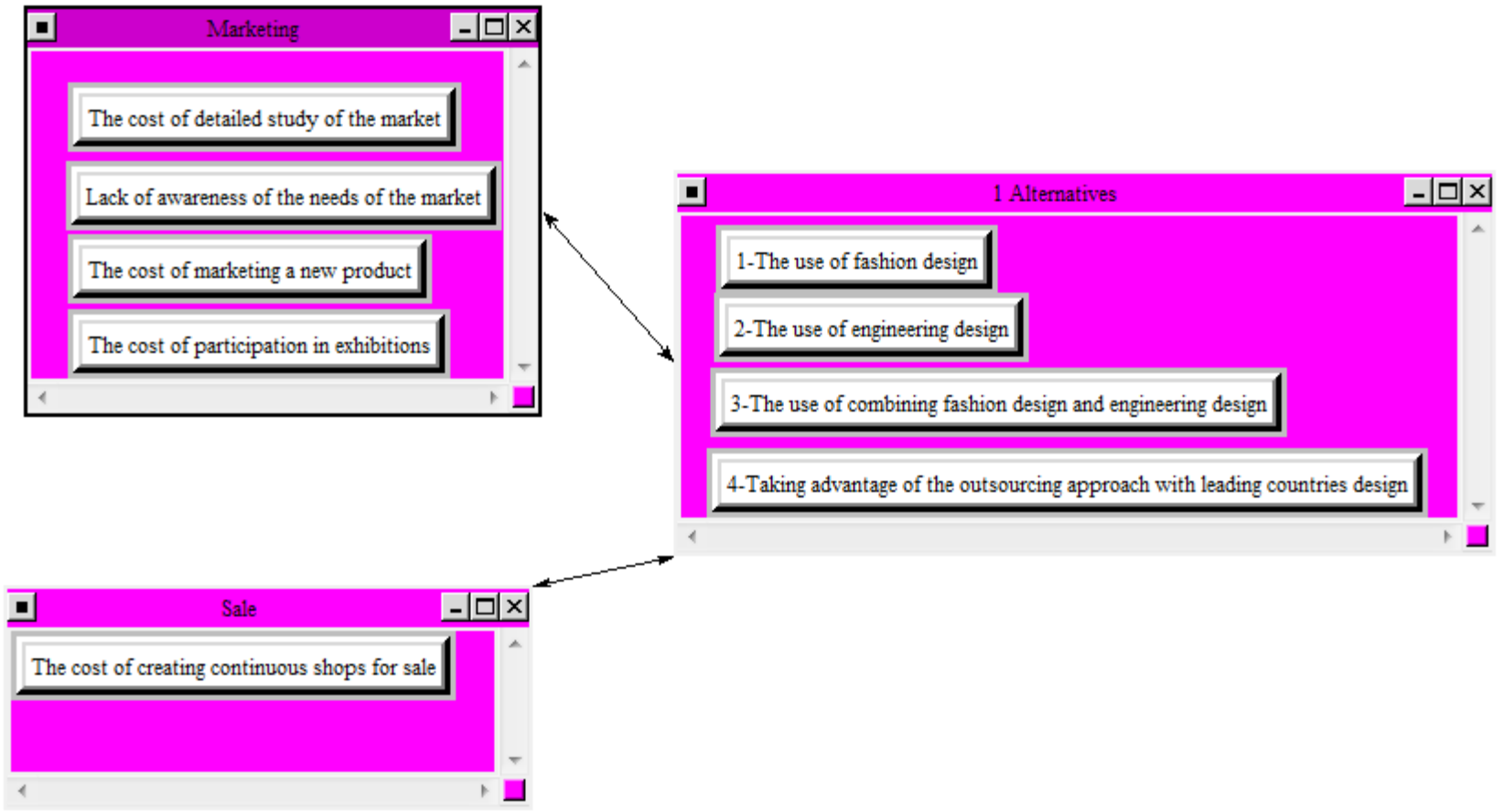
Sub network under opportunities/ environmental



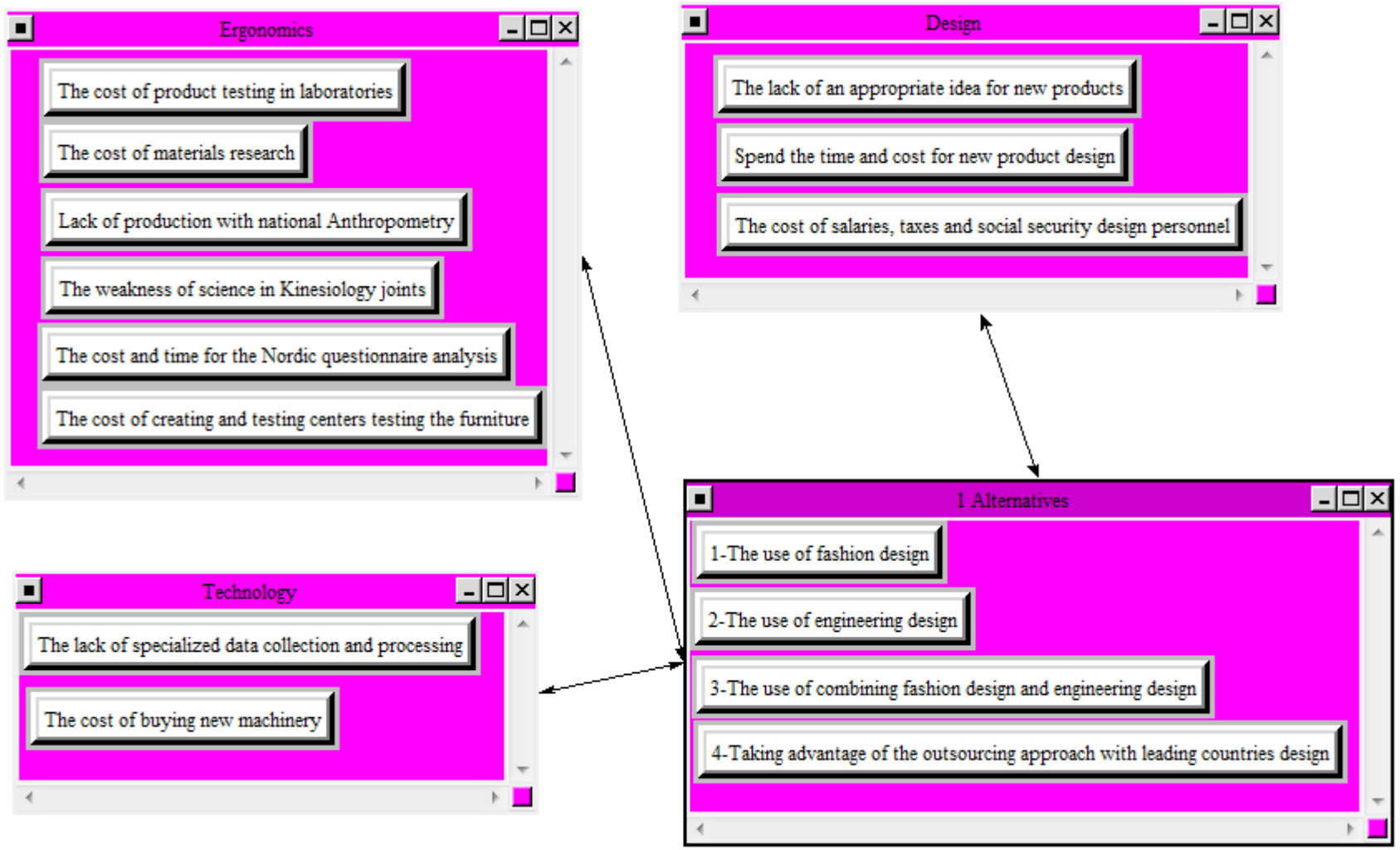
Sub network under costs/ economics



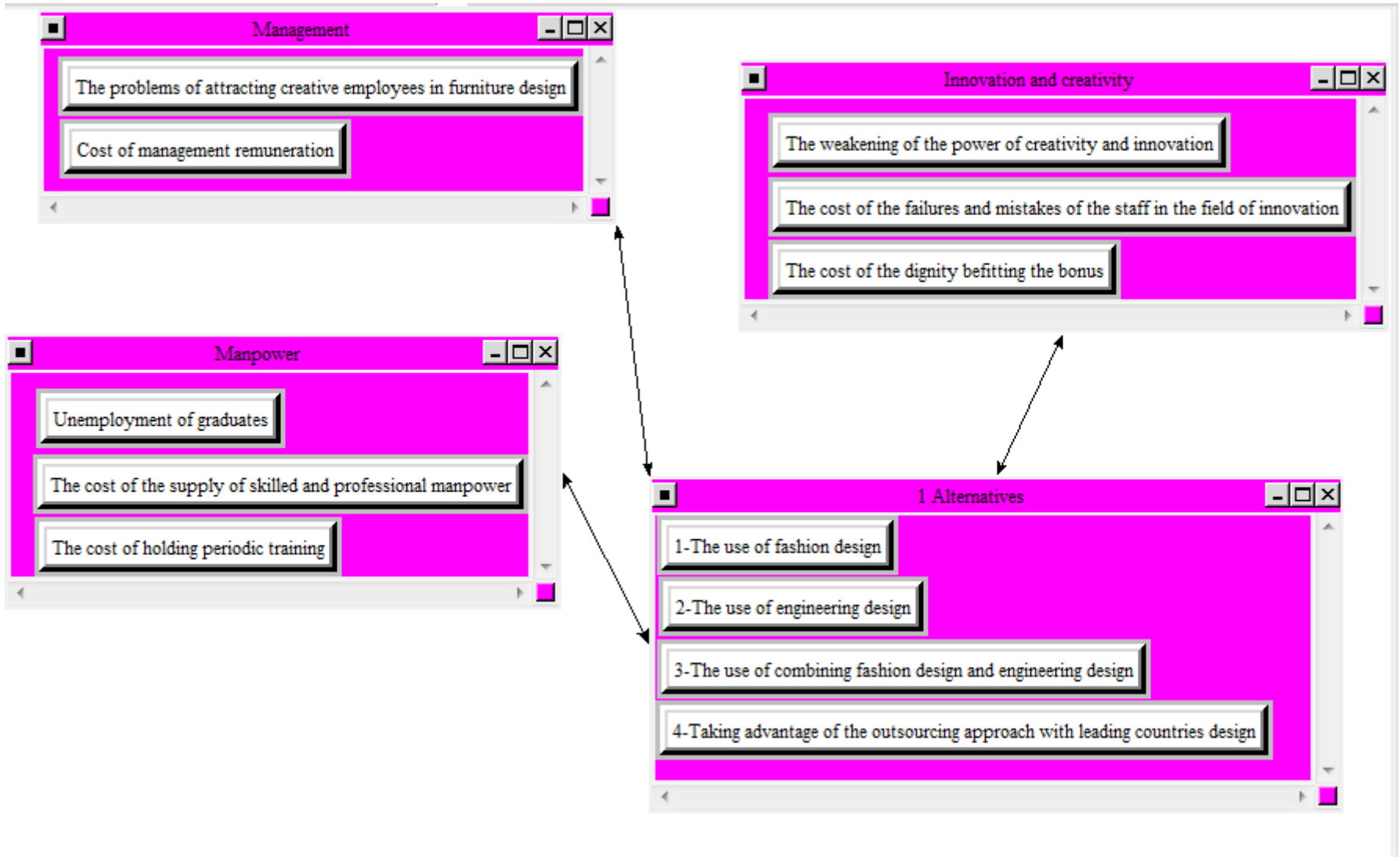
Sub network under costs/ marketing



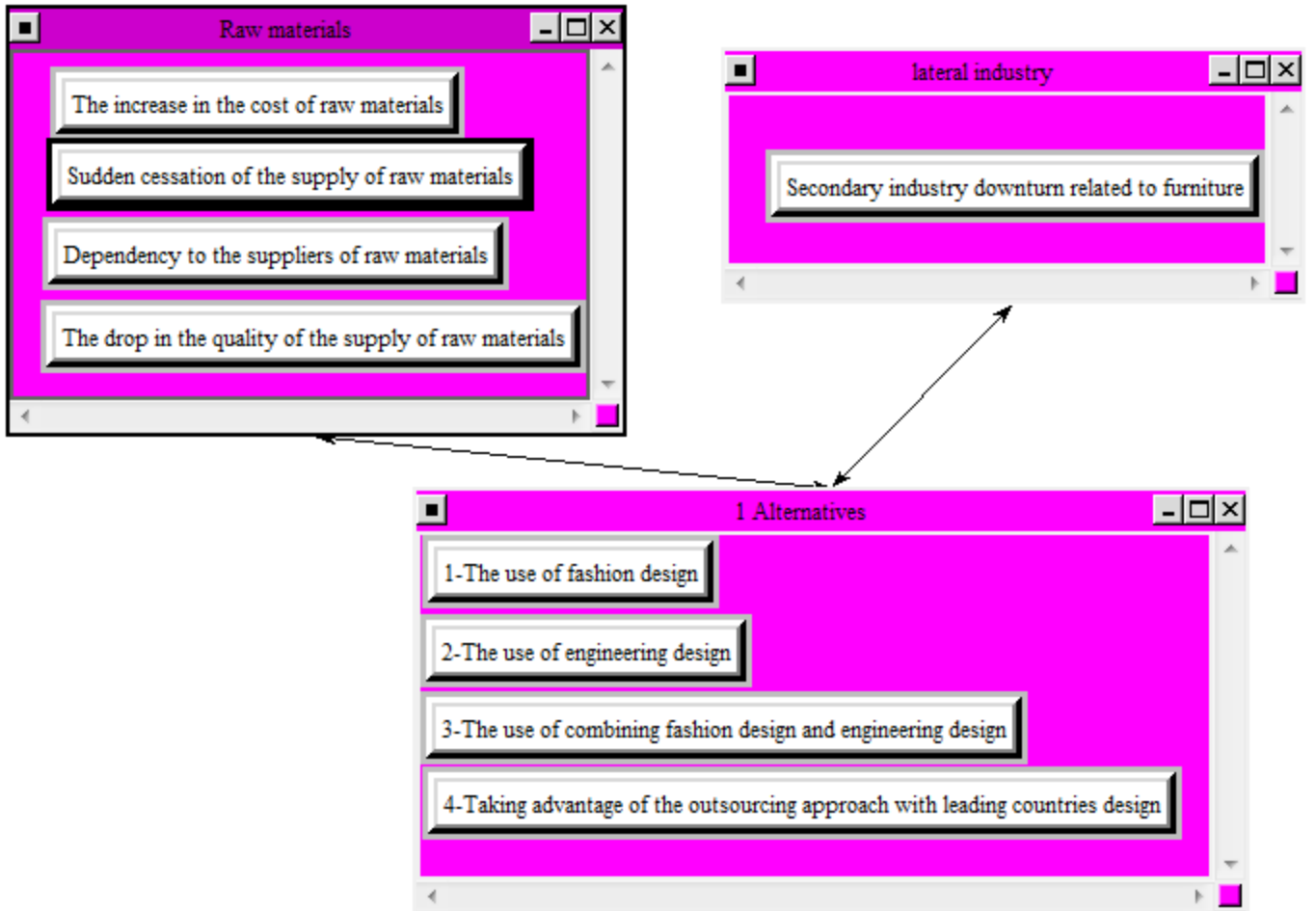
Sub network under costs/ technical



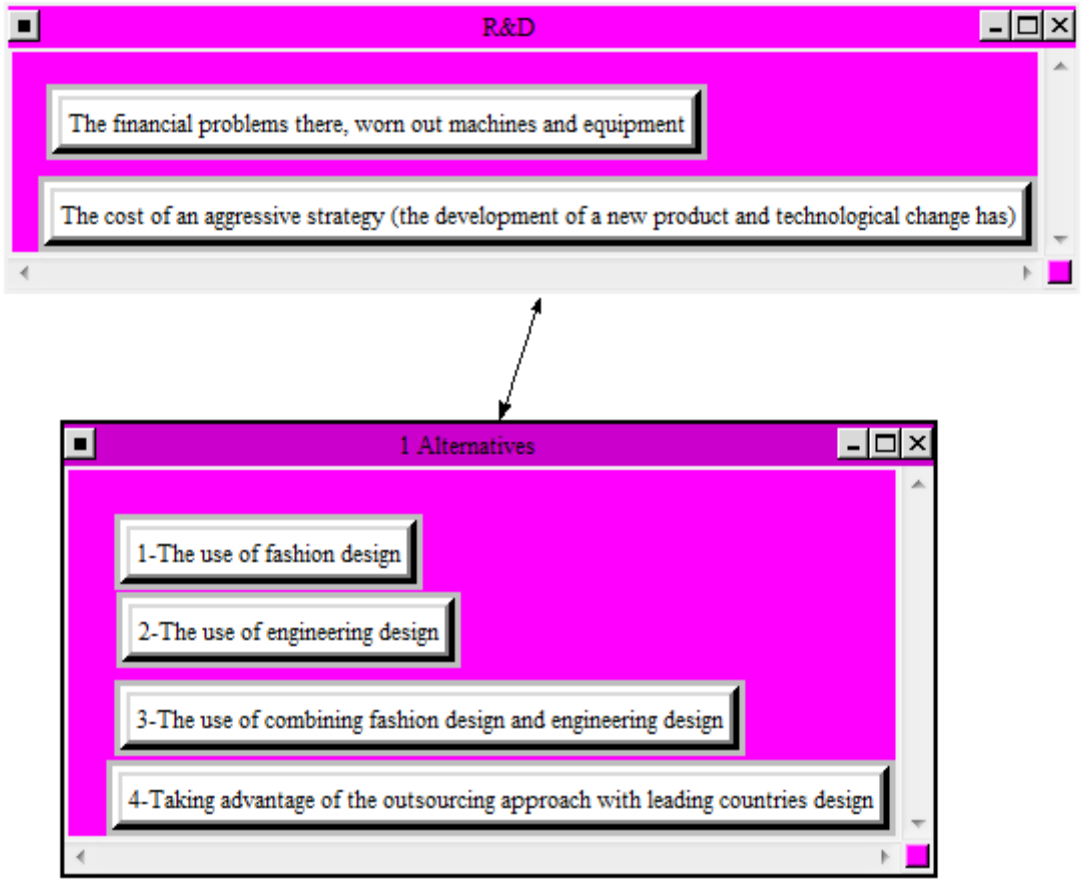
Sub network under costs/ man force



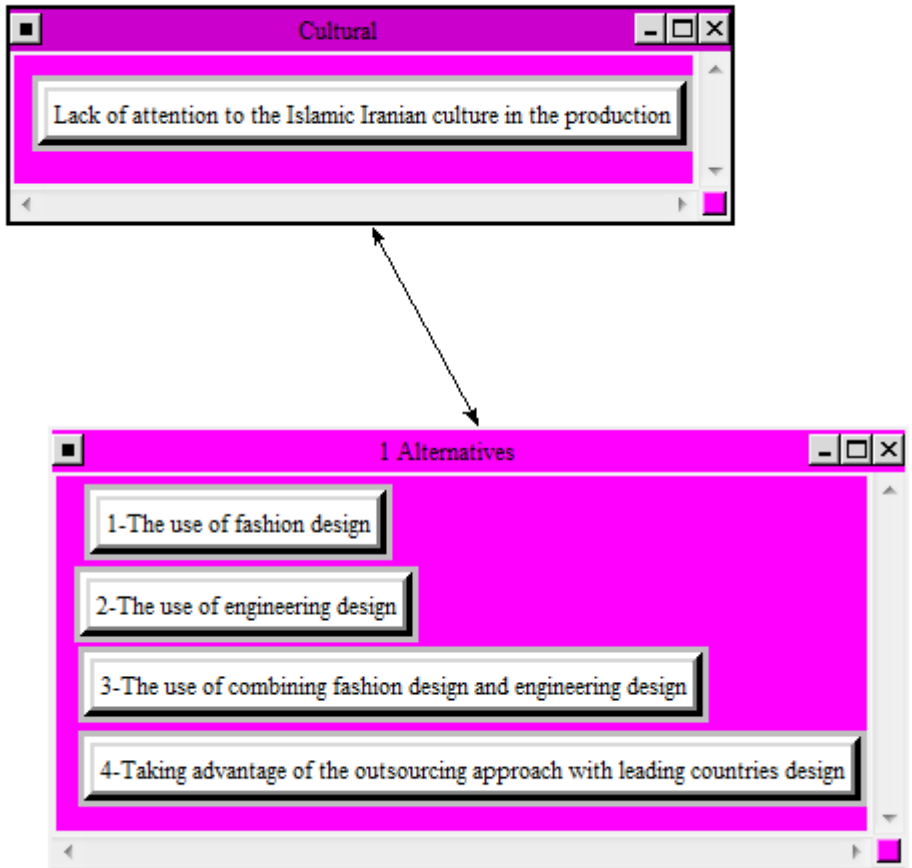
Sub network under costs/ supply



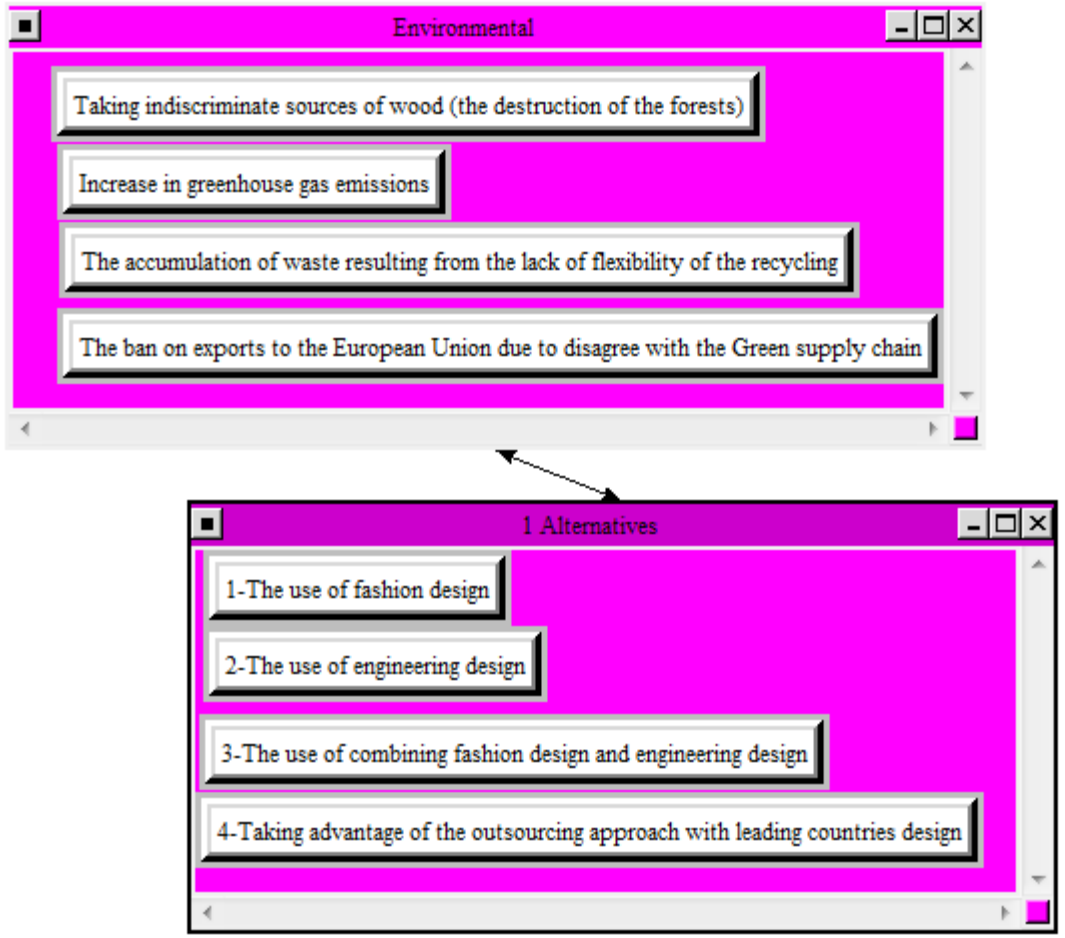
Sub network under costs/ production



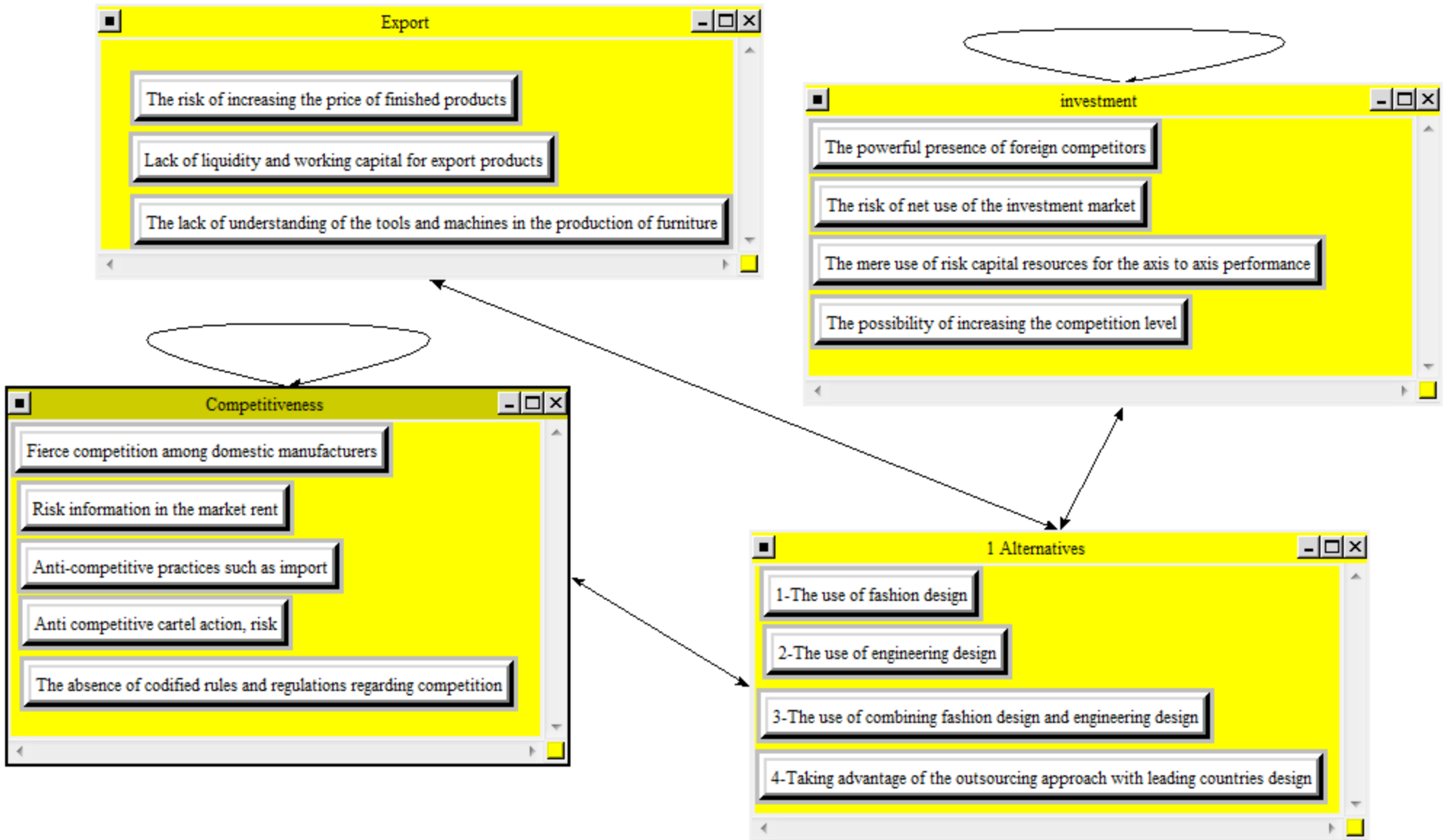
Sub network under costs/ social cultural & politic



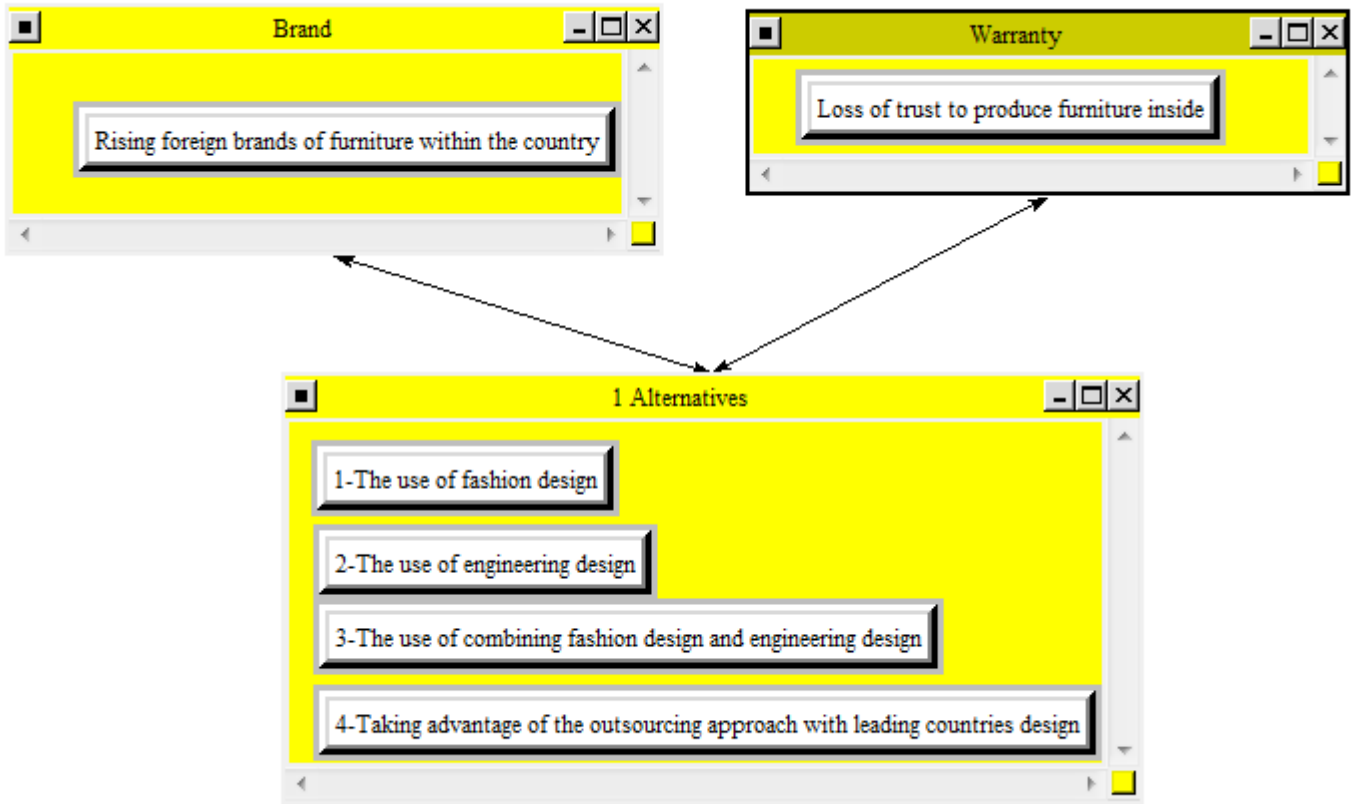
Sub network under costs/ environmental



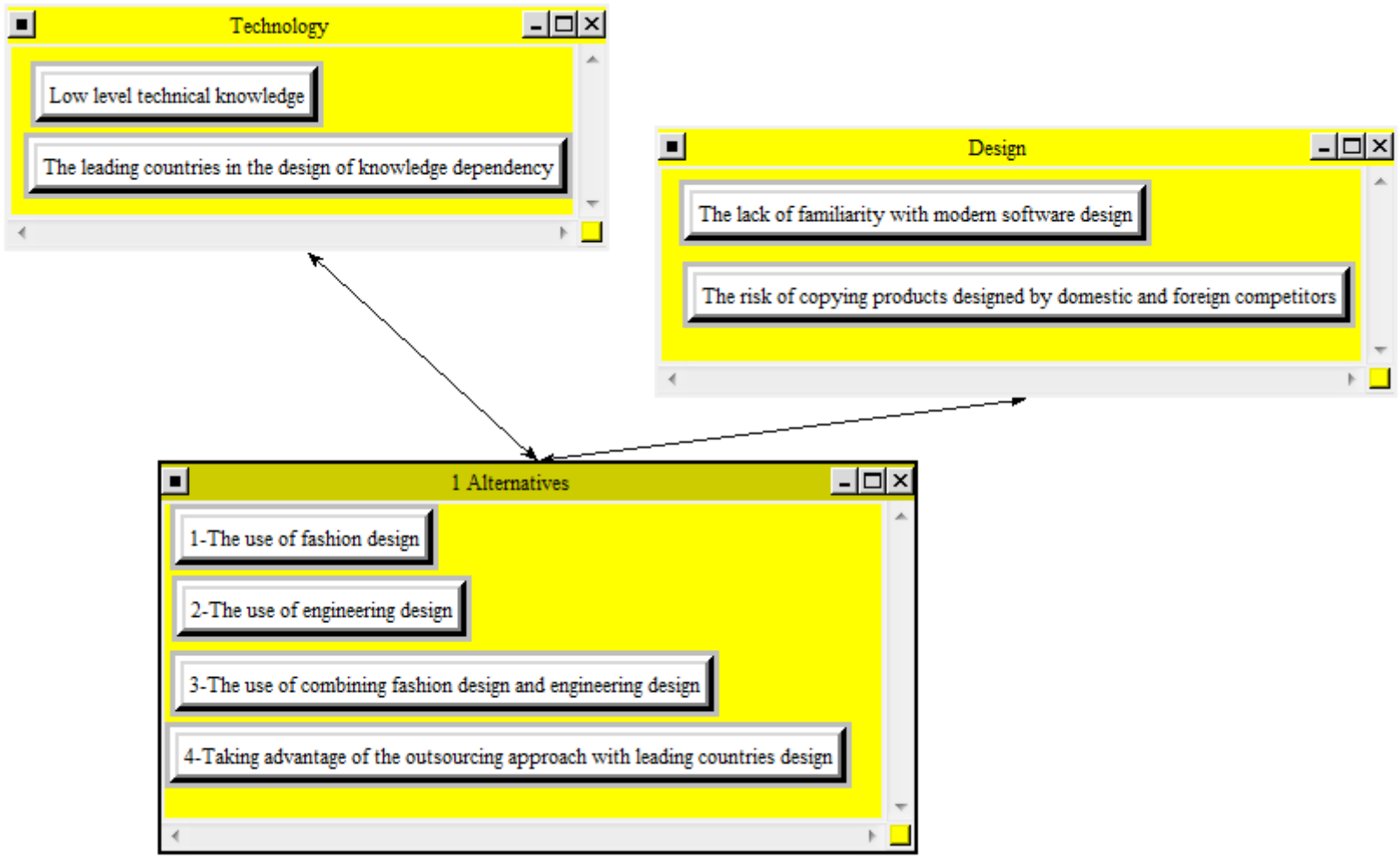
Sub network under risks/ economics



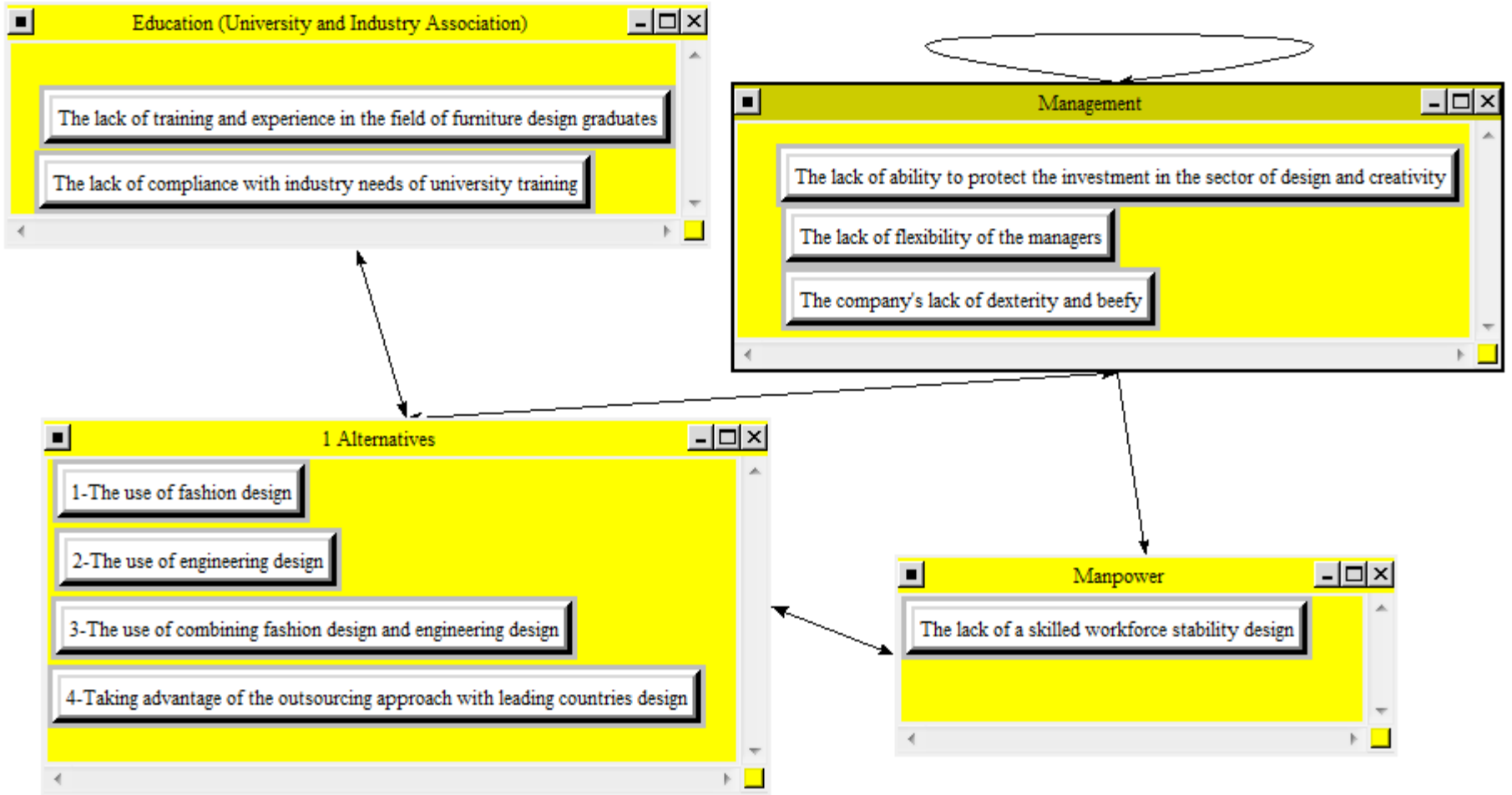
Sub network under risks/ marketing



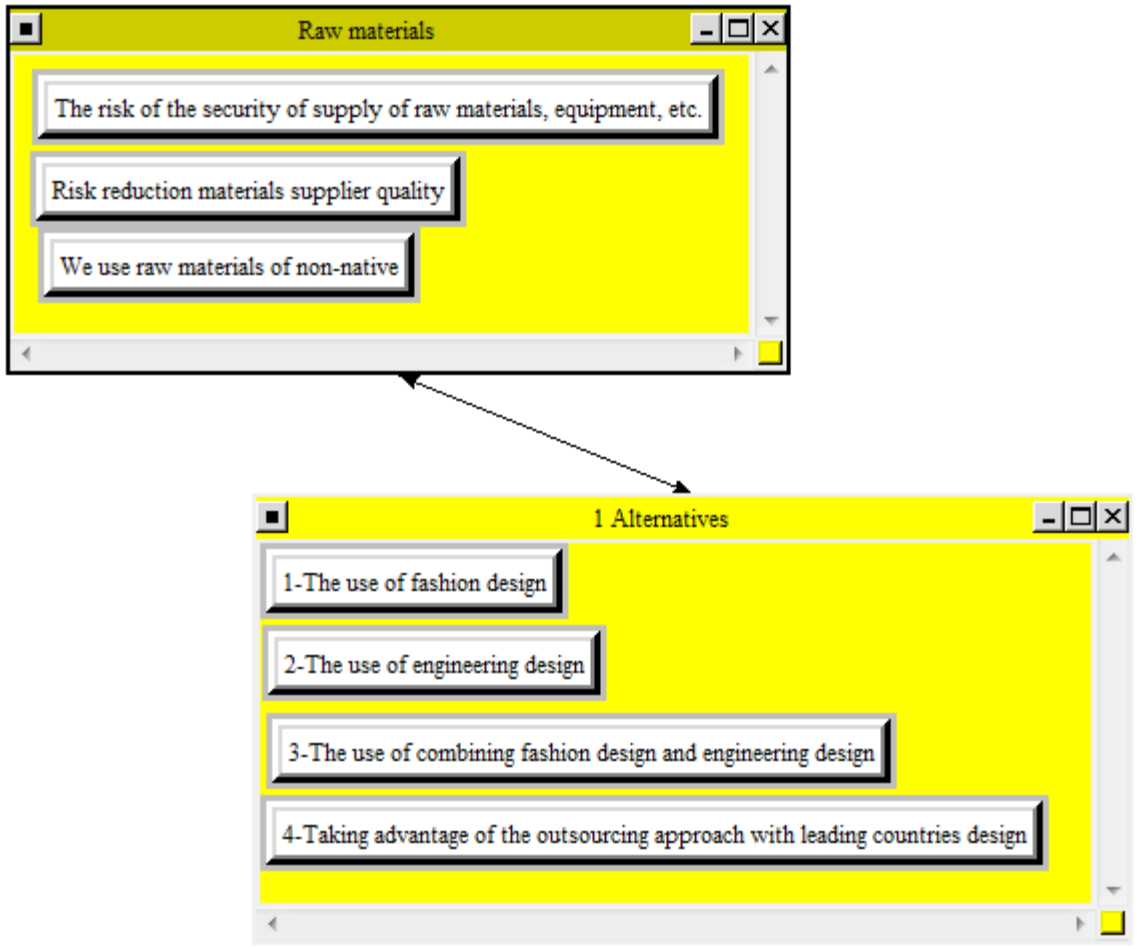
Sub network under risks/ technical



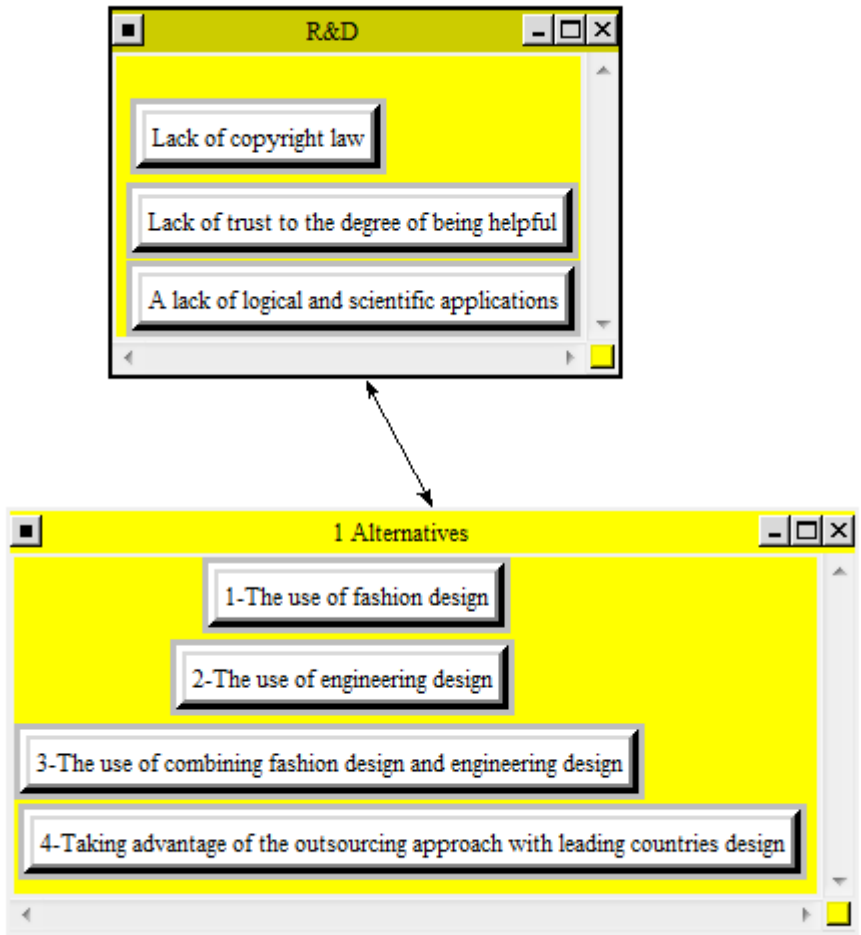
Sub network under risks/ man force



Sub network under risks/ supply

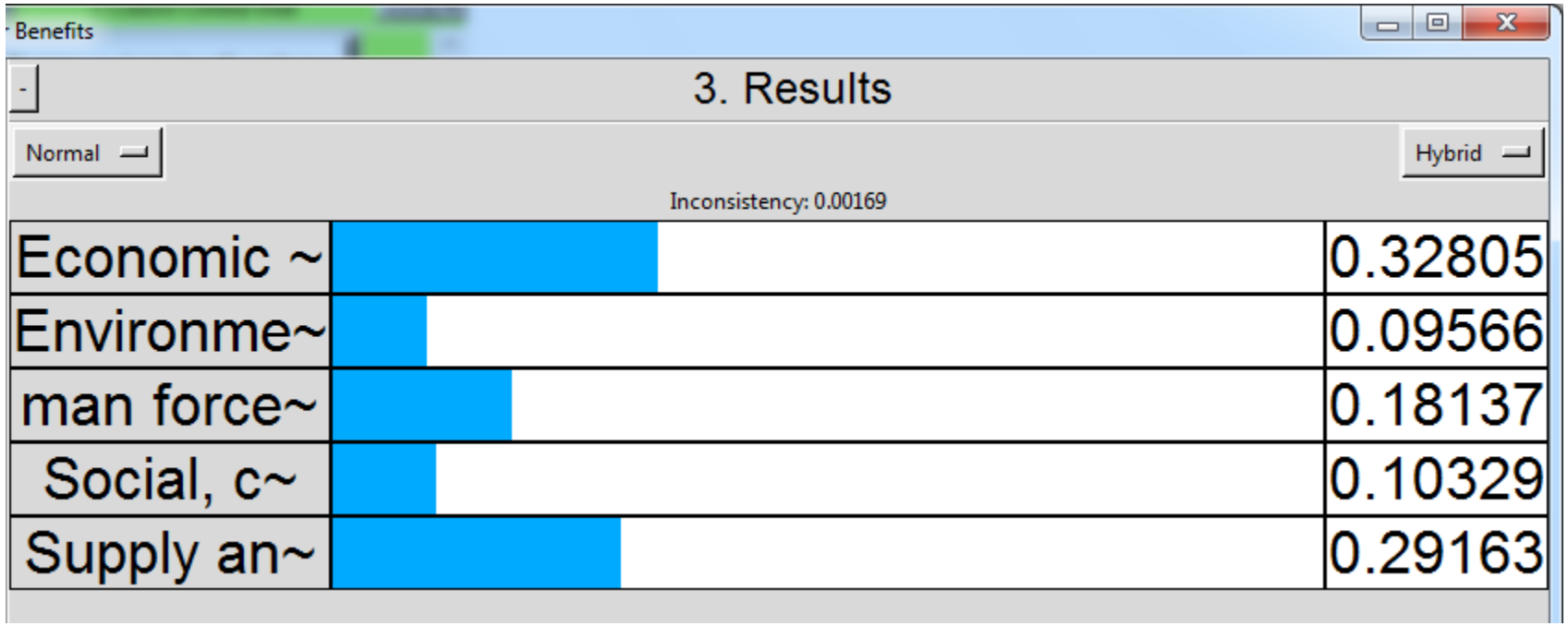


Sub network under risks/ production



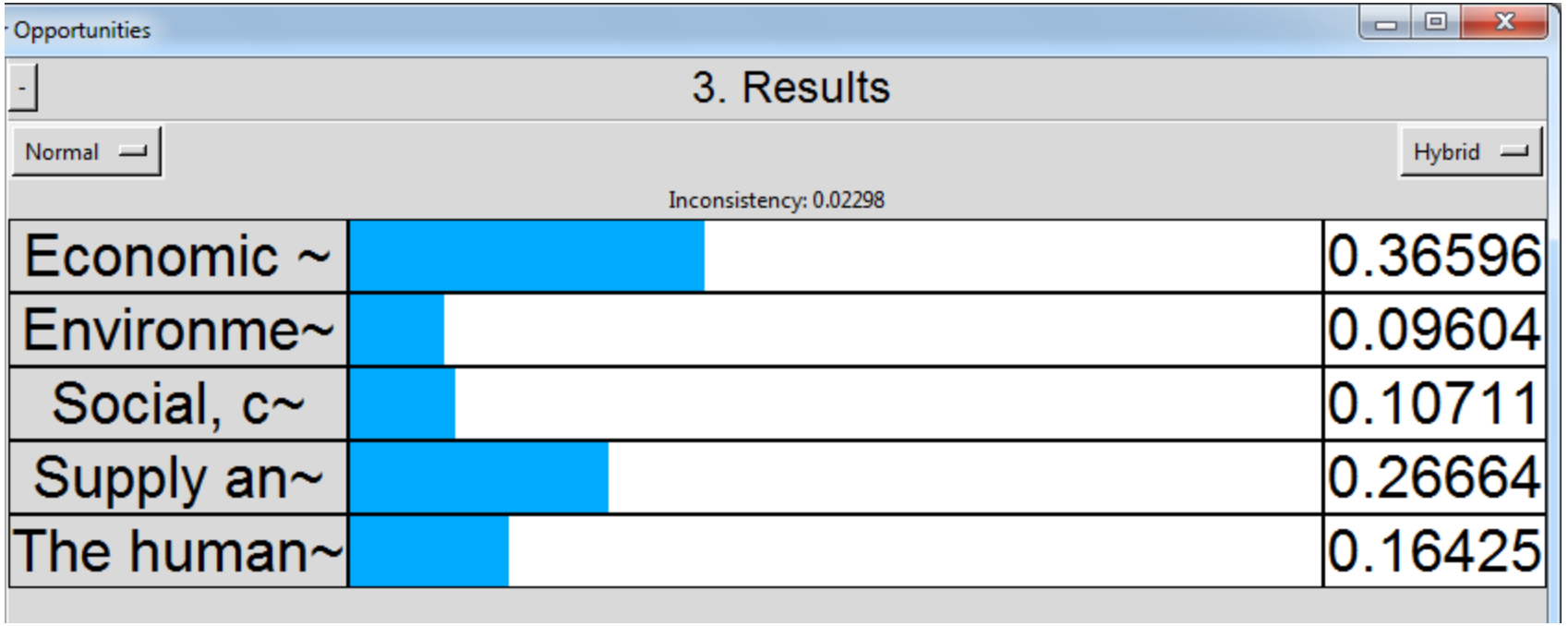
Sub network under risks/ social cultural & politic

Result of benefits/ Control criteria



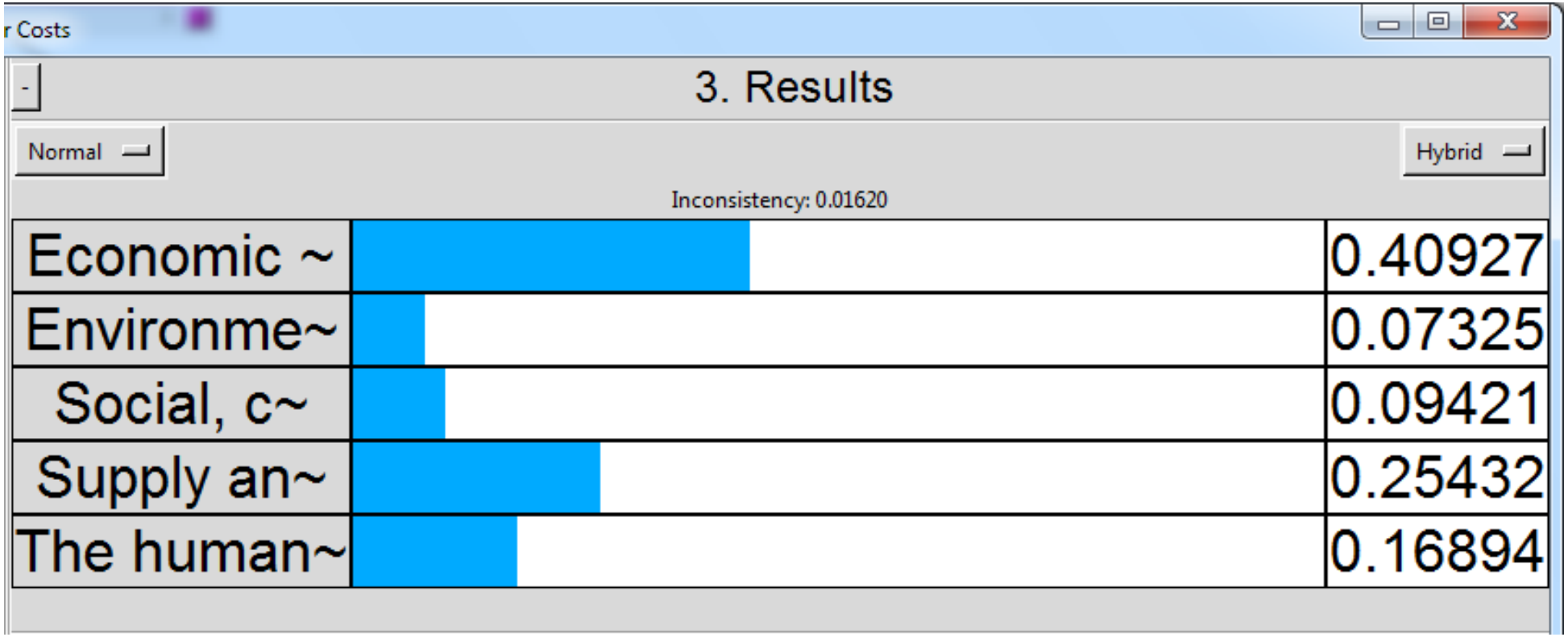
Economics and marketing has the highest priority

Result of opportunities/ Control criteria



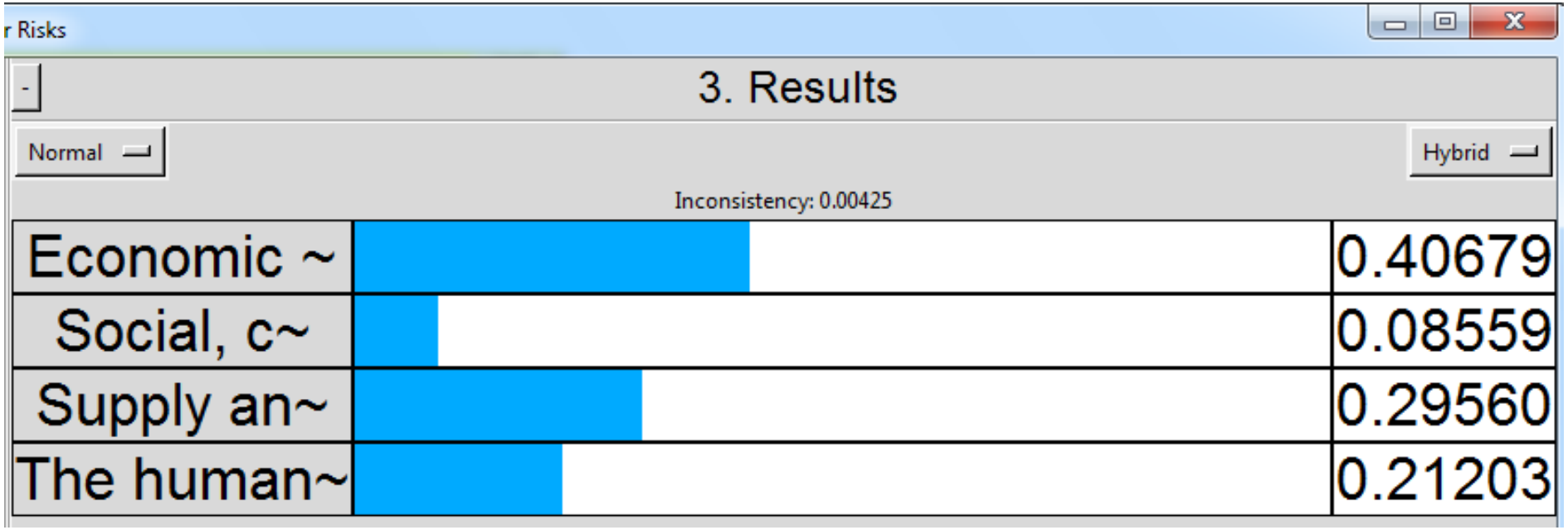
Economics and marketing has highest priority

Result of costs/ Control criteria



Economics and marketing has highest priority

Result of risks/ Control criteria



Economics and marketing has highest priority

Economics and marketing are very important criteria in current research due to following reasons

-Motivation of economic activity
-Success in decision making
-Profitability of economic activity

Result of Marketing and economics control criteria of Opportunities

- **The results show Marketing and Sale (0.604) has higher priority in comparison with Economics (0.395)**

- **In sub-network of Marketing and Sale, Branding has highest priority.**

The results are as follows:

- **Marketing 0.183, Branding 0.35, Propaganda 0.231, Services after sale 0.077, Profitability 0.103 and Warranty 0.053.**

Branding, provide

Advertising

After-sales services

Product warranty

Profitability

Results of solutions with respect to merits of Opportunities/ Marketing and sale control criteria:

Using fashion design in furniture production (S1): 0.189

Using engineering design in furniture production (S2): 0.211

Using a combination of fashion and engineering designs in furniture production (S3): 0.39

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.28

Results of solutions with respect to merits of opportunities/ marketing and sale control criteria/ Branding:

Using fashion design in furniture production (S1): 0.205

Using engineering design in furniture production (S2): 0.285

Using a combination of fashion and engineering designs in furniture production (S3): 0.448

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.06

Analysis of the solutions with respect to Branding

Using a combination of fashion and engineering designs in furniture production (S3) can restore potential of the country to brand Iranian furniture at the international market level.

Result of Marketing and economics control criteria of Benefits:

The results show Economic (0.581) has higher priority in comparison with Marketing and Sale (0.418)

In subnet work of Economics, Infrastructure has highest priority

The results are as follows:

Infrastructure 0.341, Competitiveness 0.235, Investment 0.234, Export 0.188

Creation of

Science & technology infrastructure

Government support infrastructure

Lead to

Export

Investment

Competitiveness of the furniture industry.

Results of solutions with respect to merits of Benefits/ Economics control criteria:

Using fashion design in furniture production (S1): 0.192

Using engineering design in furniture production (S2): 0.215

Using a combination of fashion and engineering designs in furniture production (S3): 0.331

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.261

- Results of solutions with respect to merits of benefits/ economics control criteria/ Infrastructure

Using fashion design in furniture production (S1): 0.199

Using engineering design in furniture production (S2): 0.288

Using a combination of fashion and engineering designs in furniture production (S3): 0.418

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.0937

Analysis of the solutions with respect to Infrastructure

Utilizing the combination of fashion and engineering designs (S3) in furniture production,

can lead to the maximum use of the capacity of the scientific and technological infrastructure of the universities.

Result of Marketing and economics control criteria of Costs:

Economics (0.604) has higher priority in comparison with Marketing and Sale (0.395)

In sub-network of Economics, Export has higher priority

The results are as follows:

Export 0.75, Import 0.25

Lack of knowledge of Export target markets

Reduces motivation of domestic producers to export

Loss of beneficial export markets

Tendency towards weak domestic markets

Negative and unhealthy competition

Results of solutions with respect to merits of Costs/ Economics control criteria:

Using fashion design in furniture production (S1): 0.25

Using engineering design in furniture production (S2): 0.21

Using a combination of fashion and engineering designs in furniture production (S3): 0.22

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.318

Results of solutions with respect to merits of costs/ economics control criteria/ Export:

Using fashion design in furniture production (S1): 0.289

Using engineering design in furniture production (S2): 0.138

Using a combination of fashion and engineering designs in furniture production (S3): 0.092

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.479

Analysis of the solutions with respect to Export

The solution S4 will lead to

Loss of export markets for the benefit of leading foreign competitors,

Dependence to leading countries is a major weakness,

Market will be lead to leading competitors.

Result of Marketing and economics control criteria of Risks:

Economic (0.671) has higher priority in comparison with Marketing and Sale (0.328)

In sub-network of Economics, Export has highest priority

The results are as follows:

Export 0.555, Investment 0.275, Competitiveness 0.168

Rules & regulations regarding competition will not be clear

Risk of a monopoly of information of Iranian furniture market

Impossibility of export for a domestic investor.

Results of solutions with respect to merits of Risks/ Economics control criteria

Using fashion design in furniture production (S1): 0.205

Using engineering design in furniture production (S2): 0.25

Using a combination of fashion and engineering designs in furniture production (S3): 0.329

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.215

Results of solutions with respect to merits of risks/ economics control criteria/ Export

Using fashion design in furniture production (S1): 0.124

Using engineering design in furniture production (S2): 0.285

Using a combination of fashion and engineering designs in furniture production (S3): 0.428

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.161

Analysis of the solutions with respect to Export

With respect to high risk of Export criteria, the solution S3 will lead to,

Increased costs of skilled designer employment,

Risk of job security for skilled labor,

Risk of not using machinery related to the design of a product engineered

Is not compatible with customer's requirements.

Overall synthesized priorities for the alternatives. We synthesized from the network sub-net under Opportunities:

Using fashion design in furniture production (S1): 0.177

Using engineering design in furniture production (S2): 0.211

Using a combination of fashion and engineering designs in furniture production (S3): 0.362

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.249

Overall synthesized priorities for the alternatives. We synthesized from the network sub-net under Benefits:

Using fashion design in furniture production (S1): 0.218

Using engineering design in furniture production (S2): 0.227

Using a combination of fashion and engineering designs in furniture production (S3): 0.301

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.252

Overall synthesized priorities for the alternatives. We synthesized from the network sub-net under Costs:

Using fashion design in furniture production (S1): 0.217

Using engineering design in furniture production (S2): 0.233

Using a combination of fashion and engineering designs in furniture production (S3): 0.222

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.327

Overall synthesized priorities for the alternatives. We synthesized from the network sub-net under Risks:

Using fashion design in furniture production (S1): 0.188

Using engineering design in furniture production (S2): 0.227

Using a combination of fashion and engineering designs in furniture production (S3): 0.296

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.287

Overall synthesized priorities for the alternatives. We synthesized from the network Super Decision Main Window:

Using fashion design in furniture production (S1): 0.225

Using engineering design in furniture production (S2): 0.217

Using a combination of fashion and engineering designs in furniture production (S3): 0.396

Applying leading countries' design capability with an outsourcing approach in furniture production (S4): 0.161

In terms of selection, Using a combination of fashion and engineering designs in furniture production (S3) in the marketplace and furniture manufacturing is considered the best solution.

We analyze S3 with respect to 8 main control criteria which are as follows:

Economic

Marketing and sale

Supply

Production

Technical

Man force

Social, cultural, and political

Environmental

Economic

If S3 is planned and implemented

Maximum use of available capacities in the scientific and technological infrastructure of universities

Protection of the share of the country's furniture and furniture market in favor of domestic power.

Foreign investment

High value added products

Transferring technical knowledge.

Marketing and sale

Using S3 in the market and furniture industry

Restore the potential of the country to brand Iranian furniture

Emergence and prosperity of Iranian brands in the international market,

Strong and reputable brands in their global markets and gain a good market share.

Supply

S3 can be used to design and manage the use of indigenous and even non-indigenous materials in design.

One work reliably and will not be concerned about the cessation of its supply,

Suitable alternatives could be found

Production

S3 leads to the creation of R & D

Overwhelming with the benefits and interests for companies,

Accuracy and quality of work increases,

Production time decreases,

Lower production costs

Increased margins,

Raising competitiveness of the product,

Timely scheduling and delivery

Technical

Using S3, a design change can always be made to a product that is not in line with competitors' products,

Distinction and difference with other products.

Market share be achieved by differentiating the design

Development of design and ergonomics

Man force

S3 offers

Job creation (architecture, art, industrial design, and wood industry)

Establishing new knowledge-based companies

Designing and producing new products

Social, cultural, and political

Using S3, a sense of self-confidence is created in the domestic producer

Respond to customer needs

Designing with respect to culture of the community

Applying beauty, quality, precision, elasticity, and elegance

Environmental

Using S3, we can use the optimal amount of raw materials available to reduce the harvest and utilization of forest resources.

Possibility of recycle

Decrease in waste of production

Green supply chain management

Sensitivity analysis

Since there may be different judgments about the comparison of priority rates of benefits, opportunities, costs, and risks or their sub-criteria, a sensitivity analysis of the results is called for (Saaty, 2001d).

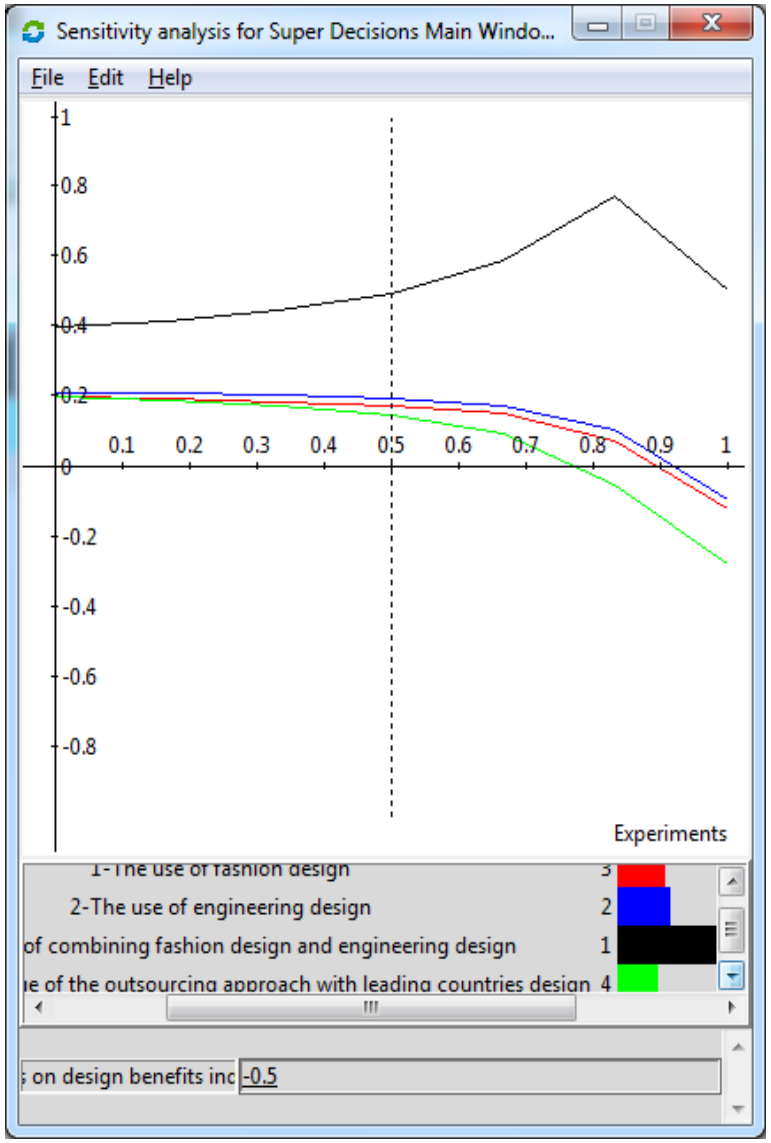
The results are illustrated in table 6.

Table 6: The results of sensitivity analysis

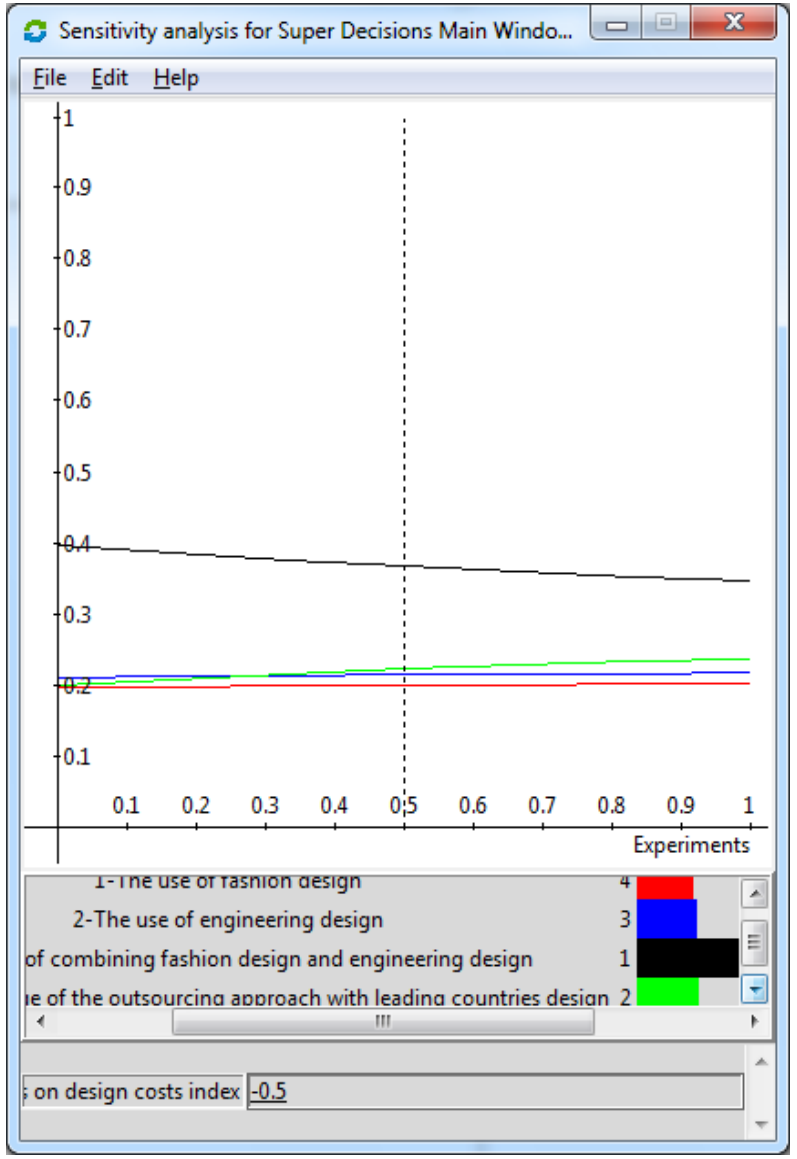
Merits	Basic Weight	Number of changes	New Weight	New Priorities
Benefits	0.313	1	0.134	**S3>S2>S1>S4**
Costs	0.146	1	0.255	**S3>S4> S2 > S1**
Opportunities	0.332	2	0.06 0.42	**S3>S2>S1>S4** **S3>S1>S2>S4**
Risks	0.207	1	0.294	**S3> S4 >S2> S1**

With respect to the result, opportunities is more sensitive than benefits, costs and risks with two times changes of alternatives priorities.

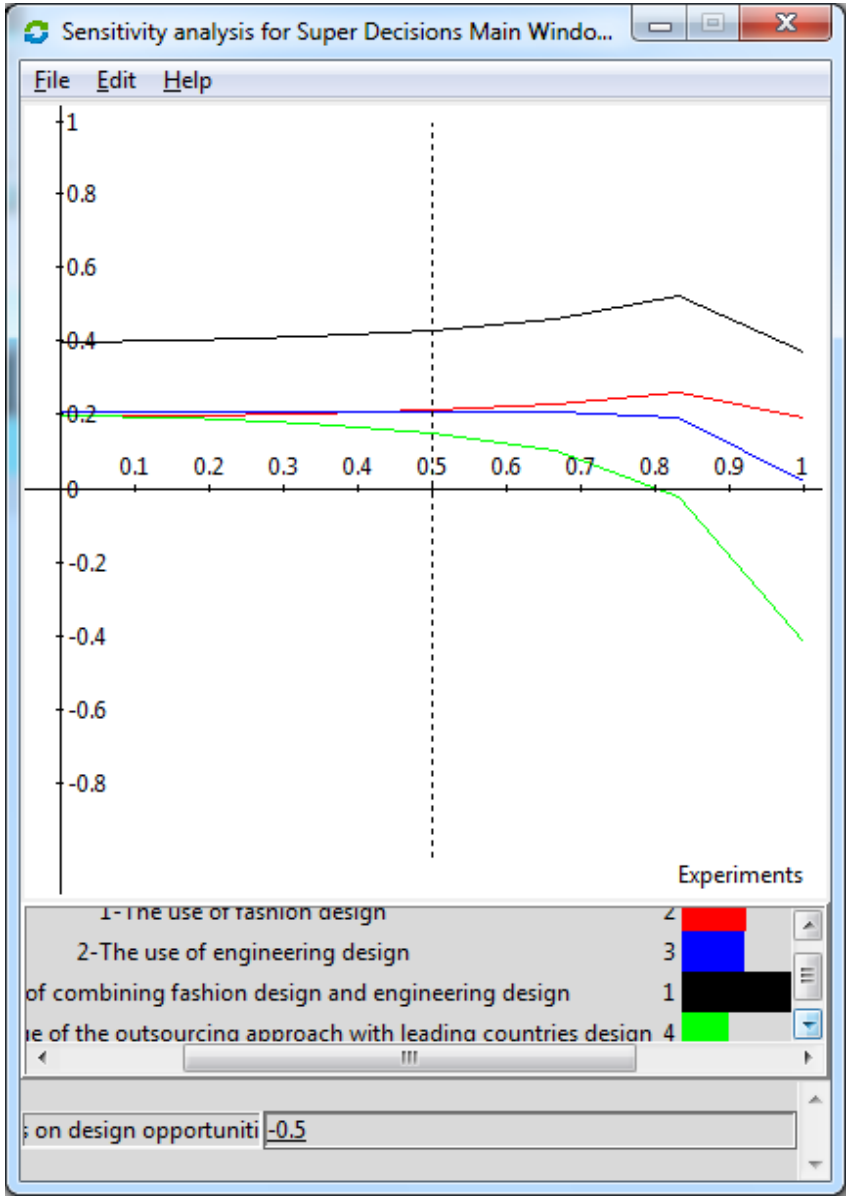
Sensitivity analysis with respect to benefits



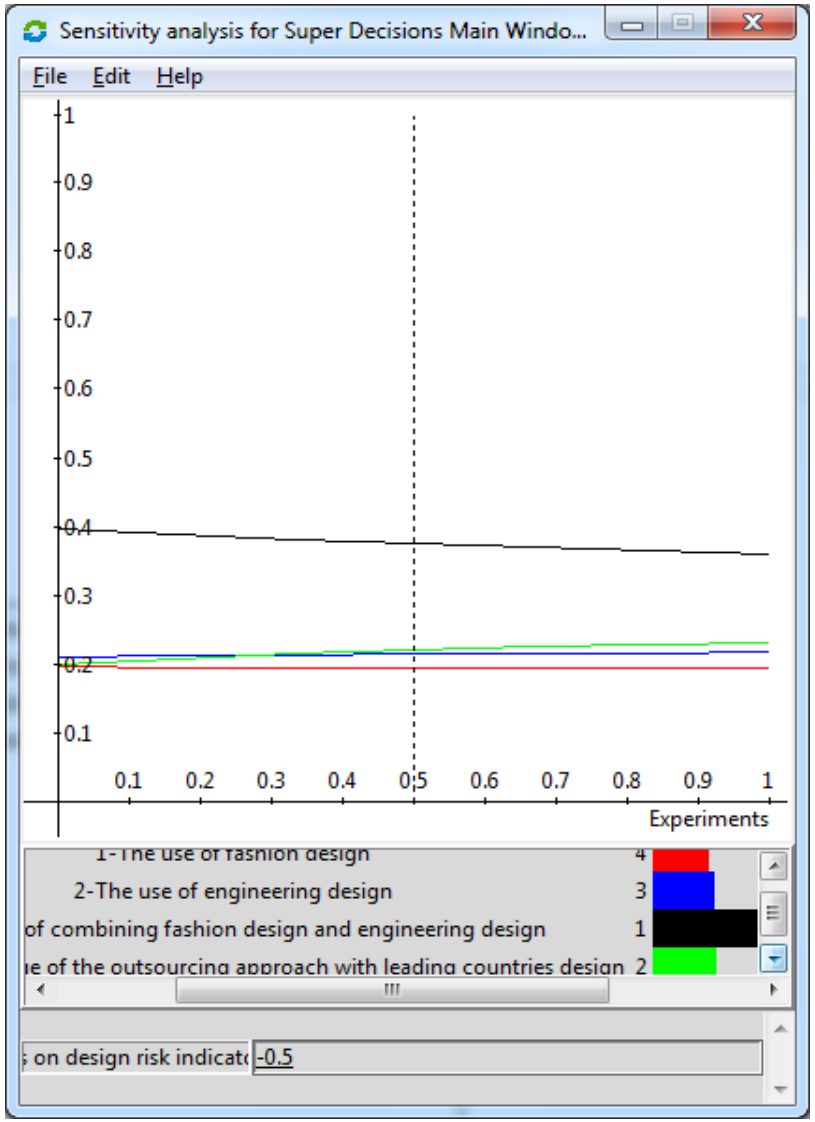
Sensitivity analysis with respect to costs



Sensitivity analysis with respect to opportunities



Sensitivity analysis with respect to risks



References

Saaty T., 2001d. Decision on National Missile Defense Program, The 6th International Symposium on the AHP in Bern, Switzerland.

Saaty T., 2001a. Decision Making with Dependence and Feed back: The Analytic Network Process, RWS Publications, Pittsburgh, PA.

Ratnasingam. J, and loras, F. 2003. The sustainability of the Asian wooden furniture industry. Holz als Roh- und Werkstoff. 61: 233–237.

Gazo, R. 2005. A review of competitive strategies of furniture manufacturers. Forest Product Journal, 55: No: 10: 66-73.

Swann, P. and Birke, D. 2005. 'How do Creativity and Design Enhance Business Performance? A framework for interpreting the Evidence', DTI Think Piece, University of Nottingham Business School.

Gemser, G. and Leenders, M.A.A.M., 2001. 'How integrating industrial design in the product development process impacts on company performance', The Journal of Product Innovation Management, vol.18, pp. 28-38

Thank you for your attention

ISAHP 2011 Sorrento, Italy