BUSINESS STRATEGY AND THE ENVIRONMENT IN A TRADITIONAL MANUFACTURING SECTOR

Laurent Antoine Bernard SOULIER

Doctor of Philosophy

The University of Aston in Birmingham

June 1999

THESIS SUMMARY

This research is concerned with the relationship between business strategy and the environment within traditional sectors. It has sought to learn more about the strategic environmental attitudes of SMEs compared with large companies operating under the same market conditions. The sector studied is the ceramics industry (including tableware & ornamental-ware, sanitary ware & tiles, bricks, industrial & advanced ceramics and refractories) in the UK and France. Unlike the automotive, oil, chemical, steel or metal processing sectors, this industry is one of the few industrial sectors which has rarely been considered. The information on this sector was gathered by interviewing people responsible for environmental issues. The actual programme of valid interviews represents approximately a quarter of the UK and French ceramics industry which is large enough to enable a quantitative analysis and significant and non-biased conclusions.

The European ceramics industry is regarded as the world's largest ceramic producing region. This sector is, as a whole, positioned on a mature/decline market which forces industries operating in this market to be highly competitive in order to survive. The nineties have seen the creation of several multinational groups in each sub-sector. Traditionally, the UK and French ceramics industry have generally been long-established and tend to be under-capitalised and oligopolistic. The impact of the ceramics industry on the environment is derived from the overall process parameters typically, waste - in solid, sludge, and gaseous form - is generated by the ceramics manufacturing process. As in other European industrial sectors, the UK and French ceramics industry have an increasing body of new environmental legislation to comply with. National and international regulations dealing with air, water, waste and noise have become more stringent over the past five years, and it is foreseen that these policies are likely to be further strengthened in the near future so as to integrate environmental concerns into industrial activities.

As a whole, all companies surveyed agreed that the ceramics activity impacts on the environment, and that they are increasingly affected both by environmental legislation, and by various non-legislative pressures. Approaches to the environmental agenda differ significantly among large and small companies. Smaller companies feel particularly pressed both by the financial costs and management time required to meet complex and changing legislation. The results of this survey also suggest that the ceramics industry sees environmental issues in terms of increased costs rather than new business opportunities. This is due principally to fears of import substitution from countries with lower environmental standards. Finally, replies indicate that generally there is a low level of awareness of the current legislative framework, suggesting a need to shift from a regulatory approach to a more self-regulated approach which encourages companies to be more proactive.

ACKNOWLEDGEMENTS

Many people throughout the entire duration of this research have helped me in different ways; advice, criticism, suggestions, discussion and above all support over the crucial period, a debt which I hope, one day, I will be in position to repay. In particular, I would like to thank my supervisor Dr. Fred Steward. I also want to express particular thanks to Dr. Steve Conway and Ms. Julie Woolie for reading and re-reading the complete manuscript, and along with others, delaying the completion of this research by taking me out to the Black Eagle !

LIST OF CONTENTS

CHAPTER 1: OBJECTIVES AND STRUCTURE OF THE DISSERTATION ...20

1. INTRODUCTION 21

2. AIMS AND ISSUES OF THE STUDY 24

2.1 Definition of the ceramics sector 24

2.2 Ground forces and interests in investigating this area of research 26

2.3 Objectives of the study 29

2.4 Approach 30

3. STRUCTURE OF THE DISSERTATION 31

CHAPTER 2: BUSINESS STRATEGY AND ENVIRONMENTAL CONSTRAINTS 36

1. INTRODUCTION 37

1.1 Objectives 38

2. CORPORATE STRATEGY AND ATTITUDES TOWARDS THE ENVIRONMENT . 39

2.1 Theoretical framework 39

2.2 Main barriers to improving environmental performances 44

3. ENVIRONMENTAL PRINCIPLES 45

3.1 Natural resources and the environment within the economics thought 45

3.2 Classical economist and their legacy to present environmental reflections 48

3.3 Neo-classical thought and the marginal revolution 50

4. ENVIRONMENTAL COMPLIANCES - A BRIEF TAXONOMY 54

4.1 Regulatory approach 55

4.2 Economic or Incentive-based approach 57

4.2.1 Charges and taxes 59

4.2.2 Tradeable permits 60

4.2.3 Deposit-refund systems 61

4.3 Communicative approach 61

4.4 Self-regulated approach 62

5. ENVIRONMENTAL LEGISLATION & REGULATION 65

5.1 Regulatory requirements relating to air pollution..66

5.1.1 European Level 68

5.1.2 Britain and Wales 69

5.1.3 France.. 70

5.2 Regulatory requirements relating to water pollution...71

5.2.1 European Level 71

5.2.2 Britain and Wales 72

5.2.3 France.. 73

5.3 Regulatory requirements relating to land contamination...74

5.3.1 European Level 74

5.3.2 Britain and Wales 75

5.3.2.1 Contaminated land.. 75

5.3.2.2 Mineral Extraction.. 76

5.3.3 France.. 76

5.4 Regulatory requirements relating to waste generation...77

5.4.1 The European level.. 77

5.4.2 Britain and Wales 78

5.4.2.1 Solid Waste... 78

5.4.2.2 Metal Release from Glazed Product.. 79

5.4.3 France.. 80

5.5 Regulatory requirements relating to noise emission 81

5.5.1 The European level.. 81

5.5.2 Britain and Wales 81

5.5.3 France.. 81

6. THE FIRM'S ENVIRONMENTAL BEHAVIOUR MODEL CONSIDERED............ 82

6.1 Environmental awareness and management of SMEs 82

6.2 Attitudes of "traditional businesses" vis-à-vis the environment..84

6.3 Can the environmental impact of a traditional sector dominated by SMEs be reduced?...85

7. CRITICAL ANALYSIS 86

CHAPTER 3: METHODOLOGY 90

1. INTRODUCTION.. 91

1.1 Objectives 92

2. RESEARCH APPROACHES... 93

2.1 Quantitative versus Qualitative Methods.. 95

3. METHODOLOGICAL APPROACH ADOPTED... 99

3.1 Research objectives, approaches and target population............................... 100

3.2 From secondary data study to questionnaire design 102

3.3 Piloting and modifying the questionnaire.. 103

3.4 Implementation of the survey.. 105

3.5 Analysing and presenting the results.. 105

4. OVERVIEW OF THE COMPANIES SURVEYED 107

4.1 Overall sample 107

4.1.1 Breakdown by sector 108

4.1.2 Breakdown by company size.. 109

4.2 Position of respondent and responsibilities.. 111

4.2.1 Position of respondent (Question 1) 111

4.2.1.1 Breakdown by sector.. 112

4.2.1.2 Breakdown by company size 112

4.2.2 Role and financial responsibilities (Questions 2 and 3)............................ 112

5. CRITICAL ANALYSIS 114

CHAPTER 4: INDUSTRY PROFILE AND MARKET CHARACTERISTICS. 115

1. INTRODUCTION.. 116

1.1 Objectives 118

2. INDUSTRY PROFILE 120

2.1 Ceramics market stimuli 120

2.1.1 The demand side.. 120

2.1.2 The supply side.. 121

2.2 Market performance 123

2.2.1 World market performance 123
2.2.1.1 The world market for tableware and ornamental-ware 124
2.2.1.2 The world market for ceramic tiles 125
2.2.1.3 The world market for sanitary-ware 128
2.2.1.4 The world market for bricks 129
2.2.1.5 The world market for industrial ceramics and refractories goods 129
2.2.1.6 Conclusion 132
2.2.2 European market performance 132
2.2.2.1 The European market for tableware and ornamental ware 135
2.2.2.2 The European market for ceramic tiles 136
2.2.2.3 The European market for sanitary-ware 138
2.2.2.4 The European market for bricks 139
2.2.2.5 The European market for industrial and refractories goods 140
2.2.2.6 Conclusion 141

3. THE CERAMIC INDUSTRY IN THE UK AND FRANCE 143

3.1 Macro-environment forces 143
3.1.1 The UK 143
3.1.2 France 144
3.1.3 Current overall issues facing the ceramics industry 145
3.1.3.1 Breakdown by sector 146
3.1.3.2 Breakdown by size 147

3.2 Micro-environment actors 147
3.2.1 The UK and French ceramics sector outlook 148
3.2.1.1 Company size 148
3.2.1.2 Industry sub-sectors 149
3.2.2 The tableware & ornamental ware industry 150
3.2.2.1 The UK tableware & ornamental-ware industry 150
3.2.2.2 The French tableware industry 151
3.2.2.3 Strengths and Weaknesses of the UK and French tableware industries 154
3.2.3 The sanitary-ware industry 156
3.2.3.1 The UK sanitary-ware industry 156
3.2.3.2 The French sanitary-ware industry 157
3.2.3.3 Strengths and Weaknesses of the UK and French sanitary-ware industries 158
3.2.4 The tile industry 158
3.2.4.1 The UK tile industry 158
3.2.4.2 The French tile industry 159

3.2.4.3 Strengths and Weaknesses of the UK and French tile industries 161
3.2.5 The brick industry 161
3.2.5.1 The UK brick industry 161
3.2.5.2 The French brick industry 164
3.2.5.3 Strengths and Weaknesses of the UK and French brick industries 164
3.2.6 The refractory and industrial ceramics industry 165
3.2.6.1 The UK refractory industry 165
3.2.6.2 The French refractory and advanced ceramics industry 168
3.2.6.3 Strengths and Weaknesses of the UK and French refractory and advanced ceramics industries 169

4. CRITICAL ANALYSIS OF THE CERAMICS SECTOR 170

CHAPTER 5: MANUFACTURING PROCESSES AND KEY ENVIRONMENTAL IMPACTS 171

1. INTRODUCTION 172

1.1 Objectives 173

2. MANUFACTURING PROCESS & WASTE ARISINGS 174

2.1 Clay raw material preparation and procurement 177
2.1.1 The Process 178
2.1.2 Waste Arisings 180

2.2 Plaster mould 180
2.2.1 The process 181
2.2.2 Waste arisings 181

2.3 *Body shaping 182*
2.3.1 The Process 182
2.3.2 Waste Arisings 183

2.4 The Drying Process 183
2.4.1 The Process 183
2.4.2 Waste Arisings 185

2.5 Finishing 185
2.5.1 The Process 185
2.5.2 Waste Arisings 185

2.6 Glazing 185

2.6.1 The Process 186
2.6.2 Waste Arisings 188

2.7 Kiln Firing *188*
2.7.1 The Process 188
2.7.2 Waste Arisings from the Kiln Firing Process 194

2.8 Decorating *194*
2.8.1 The Process 194
2.8.2 Waste Arisings 197

2.9 Inspection *197*
2.9.1 The Process 197

2.10 Packaging *198*
2.10.1 Waste Arisings 198

2.11 Specific Waste Arisings in the refractory sector *198*

2.12 Section Summary *199*

3. PRINCIPAL IMPACTS ON THE ENVIRONMENT ***201***

3.1 Impact on air *201*
3.1.1 Releases to air from Firing 202
3.1.2 Releases to air from toxic colouring agents and hazardous raw materials 202
3.1.3 Releases to air from energy used 204
3.1.4 Releases to air from transport of the raw materials and the final products 204

3.2 Impact on water *205*
3.2.1 Releases to water from raw materials procurement 205
3.2.2 Releases to water from production process 205

3.3 Impact on land *206*

3.4 Impact on waste generated *206*
3.4.1 Solid wastes generated by the ceramics manufacture 206
3.4.2 Packaging wastes 207

3.5 Impact on noise emissions *207*

4. CRITICAL ANALYSIS ***208***

CHAPTER 6: MANAGERIAL PERCEPTIONS AND INTENTIONS TOWARDS ENVIRONMENTAL ISSUES 212

1. INTRODUCTION...213

1.1 Objectives 214

2. OVERALL ATTITUDES AND BENEFITS TOWARDS ENVIRONMENTAL ISSUES 215

2.1 Level of Environmental impact of the company's respondent (Question 5) 216

2.1.1 Breakdown by sector 216

2.1.2 Breakdown by size...216

2.2 Level of benefit of having an environmental policy (Question 6) 216

2.2.1 Breakdown by sector 216

2.2.2 Breakdown by size...216

2.3 Correlation between business environmental initiatives and benefit (Question 12).........217

2.3.1 Breakdown by sector 217

2.3.2 Breakdown by size...217

2.4 Main benefit from improving environmental performance (Question 14) 217

2.4.1 Breakdown by sector 218

2.4.2 Breakdown by size...218

2.5 Benefits of adopting new procedures (Question 28)...218

2.5.1 Breakdown by sector 219

2.5.2 Breakdown by size...220

2.6 Disadvantages in adopting new procedures (Question 29)...220

2.6.1 Breakdown by sector 220

2.6.2 Breakdown by size...220

3. INTERNAL DRIVERS AND BARRIERS FOR IMPROVING ENVIRONMENTAL PERFORMANCE 222

3.1 Financial & Economic drivers and barriers for improving environmental performances..223

3.1.1 Correlation between environmental performance and efficiency (Question 7) 223

3.1.2 Correlation between environmental impact and cost benefits (Question 13)..........224

3.1.3 Correlation between financial constraints and improvement (Question 10)............224

3.1.4 Long term financial benefits (Question 30) 224

3.1.5 Short term financial benefits (Question 31) 225

3.2 Shareholder's & Employee's views for improving environmental performances............225

3.2.1 Shareholder's/supporter's views (Question 34) 225
3.2.2 Employee's views (Question 39)..........226

4. EXTERNAL DRIVERS AND BARRIERS FOR IMPROVING ENVIRONMENTAL PERFORMANCE 227

4.1 Environmental impact for improving environmental performances..........228
4.1.1 Environmental impact alone (Question 37)..........228

4.2 Market position and customer pressure for improving environmental performances 228
4.2.1 Market position and market share (Question 38)..........229
4.2.2 Customer pressure (Question 33)..........229

4.3 Institutional and public opinion for improving environmental performances..........229
4.3.1 The views of the local community (Question 36)..........229
4.3.2 Public opinion (Question 35)..........230

4.4 Legal and regulatory pressure for improving environmental performances..........230
4.4.1 Correlation between legislation and environmental action (Question 8) 230
4.4.2 Level of awareness in regard to environmental legislation (Question 9)..........231
4.4.3 Awareness of the options to meet environmental legislation (Question 15)..........231
4.4.4 Compliance with relevant legislation (Question 32) 231

5. COMPANY ACTION TO IMPROVE ENVIRONMENTAL PERFORMANCE......233

5.1 Correlation between better advice and decision process (Question 11)..........234
5.1.1 Breakdown by sector 234
5.1.2 Breakdown by size..........235

5.2 Corporate environmental policy (Question 17) 235
5.2.1 Breakdown by sector 235
5.2.2 Breakdown by size..........235

5.3 Monitoring of waste or emissions produced (Question 18) 235
5.3.1 Breakdown by sector 235
5.3.2 Breakdown by size..........235

5.4 Reduction targets for emissions and waste set (Question 19) 236
5.4.1 Breakdown by sector 236
5.4.2 Breakdown by size..........236

5.5 Accreditation under an environmental management system (Question 20)..........236
5.5.1 Breakdown by sector 236
5.5.2 Breakdown by size..........237

5.6 Type of accreditation (Question 21) *237*

5.7 EMAS (Question 22) *238*

5.7.1 Breakdown by sector 238

5.7.2 Breakdown by size 238

5.8 BS7750 (Question 23) *238*

5.8.1 Breakdown by sector 238

5.8.2 Breakdown by size 238

5.9 Action taken recently to improve environmental performance (Question 25) *239*

5.9.1 Breakdown by sector 239

5.9.2 Breakdown by size 240

5.10 Factors leading to improve environmental performance (Question 26) *241*

5.10.1 Breakdown by sector 242

5.10.2 Breakdown by size 243

5.11 Member of a local Waste Minimisation Club (Question 40) *243*

5.11.1 Breakdown by sector 243

5.11.2 Breakdown by size 244

5.12 Aware of a Local Waste Minimisation Club (Question 41) *244*

5.12.1 Breakdown by sector 244

5.12.2 Breakdown by size 244

5.13 Sources of information (Question 42) *245*

5.13.1 Breakdown by sector 247

5.13.2 Breakdown by size 247

6. CROSS-CORRELATION BETWEEN OVERALL ATTITUDES VERSUS ACTION 248

6.1 Formal corporate environmental policy versus impacts on the environment *249*

6.1.1 Breakdown by sector 249

6.1.2 Breakdown by size 249

6.2 Formal corporate environmental policy versus in favour of environmental policy *250*

6.3 Change over the last 2 years versus impacts on the environment *250*

6.3.1 Breakdown by sector 250

6.3.2 Breakdown by size 250

6.4 Change over the last 2 years versus in favour of environmental policy *250*

6.4.1 Breakdown by sector 251

6.4.2 Breakdown by size 251

6.5 Levels of waste or emissions monitored versus impacts on the environment................251
6.5.1 Breakdown by sector 251
6.5.2 Breakdown by size..251
6.6 levels of waste or emissions monitored versus in favour of environmental policy...........251
6.6.1 Breakdown by sector 251
6.6.2 Breakdown by size..252
6.7 Reduction targets set versus impacts on the environment...252
6.7.1 Breakdown by sector 252
6.7.2 Breakdown by size..252
6.8 Reduction targets set versus in favour of environmental policy.................................252
6.8.1 Breakdown by sector 252
6.8.2 Breakdown by size..252
6.9 Financial constraints versus significant cost benefits..253
6.9.1 Breakdown by sector 253
6.9.2 Breakdown by size..253
6.10 Short & Long terms financial benefits versus significant cost benefits 253
6.10.1 Breakdown by sector...253
6.10.2 Breakdown by size...253
6.11 Short & Long terms financial benefits versus financial constraints..............................253
6.11.1 Breakdown by sector...254
6.11.2 Breakdown by size...254
6.12 Action only to conform with legislation versus compliance with legislation..................254
6.12.1 Breakdown by sector...254
6.12.2 Breakdown by size...254
7. CRITICAL ANALYSIS 255

CHAPTER 7: ENVIRONMENTAL BEHAVIOUR OF TRADITIONAL FIRMS..259

1. INTRODUCTION..260

1.1 Objectives 260

2. SECTORAL AND NATIONAL DIFFERENCES 261

2.1 UK and French administrative structures for the environment 262

2.2 Sectoral and National differences in the brick sector...263

2.3 Sectoral and National differences in the industrial & refractory sector 264

2.4 Sectoral and National differences in the sanitaryware & tiles sector 265

2.5 Sectoral and National differences in the tableware sector 267

3. OVERALL ROLE OF REGULATORY PRESSURES AND COST SAVINGS **269**

3.1 Environmental awareness, tighter standards, more regulation and market based instruments 270

3.2 Outline of environmental responses and firms' characteristics 270

3.2.1 Group 1: Defensive 272

3.2.2 Group 2: Laggard 273

3.2.3 Group 3: Compliance 274

3.2.4 Group 4: Reactive 275

3.2.5 Group 5: Proactive 276

4. RATIONALE FOR NOT INTRODUCING ENVIRONMENTAL IMPROVEMENT **278**

4.1 Insufficient financial incentive 278

4.2 Inadequacy of environmental regulation 279

CHAPTER 8: CONCLUSION **280**

1. INTRODUCTION **281**

1.1 Background 281

1.2 Research focus 282

2. CHARACTERISTICS OF THE SECTOR **283**

2.1 Impact of the ceramics industry on the environment 283

2.2 Principal sources of legislative pressure affecting the ceramics industry 284

3. CORPORATE ATTITUDES AND PERCEPTIONS OF THE ENVIRONMENT ... **286**

4. CONCLUSIONS AND FURTHER RESEARCH **291**

BIBLIOGRAPHY **293**

APPENDICES **314**

APPENDIX A : SOURCES *315*

a. Official sources for France *315*

b. Official sources for the United Kingdom *315*

c. Trade unions and employer's federations for France *316*

d. Trade unions and employer's federations for the United Kingdom *317*

e. Trade unions and employer's federations for Europe *317*

f. Technical magazines for France *317*

g. Technical magazines for the United Kingdom *318*

h. International technical magazines *318*

APPENDIX B : LIST OF BRITISH AND FRENCH CERAMICS MANUFACTURERS *319*

a. British companies *319*

b. French companies *341*

APPENDIX C : GLOSSARY OF TERMS *357*

APPENDIX D : TELEPHONE QUESTIONNAIRE *360*

a. English questionnaire *360*

b. French Questionnaire *370*

APPENDIX E : DATA TABULATIONS *380*

a. UK by size *380*

b. France by size *385*

c. UK by sector *389*

d. France by sector *394*

e. UK - Cross correlation by sector *398*

f. UK - Cross correlation by size *399*

g. France - Cross correlation by sector *401*

h. France - Cross correlation by size *402*

LIST OF TABLES

Table 1: Environmental strategies adopted by companies 43
Table 2: Principle barriers to improving environmental performances 44
Table 3: Arguments for and against "Voluntary Environmental Agreements" 63
Table 4: Major prescribed air pollutant: what, why and from where? 67
Table 5: National limits for metal release form glazed goods 80
Table 6: Research plan 91
Table 7: Comparison of the purposes of basic and applied research 93
Table 8: The four types of validity 95
Table 9: Attributes of the quantitative and qualitative paradigms 97
Table 10 : Number of UK and French ceramics industry with over 25 employees 101
Table 11 : Sampling frame for survey 102
Table 12 : Pilot survey 104
Table 13 : Interviews carried out in the UK 107
Table 14 : Interviews carried out in France 107
Table 15: Ceramics industry market positioning 116
Table 16: A taxonomy of ceramic products 117
Table 17: Ceramics industry characteristics 119
Table 18: World-wide distribution of ceramic tile manufacture 126
Table 19: World-wide consumption of ceramic tiles 127
Table 20: Production, consumption and exporting in the world 128
Table 21: Refractory types 130
Table 22: Global market for Industrial and Refractories goods in million ECU (1992) 131
Table 23: European market leader for household ware in 1994 in billion ECU 136
Table 24: Top Manufacturing countries in Europe 137
Table 25: Top European Exporting countries in million m^2 137
Table 26: Top European consumers countries in million m^2 138
Table 27: Market leaders in the ceramic production sectors in central Europe 142
Table 28: employment per business unit in the UK and France ceramics sector 149
Table 29: Sub-sectors in the UK and France ceramics industry, 1993 150
Table 30: Manufacturers' shares of the UK china and earthenware market, 1993 151
Table 31: Geographical distribution of the tableware and ornamental ware industry 153
Table 32: Size of firms in the Limoges region by staff numbers in 1994 153
Table 33: The UK sanitary-ware manufacturers, 1993 157
Table 34 : The UK's ceramic tiles market, 1993 159
Table 35: Projected UK brick output for 1995 161

Table 36: The UK's major brick producers..163
Table 37: The UK's refractory manufacturers, 1993 166
Table 38 : The UK annual refractory sales (tonnes) 167
Table 39: The UK's advanced/industrial ceramics manufacturers, 1993 167
Table 40: Barriers affecting the ceramics industry...170
Table 41: Type of wastes generated during the production process 172
Table 42 : General process components 176
Table 43: Raw materials used in the making of ceramics product 178
Table 44: Glaze raw material..187
Table 45: Firing temperatures of the ceramics types 191
Table 46: Typical specific energy consumptions (SEC) for tableware, tiles, sanitaryware....193
Table 47: Common ceramics colour compounds 196
Table 48: Rejection Rates for Different Product Types...198
Table 49: Summary of wastes arisings from common stages of the manufacturing process 200
Table 50: Principal releases to air 202
Table 51: Solid process wastes...207
Table 52: The environmental significance of key process component waste arisings..........209
Table 53: Significance of environmental impacts within the different industry sub-sectors..211
Table 54: level of analyses.. 213
Table 55: Overall attitudes and benefits towards environmental initiatives 215
Table 56: Internal drivers and barriers for improving environmental performances......,......222
Table 57: External drivers and barriers for improving environmental performances 227
Table 58: Company action to improve environmental performance 233
Table 59: Opinion towards action 248
Table 60: Ceramics industry market positioning.. 261
Table 61: Taxonomy of the ceramics industry according to its attitudes to environment..... 287

LIST OF FIGURES

Figure 1: International production of ceramic goods in current prices 24
Figure 2: Structure of the ceramics industry 25
Figure 3: The "league table" of the European Ceramics market 28
Figure 4: Overview of study and report 35
Figure 5: Alternative positions to achieve competitive advantage 42
Figure 6: Trade-offs among the three main objectives of sustainable development............. 47
Figure 7: Scope of environmental impacts in the ceramics life cycle 66
Figure 8: Linkages between environmental and economic system.................................... 86
Figure 9: Framing the research study 94
Figure 10: The research process 99
Figure 11 : Companies interviewed in the UK and France vs. sector................................108
Figure 12 (UK) : Company sizes vs. sector..109
Figure 13 (France) : Company sizes vs. sector 109
Figure 14 : Companies interviewed in the UK and France vs. size..................................110
Figure 15 (UK) : Company sectors vs. size..111
Figure 16 (France) : Company sectors vs. size 112
Figure 17 (Q2-UK) : Prime role within the company 114
Figure 18 (Q2-France) : Prime role within the company..114
Figure 19: International production of ceramic goods in current prices............................123
Figure 20: Global market structure for Household ceramics in 1994...............................125
Figure 21: World production of ceramic tiles in million square metres 126
Figure 22: Percentage of the ceramic World Production in 1994 127
Figure 23: Sanitary-ware market share by production in 1995..129
Figure 24: Number of employees in 1995 133
Figure 25: Ceramics goods production in billion ECU, 1995...134
Figure 26: International production of ceramic goods in constant prices..........................135
Figure 27: Distribution of sanitary-ware turnover within Europe in 1994...........................139
Figure 28: Number of brickworks in the EU 140
Figure 29: Brickworks employment in the EU 140
Figure 30: European sales figures for shaped refractories...141
Figure 31: Sector sources of GDP...145
Figure 32 (Q4) : Key issues facing French and British business 146
Figure 33: Market actors 147
Figure 34: Production breakdown by sales in 1994 154
Figure 35: French Production of Porcelain 154

Figure 36: Principle exporters of tableware products in 1994 155
Figure 37: Major French tableware groups in 1995 156
Figure 38: French sanitary-ware market for 1994 in millions of pieces 158
Figure 39: French consumption per product for 1994 in percentage....................160
Figure 40: Employment in the UK brick industry 163
Figure 41: Production broken down by properties....................168
Figure 42: Common process components of ceramics manufacture.................... 175
Figure 43: The ceramics firing process 189
Figure 44 (Q28) : Benefits of adopting new procedures.................... 219
Figure 45 (Q29) : Disadvantages in adopting new procedures....................221
Figure 46 (Q21) : Accreditation under an environmental management system 238
Figure 47 (Q25) : Improved environmental performance over the last 2 years....................239
Figure 48 (Q25) : No action over the last 2 years vs sector....................240
Figure 49 (Q25) : No action over the last 2 years vs size....................240
Figure 50 (Q26) : Factors influencing companies to change procedure 242
Figure 51 (Q40) : Member of a local waste minimisation club 243
Figure 52 (Q41) : Aware of a local waste minimisation club....................244
Figure 53 (Q42) : Where to turn for advice on environmental issues....................246
Figure 54: Modes of gaining environmental compliance, ranging from incentivisation to legal penalty 269

CHAPTER 1

OBJECTIVES AND STRUCTURE OF THE DISSERTATION

1. INTRODUCTION

During the past ten years the relationship between business and the environment has increasingly been discussed by academics, politicians and company managers. This had lead to the emergence of a significant number of new publications, publishers, authors, journals and newsletters with streams of articles on how concern for the environment can save companies money by reducing their waste and energy use. Many companies now sponsor or publish reports and papers on environmental themes, and government departments, agencies and quangos provide extensive coverage of many issues which are relevant to the relationship of business and the environment.

It is now accepted that all kinds of economic activity affect the environment and that the perceived and recognised spatial implications and consequences of this interaction have changed considerably during recent years. The environment and business relationship has now become a matter of great public concern[1].

For many companies, concern about the environment has been a necessary evil -compliance with government legislation and public pressure to control the cleanliness of their business. Indeed, quite clearly environmental policy has become more rigorous both in individual nation states and at the level of the European Union due to a number of serious environmental incidents in the 80s. As a result, the governments of Europe came to the conclusion that the EC needed a proper legal framework in order to tackle pollution on an international scale. Consequently, environmental policy formally became part of the EC treaty in the Single European Act of 1986. Today, over three hundred directives have been agreed to protect Europe's environment and transposed into national legislation, covering water management, air quality, conservation and waste management. The goals of this environment policy are:

- To preserve, protect and improve the quality of the environment;
- to contribute towards the protection of human health;
- to ensure a prudent and rational utilisation of natural resources.

However, it also emerged that environmental policies have both a negative and a positive pole. The negative pole is characterised by reactive political strategies designed to prevent

---

[1] Indeed in the last decade, it emerged that consumers were more inclined to purchase less-polluting products which was confirmed by the success of the *Green Consumer's Guide*, first published in Britain in 1988. The *Guide* was a bestseller for nine months and sold more than 300,000 copies; it has now been published in 10 foreign-language editions.

activities that are seen as harmful; the positive pole is characterised by proactive policies designed to encourage activities which aim to reduce the quantity of materials used, the toxicity of product released, and the overall cost to the consumer. It seems therefore inevitable that such policies are likely to be further strengthened in the future and this will affect the way in which every business is run and the way managers must recognise their responsibility, not only to a company, but also to the environment in which it operates. More importantly, many of the more recent initiatives on the environment, emanating from the European Commission, have been market driven and are voluntary. The underlying principles on which these policies are based are preventative action dealing with environmental damage at source and 'the polluter pays principles'. Collectively their impact is to demand that businesses take more responsibility for the environmental damage which they create and to approach corporate environmental management in a more proactive way.

Thus, the integration of environmental considerations into the economic sector is proceeding, but the extra cost of clean technologies and economic competition could in the short term lead to numerous bankruptcies. Among the threats that will be taken more and more seriously are the toxicity of certain substances, the danger of allergic reactions to others, and accidental or intentional releases into water, air and/or soil at the time of production and during or after use. Furthermore, investors, banks and insurance companies are beginning to look at the environmental records of companies. Indeed, banks are less predisposed to lend to a business which will be unable to repay because of environmental problems. More importantly, insurers are starting to give credence to pollution-driven climate change 'global warming' which may have been responsible for more and fiercer windstorms over the past decade and they also anticipate a significant rise in claims, up to $2 trillion in the US solely, for pollution cleanup and asbestos problems.

Undoubtedly, corporate strategy and attitudes towards environmental matters is increasingly of concern. More generally however, the key strategic issues facing multinationals are substantially different from those facing the small business. Small businesses are likely to be operating in a single market, or a limited range of markets, probably with a limited range of products or services. It is also likely that, unless the company is specialising in some particular market segment, it will be subject to significant competitive pressure: so issues of competitive strategy are likely to be especially important for the small firm. Decisions on competitive strategies are likely to be strongly influenced by the experience of those running the business. Small firms are also likely to be private companies. This significantly affects their ability to raise capital. Combined with the legacy of the founder's influence on choice of product and market, this may mean that choices of strategy are significantly limited. It is therefore not surprising that environmentally aware companies are found amongst the larger companies while SMEs place the environment low on their list of priorities (if it is a priority at all). This is principally due to a lack of basic technological know-how compounded by limits on the management time and attention which can be devoted to medium to long term strategic problems, and a chronic lack of resources. At present they are likely to feel that their first priorities lie elsewhere, but these companies will be coming under increasing pressure in the future, not only from legislation but also from their customers.

In line with the above discussion, the overall aim of this study is to assess the corporate strategy and managerial attitudes of traditional businesses vis-à-vis the environment. This research examines the general context of environmental management by considering the main drivers towards environmentalism and reviews the range of environmental policies (legislative, economic, communicative and self-regulated) companies have to comply with. It also sought to learn more about the strategic environmental attitudes of Small and Medium-sized Enterprises (SMEs[2]) compared with large companies operating under the same market characteristics. The sector covered is the ceramics industry (including tableware & ornamental-ware, sanitary ware & tiles, bricks, industrial & advanced ceramics and refractories) in the UK and France. The results are based on an analysis conducted using quantitative methods. As with all kinds of economic activity, the ceramics industry affects the environment by generating a substantial amount of waste which may be detrimental to the environment. Moreover as a whole, this industry is largely formed by SMEs.

---

[2] The European Commission has established a common definition for small and medium-sized enterprises. In order to be considered as a SME a company should employ less than 250 people, be independent and have an annual turnover below ECU 40 million.

2. AIMS AND ISSUES OF THE STUDY

This section briefly defines the industry under review and outlines the main ground forces behind the decision to investigate this area of research. It also presents the objectives of the study, and finally the approach adopted.

2.1 Definition of the ceramics sector

On a global level the ceramics sector is concentrated in North America, the Far East and Europe, and to a lesser degree elsewhere (Coope & Partners, 1995). Estimates both of the exact size of the ceramics industry across the world and the sectoral breakdown by country vary due to the absence of a comprehensive data collection and an information system spanning the whole spectrum of the industry. However it was estimated (L'industrie Céramique, 1992) that the World ceramics industry had a total production per annum of around 60 billion ECU and employed approximately 1.3 million people world-wide.

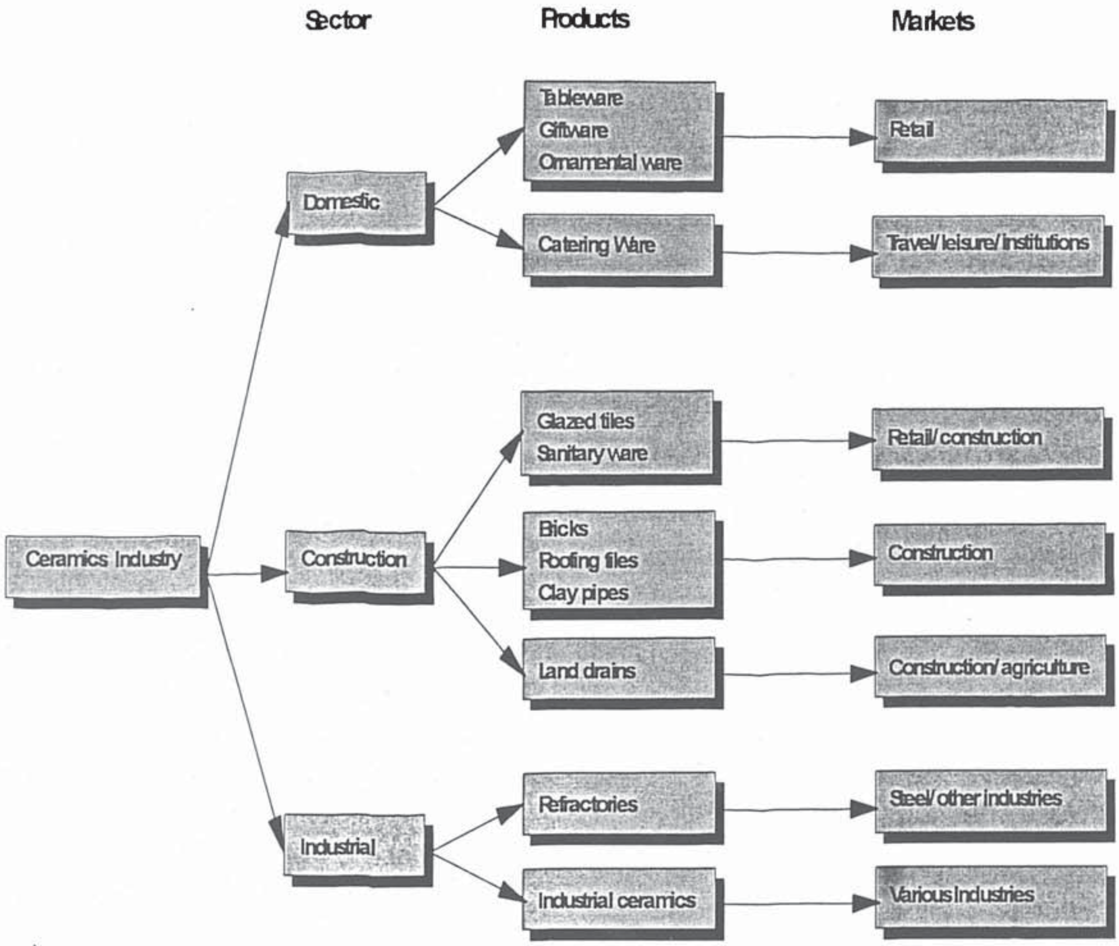
The ceramics industry operates on a highly competitive, mature and price-sensitive market which may limit the capacity for investments such as in environmental protection. Indeed, fierce international competition from both low labour-cost and high-productivity countries, together with changing exchange rates and the general economic recession has led to a gradual erosion of EU ceramics companies' market share. Despite this, the EU still remains the world's largest ceramic producing region (Figure 1) with a turnover estimated in 1995 to be 19 billion ECU and a workforce of about 220,000 distributed approximately across 2,000 companies of over 25 employees (Eurostat, 1996). The figures bear out the predominance of small and medium-sized companies in the overall picture. Indeed, the ceramics sector is predominantly formed by SMEs; 74% of the ceramics workforce in 1995 were in a company employing less than 250 workers.

Figure 1: International production of ceramic goods in current prices

Source: DEBA, Census of manufacturers, Nikkei

According to the NACE[3] coding system, the ceramic goods industry (Figure 2) embraces a very wide range of products from bricks and roof tiles (NACE 241); floor and wall tiles (NACE 248.3); sanitary ware (NACE 248.5); tableware and ornamental ware (NACE 248.6 & 248.7); industrial ceramics (NACE 248.8); and refractory products (NACE 248.1).

Figure 2: Structure of the ceramics industry



This industry is of particular interest as it represents one of the very few sectors in the EU which encompass such a broad range of companies and technologies. Firm size ranges from small family companies producing clay-based products according to methods developed several millennia ago to important materials groups at the forefront of developments in advanced ceramics. Indeed, ceramic products are used by a multitude of industries, both high tech industries such as electrical and electronic industries (insulators), aerospace

[3] This European system classifies economic activity in terms of the nature of goods and services produced or by the nature of the production process employed. It is arranged on the decimal system and is subdivided into divisions (1-digit codes), classes (2-digit codes), groups (3-digit codes), sub-groups (4-digit codes) and items (5-digit codes).

industries (space shuttle covering), medical industries (bioactive bone implant), and by more traditional industries notably the building and construction industries (tiles, sanitary-ware, bricks), domestic and leisure industries (tableware, hotel ware, ornamental ware, etc.), and metallurgy (refractories). However, despite the growth potential of the advanced ceramics product, traditional products still account for 80% of the world-wide turnover.

For the purpose of this study four particular sectors have been categorised :

- Tableware (including ornamental-ware);
- Sanitary ware & Tiles;
- Bricks;
- Industrial Ceramics and Refractories (including advanced ceramics).

2.2 Ground forces and interests in investigating this area of research

Throughout the 1980s and 1990s, academics, politicians and businesses began to realise the increasing importance of the natural environment to business practices (Roome, 1992; Smith, 1990; Stern, 1991). However, several reports have had an undeniable influence on the early stages of this study. Indeed, in the late 1980s, as a result of the report of the Brundtland Commission (World Commission on Environment and Development, 1987), the optimistic ideas of sustainable development made the environment a key concern for most Western societies. Sustainable development also became one of the principal policy objectives at both international and national political levels. Several authoritative action programmes and documents, such as *Agenda 21* (UNCED, 1992), which emerged from the United Nations Conference in Rio de Janeiro on Environment and Development in 1992 and *Towards Sustainability* (5th Environmental Action Programme) published by the European Union in 1992 and re-adopted after review in 1996, have stressed as ever the absolute necessity to accelerate and improve better integration of environmental goals at global, national and local levels. In the well-known words of the Brundtlands Commission:

> *development should meet the needs of the present without compromising the ability of future generations to meet their own needs* (WCED, 1987: 8)

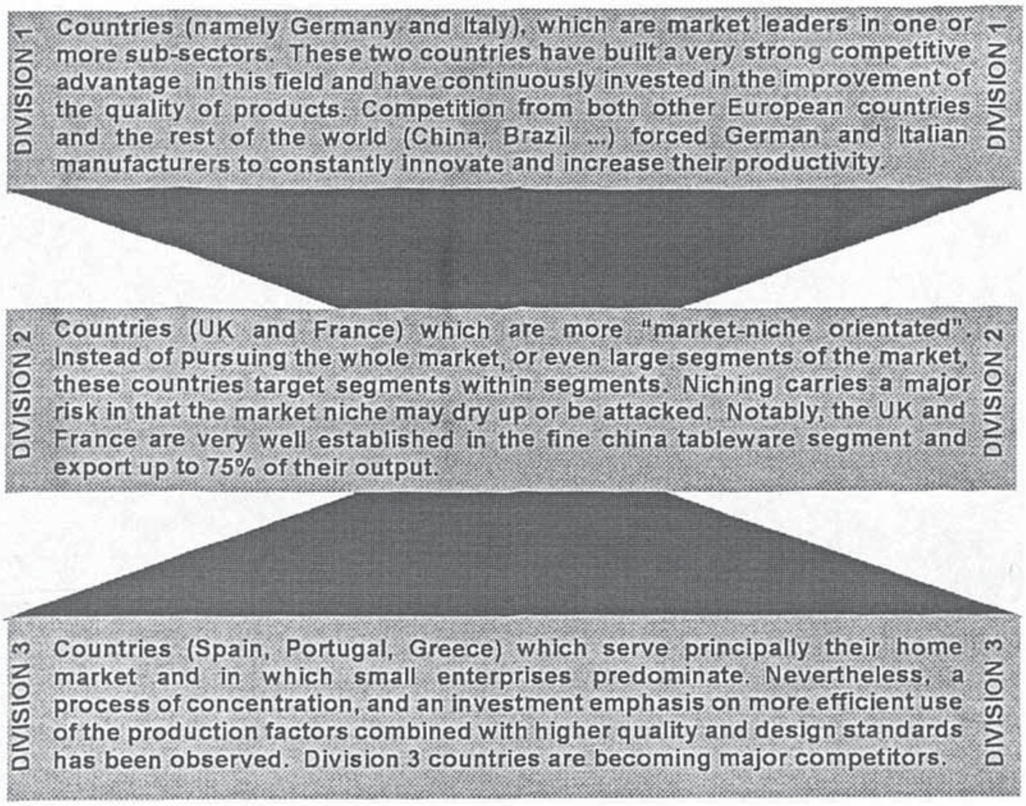
Furthermore, a 1991 survey conducted by McKinsey and Company, (McKinsey, 1991) examined 200 international corporate leaders and found that 90% were of the view that the environment would be one of the central issues of the 21st century and that environmental expenditure would increase over the next decade.

It appeared, therefore, of great interest to thoroughly investigate how and to what extent a traditional industry such as ceramics operating in a mature market reacts to environmental pressure; where small and medium-sized family companies are predominant, continue to operate in regions whose traditional location was based on the availability of raw materials and fuel, and maintain manufacturing methods developed several millennia ago. Indeed, the role of SMEs in job generation and structural change is currently the subject of intense debate not only nationally but globally. Whilst their potential and actual role is the subject of controversy their increasing overall significance in numerical terms is in little doubt. Furthermore, after an extensive research review it emerged that this sector was rarely studied despite the fact that it generates in the EU the same value added as the domestic electrical appliances sector and is as large an employer as the computer and office equipment industry (Eurostat, 1996). While it would prove instructive to compare different industry sectors, this has not been undertaken, for two reasons. Firstly, it was judged that time and resource limitations would have made it impossible to examine the sectors in the detail required. Secondly, the wide range of applications in the ceramics sector, encompassing low- and high-tech products, makes it interesting from the point of view of both. By concentrating on a single sector, it has been possible to devote greater attention to other factors, such as industry structure and socio-cultural differences.

The ceramics sector of two countries, Great Britain and France, will be analysed in-depth in order to assess the managerial attitudes and strategic role of traditional businesses vis-à-vis environmental issues. The two countries have been chosen primarily for practical reasons: the author was able to use his fluency in English and French, to conduct interviews in the country's language, to examine material from each market, in a way which would not have been possible for other countries. Indeed, at the early stage of the research it emerged that very little material produced by foreign countries was translated into English. Furthermore, while they show interesting contrasts, the sectors in both countries are sufficiently similar to make comparisons meaningful.

Secondly, the two countries in the past decade have modernised and restructured their traditional industry on a global basis, which has been accelerated somewhat by recent and continuing recessionary pressures. In 1994, the turnover of ceramics companies with 25 employees were fairly similar in both countries, accounting for ECU 2,650 million for the UK and 2,610 for France. However, in the UK approximately 43,000 people were employed in 800 sites while for France 33,000 were employed across 2,000 sites. Traditionally, the UK and French ceramics sectors tend to be oligopolistic and the companies have generally been long-established in the industry and are market-niche oriented. They often have connections outside the industry, such as subsidiaries or holding companies and there is little vertical integration. The sectors in both countries fall within Division 2, as illustrated in Figure 3.

Figure 3: The "league table" of the European Ceramics market



Thirdly, the two countries are economically and environmentally comparable. Until recently the development of environmental legislation in the UK and France was relatively "piecemeal", but new legislation and tighter standards have been introduced over the past few years to pressure companies to improve their overall environmental performance. However, traditionally, France has had a more centralised and interventionist administration than the UK.

Finally, without any doubt, the author's work for an international environmental consultancy has largely influenced the way this study has been conducted. Indeed, there was a conscious decision, from the early stage of this study, to emphasise the research on managerial attitudes towards environmental issues facing this industry. Principally because it appeared to be of interest to combine theoretical discussion and expected consequences with the view of the people directly concerned. The issues of competitiveness and environmental regulations for industry have been brought to the fore, addressing specifically the impacts of market based, and command and control, environmental initiatives on the ceramics industry.

From the results of the survey, it is hoped that the limitations of various approaches will be observed.

2.3 Objectives of the study

The overall purpose of this study is to investigate how new environmental market pressures and policies impinge on a 'traditional' mass production manufacturing industry and to assess corporate strategies and managerial attitudes (proactive or reactive) towards environmental issues. This research has investigated the environmental views and strategic attitudes of the ceramics industry in the UK and France. From this in depth analysis conclusions have been drawn on the effect of these increasing 'drivers' on industry. To achieve the above objectives the macro and micro environment of the ceramics industry has been investigated.

As presented below, the more specific objectives fall into three intertwined topics:

Corporate strategy and environmental pressures

- To present a comprehensive analysis of contemporary approaches to corporate environmental management and to identify the most significant macro & micro forces that most influence corporate policy;
- To identify company attitudes towards environmental issues;
- to review 'environmental governance[4]', affecting industries;

Sector overview and key environmental impact

- to provide a quantitative and qualitative representation of the industry's current environmental performance across the production of ceramic tableware, sanitaryware, tiles, refractories and advanced ceramics;
- to identify key micro and macro environment forces (economic, technological, political/legal and social/cultural) which may have influenced the performance of the ceramics industry either positively or negatively;

[4] By 'environmental governance' we mean the techniques and instruments - legal, voluntary, persuasive, contractual, etc - by which 'the environment' is used to achieve a framework of compliance with political and economic imperatives.

Management practice

- to assess the management position adopted by ceramics firms to tackle environmental issues, and their attitudes to environmental initiatives;
- to identify their current commitment to, and motivations for, improving the environmental performance of their companies, and the barriers to achieving improved environmental performance;
- to assess the present measures implemented by companies to curb environmental degradation;
- to learn more about the strategic environmental attitudes of SME businesses compared with large companies operating under the same market characteristics.

2.4 Approach

As indicated above, four sectors (Tableware & Ornamental-ware, Sanitary ware & Tiles, Bricks, Industrial & Advanced Ceramics and Refractories) and two countries (Great Britain and France) were selected for an in-depth investigation. To respond to the outlined objectives extensive literature reviews on business strategy and environmental issues were completed. Moreover, in the course of this research several organisations and companies in Great Britain and France were consulted including ceramics manufacturers, representatives from the Ministry of the Environment, the Department of Trade and Industry, the European Commission, national and international trade organisations, research institutes and universities.

Finally, a questionnaire was developed and piloted. After modifications, data were collated over a six month period during the spring and summer of 1996. Questionnaires were completed through an intensive programme of telephone interviews. The actual programme of valid interviews carried out totalled 185 (94 for the UK and 91 for France). The questionnaire was divided into four sections and was structured to define a company's position in relation to a spectrum of pressures and responses:

- Section (1) looks at the current overall issues facing the ceramics industry;
- Section (2) assesses the drivers and barriers for improving environmental performance;
- Section (3) looks at the company action to improve environmental performance;
- Section (4) reviews the environmental sources of information commonly used by ceramics manufacturers in both countries.

3. *STRUCTURE OF THE DISSERTATION*

The dissertation is structured to reflect the objectives outlined above. It is divided into seven separate chapters.

Chapter 1: Introduction

This introductory chapter sets out the aims, issues and objectives of this study, and presents in a concise way the structure adopted.

Chapter 2: Business strategy and environmental constraints

This chapter briefly outlines companies' main perceptions and attitudes towards environmental issues in general and within traditional sectors. It also carries out a literature review on the environmental discourse which surrounds environmental policy issues and assesses environmental policy instruments. Indeed, environmental policy is not an exogenous parameter to which economic agents respond, but is motivated by both empirical and theoretical considerations which may take managerial behaviour into account. Policy instruments are the measures that public authorities employ to remedy the environmental externalities. It is therefore, essential to outline theoretical environmental reflections in order to clearly interpret current environmental policy decisions which impact on the ceramics industry so that the conclusions reached in the later chapters of this study can be set back in their wider context.

In order to keep a consistent approach with the following chapters, international and domestic legislation and regulation directly affecting the ceramics industry are examined according to air, water, land, waste and noise.

The main objectives of this chapter are:

- to examine the relevant theoretical literature on corporate strategy and to identify the main barriers to improving environmental performance particularly companies operating in traditional sector;
- to present the relevant environmental economics thought required for the comprehension of the contemporary environmental debate;
- to review the range of environmental policies (legislative, economic, communicative and self-regulated) companies have to comply with;
- to review the regulatory and legislative conditions currently facing the UK and French ceramics industry as well as possible future requirements and assess the commercial consequences and impacts on the competitiveness of the ceramics industry;

- To outline the firm's environmental behaviour model considered and to assess attitudes and environmental impact of 'traditional businesses' dominated by SMEs vis-à-vis the environment.

Chapter 3: Methodology

This chapter aims to present the methodological approach adopted. In the course of the study it emerged that very little information, qualitative or quantitative, on the impact of the ceramics industry on the environment was available in the public domain. Almost all the companies interviewed classified this information as confidential, fearing that it could be detrimental to their interests. The collection of information therefore proved to be more difficult than anticipated. For instance, the French trade union representatives maintained a policy of not providing any information to the public, such as company addresses, number of employees, turnover, etc. This reticence is prevalent in traditional sectors which, due to their manufacturing processes, are often viewed as major polluters. Finally, this chapter presents the grounds for opting for a quantitative approach and the sampling process embraced.

The objectives of this chapter are four-fold:

- to briefly review research approaches;
- to present advantages and drawbacks of quantitative and qualitative methods;
- to present the data collection approaches used;
- to provide a statistical overview of the companies investigated.

Chapter 4: Industry profile and market characteristics

This chapter presents an overview of the industry covered in the study (Tableware & Ornamental-ware, Sanitary ware and Tiles, Bricks, Industrial and Advanced Ceramics, Refractories) including details of: supply and demand drivers, product types, world and European market dynamics and performances, with particular reference to the UK and France ceramics industry. For these two countries the macro and micro-environment is discussed in detail. Indeed, for the third (the UK) and fourth (France) European ceramics producers many similarities were noticed as well as differences. For instance, most of the ceramics products are positioned in a mature-declining market and, on average, UK manufacturers tend to be larger which allowed for higher investments and economies of scale.

The principal aims of this chapter are :

- to present the market dynamics of the industry sub-sectors such as recent performance, level of competition, international perspectives, and future market prospects for the sub-sectors;

- to set the UK and French ceramics industry back in the international context;
- to undertake a comparison of the UK and French ceramics industry sub-sectors in relation to broader societal forces that affect a company (i.e. demographic, economic, natural, technological, political, and cultural macro-environment forces);
- to review the strengths and weaknesses of the UK and French ceramics industries;
- to assess the UK and French managerial opinions on the key issues affecting the profitability of the ceramics industry.

Chapter 5: Manufacturing processes and key environmental impact

This chapter describes the production process in terms of process components that are common to the ceramics industry, so as to determine the waste generated from these components and the nature of their associated environmental impacts. Typically, it is possible to identify 10 common components in the ceramics production process of which waste - in solid, sludge, gaseous form and to some extent noise emissions - is generated. Indeed, the volume of waste generated is affected to a large extent by the level of production control, quality of product design, quality of production equipment, quality of raw material inputs, quality of management and the production-line workforce.

The objectives of this chapter are two-fold:

- to identify the waste arisings from the common process components and discuss the nature of their associated environmental impacts;
- to analyse the impacts of solid & liquid wastes, gaseous & noise emissions on the environment (defined as air, water, land, waste and noise) and compare the environmental performances of the two countries.

Chapter 6: Managerial perceptions and intentions towards environmental issues

This chapter examines the attitudes of British and French ceramics manufacturers in relation to the way they perceive and react to environmental issues. This chapter also looks at the level of environmental initiatives in place within the ceramics industry and the willingness of manufacturers to improve their environmental performance in order to achieve environmental sustainability. It combines written comments and graphical presentation when relevant. For more information and detailed analysis reference should be made to the appendices.

Its more specific objectives are :

- to highlight the perceived drivers and barriers for improving environmental performance such as production efficiency, cost benefits and better image;

- to assess the general environmental awareness of the UK and French managers, for instance, their knowledge on environmental options and technology available or the type of information sources used;
- to assess company actions to improve environmental performance;
- to assess the management position adopted by ceramics industries to tackle environmental issues and their attitudes to environmental initiatives.

Chapter 7: Environmental behaviour of traditional firms

This chapter focused upon the main empirical findings discussed in the preceding chapters bear upon the firm's environmental behaviour model discussed in Chapter 2 Section 6. This chapter categorised into five stage groups the companies interviewed according to their attitudes towards environmental attitudes. In general, replies indicate that most companies in the ceramics industry react to events, adopting incremental changes to ensure compliance rather than taking the initiative to find or create, and thus exploit environmental opportunities.

Further objectives are to discuss:

- The overall role of regulatory pressures and cost-savings and other commercial concerns in shaping the environmental responses of the companies surveyed.

- The main findings from the comparative analysis conducted in Chapter 6 regarding industry sub-sector/industrial structure especially where these differed and national differences between the UK and France in terms of regulatory traditions, economics and broader culture.

- The firms which had not introduced environmental improvements in the last two years, but who believe that such initiatives would not yield financial benefits.

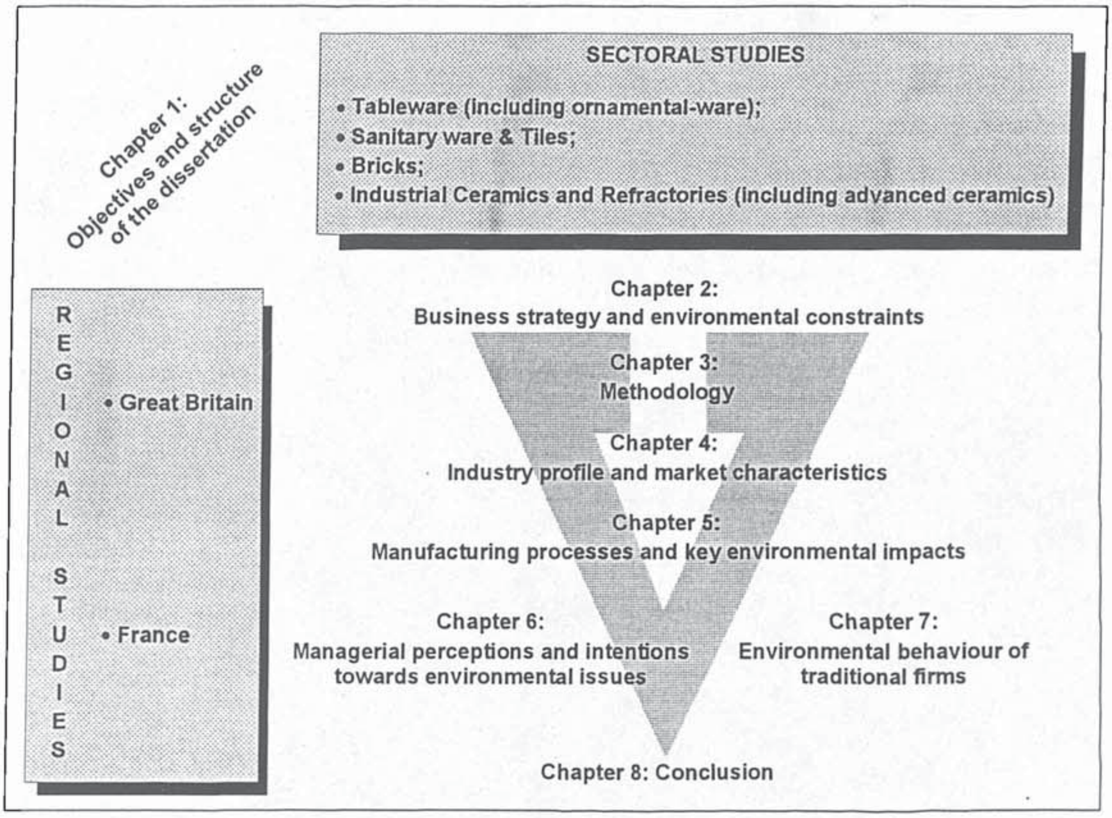
to illustrate the above trends, when appropriate, responses from interviews conducted with trade bodies and research organisations have proved important in amplifying the current analysis.

Chapter 8: Conclusion

This chapter presents the general conclusions and outlines several areas which represent a potential future research agenda.

The following figure (Figure 4) provides a visual overview of the study and the structure of the report.

Figure 4: Overview of study and report



CHAPTER 2

BUSINESS STRATEGY AND ENVIRONMENTAL CONSTRAINTS

1. INTRODUCTION

The relationship between business and the environment has been the subject of some concern and discussion since the late 1960s when many industrialised countries began to introduce significant pollution control programs. Some of these concerns were voiced at the 1972 United Nations Stockholm Conference on Development and Environment. At that time it was viewed that:

> *Environmental issues are going to exercise a growing influence on international economic relations. They are not only a formidable competitor for developed countries' resources but they are also a factor which is, to an ever increasing degree, going to influence the pattern of world trade, the international location of industry, the competitive position of different groups of countries, and their comparative costs of production. Environmental actions by developed countries are going to have a profound and manifold impact on the growth and external economic relations of developing countries.* (United Nations, 1972, 198)

The empirical literature on trade and the environment is vast and ambivalent on the question of whether differences in environmental standards affect companies' competitiveness. Some studies (Low *et al*, 1992; Lucas *et al*, 1992) indicate that environmentally "dirty" industries located in countries with high environmental standards are more inclined to migrate towards lower income countries where environmental criterions are weaker.

> *... stricter regulation of pollution-intensive production in the OECD countries may well have led to significant locational displacement, with consequent acceleration of industrial pollution intensity in developing countries.* (Lucas *et al*, 1992, 80)

Other studies (Dean, 1992; Pearce, 1992) have documented that there is little evidence of industrial plant relocation due to differing national environmental policies. As argued by Dean (1992):

> *More stringent regulations in one country are thought to result in loss of competitiveness, and perhaps industrial flight and the development of pollution havens. The many empirical studies which have attempted to test these hypotheses have shown no evidence to support them.* (Dean, 1992, 27)

Similarly, Pearce concludes:

> *Overall, ... there is no evidence that industrial competitiveness has been affected by environmental regulation... [and] there is little evidence to support the "pollution haven" hypothesis.* (Pearce, 1992, 27-28)

Therefore, the underlying challenge for policy makers is to find appropriate economic policy responses to achieve the transition to an environmentally sound ("sustainable") economy without paying an excessive price in terms of social disruption or suffering short term competitive disadvantages. However, it is widely recognised that a transformation of industrial behaviour for the benefit of a sustainable economy will not come about by mere regulation. As explained by Meredith and Wolters (Meredith *et al*, 1995), legislation can only be partially successful due to inadequate implementation and poor compliance. In essence, therefore, sustainability cannot be reached in the absence of proactive[1] environmental strategies, by individual firms, promoting clean products and processes.

The aim of this chapter is to look at the wider framework of business strategy towards environmental issues and policies so that the conclusion reached in the later chapters of this study can be set in their wider context.

1.1 Objectives

The main objectives of this chapter are:

- to examine the relevant theoretical literature on corporate strategy and to identify the main barriers to improving environmental performance particularly companies operating in traditional sector;
- to present the relevant environmental economics thought required for the comprehension of the contemporary environmental debate;
- to review the range of environmental policies (legislative, economic, communicative and self-regulated) companies have to comply with;
- to review the regulatory and legislative conditions currently facing the UK and French ceramics industry as well as possible future requirements and assess the commercial consequences and impacts on the competitiveness of the ceramics industry;
- To outline the firm's environmental behaviour model considered and to assess attitudes and environmental impact of 'traditional businesses' dominated by SMEs vis-à-vis the environment.

[1] Thus according to Roome (1992), Norcia *et al* (1993), Little (1991) and Newman *et al* (1993), while a passive or a reactive strategy focuses on doing the minimum that is required by law, a proactive approach aims at moving beyond compliance, in order to gain an edge over competitors. According to authors such as Taylor (1992) and Welford (1992) a proactive stance therfore requires total managerial commitment. It means incorporating environmental concerns into all the activities of the organisation, like product quality, employee relations and corporate image.

2. CORPORATE STRATEGY AND ATTITUDES TOWARDS THE ENVIRONMENT

Corporate strategy has been driven by different forces in the past, by production pressures, personnel pressures, and more lately by information pressures. The 90s according to Welford (1995) shows clear signs of corporate strategy being driven by environmental pressure. Major changes in corporate strategy are clearly visible due to the increased environmental concerns of stakeholders and the belief that 'being' green pays through cost reduction and increased market entry. This section examines much of in this field. In so doing it builds a basis for the more practical chapters which follow. This is a subject area which is still relatively underdeveloped, and given the paucity of literature, the intention of this section is to provide a framework for current theories of corporate strategy and environmental pressures. This section also identifies the main barriers to improving environmental performance.

2.1 Theoretical framework

Simpson (1991) suggests that corporate responses to environmental pressures can be categorised into three main groups; the 'Why Mes', the 'Smart Movers' and the 'Enthusiasts'. The 'Why Mes' are the companies that have been forced to improve their environmental performance as a result of some well-publicised event. Some outstanding environmental accident acts as a catalyst and induces the company to take some action in the field. 'Smart Movers' are the ones that have been able to exploit the opportunity created by the arrival of the green consumer to gain competitive advantage. The 'Enthusiast' include company like The Body Shop, that have moved beyond compliance, and have incorporated their environmental strategy into their overall business strategy.

Equally, Molenkamp (1995), identified four corporate environmental strategies; defensives, co-operatives, proactives, preventives. Defensives are companies who take corrective steps only when pushed by law. Co-operatives are the ones who make a sincere effort to comply with standards of their own accord. Proactives include company open, acting in advance on anticipated, more stringent laws, setting an example for others. Preventives are companies who environmental performance is integrated into the company philosophy. Molenkamp indicates that the response of many companies to concerns regarding the environment has passed through a number of phases. Initially, industry responded with a defensive attitude by arguing that they were not causing any environmental problems. This commonly shifted to a more preventative attitude based on compliance with environmental legislation. Some companies have since adopted a more positive and offensive attitude based on the integration of environmental concerns into their core business activities and with open communication about their environmental performance.

Similarly, Steger's conceptual model (1990, in Roome, 1994) distinguished four corporate environmental strategies; indifference, offensive, defensive, and innovative. Indifferent companies are those that have low environmental risk and even less environmentally-based opportunities for growth. Offensive companies are those that have low environmental threats and high environmental opportunities, for instance companies that manufacture pollution control equipment. Those adopting a defensive strategy are companies like the chemical companies, which have high environmental threats and low environmental opportunities. The innovators are those that have both high environmental threats and high environmental opportunities for growth.

In Roome's Strategic Options Model (Roome, 1992), there are five environmental strategies for companies, namely; non-compliance, compliance, compliance-plus, commercial and environmental excellence, and leading edge. These are referred to as; stable, reactive, anticipatory, entrepreneurial and creative in Ansoff's Strategic Posture Analysis (1990, in Ketola, 1993). The first three strategies are related to compliance with the environmental standards, as the name suggests. Compliance-plus implies looking beyond the existing standards and norms. it involves integration of the environmental management techniques with the entire management system of the company. Excellence and leading edge approaches view environmental management as good management, recognise the opportunities that have arisen as a result of the environmental revolution and strive towards state-of-the-art environmental management. Hence, it is through the adoption of excellence and leading edge strategies that a company can gain competitive advantage.

The difference between Steger's and Roome's models is that while Steger perceives corporate response to the environment as based on environmental risks and market-based opportunities, Roome argues that environmental pressures like legislation, constraints within the firm, and the ability of managers to bring about an organisational change in order to incorporate environmental issues, are equally important. Jame's framework (1992) is similar to that Roome's. He believes that there are four categories into which companies can be divided, in accordance with the environmental strategy adopted by them. The first category is similar to Steger's indifference and Roome's non-compliance, where all environmental issues are simply ignored. Companies that do the minimum that is required by law fall in the second category. In the third category are companies that move beyond legislation and the last group consists of companies that use the environment as a tool for gaining competitive advantage.

Welford's (1994) categorisation of the SME (Small and Medium Sized companies) sector into four main groups is slightly different. The first group is referred to as the 'ostriches'. Companies that fall in this category not only assume that concern for the environment is a passing phase and that their impact on the environment is negligible, but also assume that their competitors feel the same and hence do nothing to conserve the environment. Then there are the 'laggards', companies that are aware of the environmental challenges facing them, but are unable to combat those challenges because of cost constraints, lack of trained manpower, lack of knowledge, etc. The third group consists of the 'thinkers', companies that know that something should be done, but are still waiting for others to show the way forward. The 'doers' are the ones that have proceeded to put their thoughts into actions.

Topfer (1985, in Bostrum *et al*, 1992) also divides companies into four categories, namely; resistant, passive, reactive, and innovative. Companies that fall in the first category are the ones that view concern for the environment as a hindrance to their growth and do their level best to hinder the passing of environmental laws. Passive companies are like Steger's indifferent companies, who ignore the issue altogether. Roome argues that action taken by reactive companies has been triggered off by legislation, whereas Topfer sees it as a defensive move to catch up with the competitors. The last category, the innovators, are the same as Steger's innovators and Simpson's enthusiasts.

Pietilainen (1991, in Bostrum *et al*, 1992) has taken a different approach to classifying the various environmental strategies that can be adopted by an organisation. Rather than classifying strategies in an ascending order of increased environmental responsibility, Pietilainen has identified the various strategic options that can be pursued by organisations simultaneously. One option available to companies is to improve market communication by highlighting a product's environmentally beneficial attributes and use it as an 'advertising gimmick'. The second strategic option is improving the existing manufacturing processes by using cleaner and more efficient technology. The third strategy is applicable to companies belonging to one particular industry, e.g. companies engaged in the manufacture of pollution abatement equipment. machines based on the conservation of energy and raw materials, waste reduction, recycling, etc. The fourth strategy incorporates taking a long-term approach to the environment , basing the entire strategy and product mix on the environment, and carrying out research and development extensively.

Vandermerwe and Oliff's (1990) framework is based on a similar approach. In their framework, improving market communication, improving manufacturing processes, and carrying out research and development, are the three main options available to organisations. Thus environmental improvement will be driven by marketing and manufacturing innovations and ongoing research and development to support those innovations.

Porter's well-known framework (Porter, 1985) of the competitive forces that determine industry profitability, can be used to indicate the nature of competition with regard to the environment in any particular industry (Beaumont *et al*, 1993). The following Figure 5 sums up Beaumont, Pederson and Whitaker's strategic environmental framework. It presents the various options available to companies for achieving competitive advantage.

Figure 5: Alternative positions to achieve competitive advantage

Aston University

Illustration removed for copyright restrictions

Source: Beaumont et al (1993) ***Managing the Environment***

Beaumont, Pederson and Whitaker's perceive corporations at six different levels, in accordance to their response to the environment. The first two levels are similar to Roome's non-compliance and compliance. The third level is referred to as 'corporate action', where management begins to regard environmental matters as important and takes a broader and a more long-term perspective of the environment. At the fourth level changes take place in the organisation in response to environmental issues. The fifth level is 'supply chain action', where environmental matters become an integral part of the entire industry's supply chain. At the final level of 'business scope action', an organisation expands its activities, using environmental issues to get ahead in business.

Dodge and Welford have developed an environmental performance scale which has become known as the ROAST scale (Welford, 1995). It extends the traditional environmental categorisations to include sustainable development. In order to measure improving environmental performance Dodge and Welford argue that we need to define an ultimate goal towards which the organisation must move. This goal may not be achievable but it will serve as an upper boundary of sustainable performance on a five point scale. The five point ROAST scale is therefore be represented by the following interval values:

•	**R**	Resistance (Stage 1)	Total resistance to environmental values and rules. Organisations would be absolutely unresponsive and reactive to environmental initiatives.
•	**O**	Observe & Comply (Stage 2)	The organisation observes environmental laws but actions reflect an unwilling attitude or lack of ability to comply. Actions are being enforced through legislation or court decision.
•	**A**	Accommodate (Stage 3)	Organisation begins to adapt to change. Early indications of proactive and responsive behaviours. Actions are no longer based entirely on complying with environmental legislation; the organisation begins to exhibit voluntary behaviour.
•	**S**	Seize & Preempt (Stage 4)	The organisation voluntarily seizes and preempts its actions with environmental concerns. It proactively engages in setting the agenda. It is responsive to the many external stakeholders. The latter phases would display the attributes of sustainable development.
•	**T**	Transcend (Stage 5)	The organisation's environmental values, attitudes, beliefs and culture exhibit a total support for the environment. The organisation would proactively support and be responsive to all living things. It would act in a way which is fully consistent with sustainable development.

Table 1 synthesise the various environmental strategies referenced above into a 10 point strategy classification commonly adopted by companies.

Table 1: Environmental strategies adopted by companies

1	**Ostrich** Companies that assume environmental challenge is a passing fad
2	**Resistant/Defensive** Companies that hinder the passing of environmental laws and regulations
3	**Why mes** Companies in which some well-publicised event or accident acts as a catalyst
4	**Indifference/non-compliance/stable/passive/laggards/ignored** Companies having low environmental risks, low environmental returns, cost constraints etc.
5	**Thinkers** Companies waiting for others to take the lead
6	**Offensive/smart movers**

	Companies having high environmental returns
7	**Compliance/reactive/localised action**
	Companies having high environmental risks
8	**Compliance-plus/anticipatory/doers/corporate action**
	Companies that move beyond compliance (proactive)
9	**Commercial and environmental excellence/entrepreneurial**
	Companies where there is clean technology and organisational reform
10	**Innovative/enthusiasts/leading edge/business scope action**
	Companies having high environmental risk and also high return

2.2 Main barriers to improving environmental performances

In-depth studies carried out for two product groups (paints and batteries) in different European Countries have identified several barriers to improving environmental performances (Scholl, 1995; Oosterhuis *et al.*, 1996) . The main stumbling blocks were technical and information barriers. A lack of information on, and confidence in the 'alternative' products (both regarding their quality and their environmental superiority) was perceived as the single most important barriers on the demand side. Partly, as a result of this limited demand, producers were therefore hesitant in investing large sums of money in the development and market introduction of 'greener' products.

The following table (Table 2) lists the principle barriers encountered by manufacturers to improving environmental performances.

Table 2: Principle barriers to improving environmental performances

Awareness Barriers	A lack of knowledge about the environmental problems related to products and about the existence of alternatives.
Economic barriers	The higher costs of the alternative and or a lack of economic incentives to supply or demand 'greener' products.
Information barriers	A lack of accessible, understandable, manageable and reliable information on the environmental aspects of products and their alternatives
Legal and institutional barriers	All kinds of regulations, standards, established practices, etc. which prevent the introduction of the alternative.
Organisational barriers	Difficulties with fitting new products (and related processes) into the established organisational structures.
Technical barriers	A lack of availability or (proved) quality of the alternative

Adapted from Scholl, 1995 and Oosterhuis *et al.*, 1996

3. ENVIRONMENTAL PRINCIPLES

Historically, environmental action in industry has largely been a result of its effort to comply with domestic and international legislation. Since the first Environmental Action Programme in 1973, European environmental policy has gradually evolved to a state where it now comprises a substantial body of legislation (Brinkhorst *et al*, 1993). Throughout the last twenty years the range of policy instruments applied by government in order to respond to the growing level of environmental concern has increased significantly.

Prior to the study of the key environmental policies affecting an industry, it is important to analyse some of the more important theoretical development in environmental economics appropriate to this study and to explore their roots. Indeed, many of the issues that faced economists in the past are still pertinent today. The necessary result however has been that a number of interesting and relevant areas of comment and study have been rather arbitrarily cut short and circumscribed.

3.1 Natural resources and the environment within the economics thought

The origins of environmental economics as a theory is rather recent, dating back to the late 1960s and early 1970s, and is based around the debate concerning environmental quality versus economic growth. During the 1970s environmentalists' concern was primarily focused on source limits (population growth, natural resource depletion and food supply), with less emphasis on sink limits (pollution and the assimilative capacity of ecosystems). The "limits to growth" debate of the 1970s has been gradually superseded during the 1990s by the "global environmental change" debate which was internationally recognised at the 1992 conference of the UNCED[2] as the essential concern of decision makers. This relatively new area of academic work has already generated a large and diverse theoretical literature, often with inconsistencies between them. Nevertheless, the foundation of contemporary environmental economics is thoroughly grounded in the works of classical, and neo-classical economists.

At the risk of oversimplification, the central concept of environmental economics is at the present time to sustain the economic growth without damaging the competitivity of local industries compared with competitors established in other countries with more relaxed rules and to ensure that future generations would be at least as prosperous, on a welfare basis, as current generations. This notion, popularised under the concept of "sustainable

---

[2] United Nations Conference on Environment and Development

development[3]", has became, without doubt, a fashionable "buzzword" in environmental circles and in much of the world of international development.

A large and diverse literature has now developed on the notion of sustainable development (see e.g. World Commission on Environment and Development, 1987; Redclift, 1987; Turner, 1988; Stockholm Group, 1988; Pearce, Barbier Markandya, 1990; Pearce and Turner, 1990) and many definitions, quite often incompatible, have been suggested and debated. Nevertheless, sustainability was the central theme of the UNCED conference held in Rio de Janeiro in June 1992. In the mid 80s, a real political awareness emerged and raised consciousness of sustainability. Certainly, the declaration pronounced by Mrs Thatcher is confirmation of the changed perception of politicians of the nature of environmental concern.

> *The challenge of the 1990s will be to preserve the environment for the next generation.* (Thatcher, 1983)

Allen defined this concept as follow:

> *Development that is likely to achieve lasting satisfaction of human needs and improvement of the quality of human life.* (Allen, 1980, 23)

Allen's argument of sustainable development takes inspiration from the definition advanced by the World Conservation Strategy (IUCN, 1980) which, since 1980, had recognised the necessity of integrating development and environment:

---

[3] The most publicised definition of sustainability is that of the World Commission on Environment and Development in 1987 also known as the Brundtland Commission, name of the chairman, Mrs Gro Harlem Brundltand, Prime Minister of Norway:

" We came to see that a new development path was required, one that sustained human progress not just in a few places for a few years, but for the entire planet into the distant future. Thus "sustainable development" becomes a goal not for the "developing" nations, but for industrial ones as well" (p4).

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

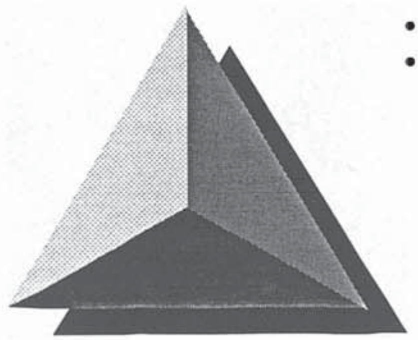
the concept of "needs", in particular the essential needs of the wold's poor, to which overriding priority should be given; and

the idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs... ... Even the narrow notion of physical sustainability implies a concern for social equity between generations, a concern that must logically be extended to equity within each generation." (P43)

Development and conservation are equally necessary for our survival and for the discharge of our responsibilities as trustees of natural resources for the generations to come. (IUCN, 1980, 1)

From the conventional economic perspective, the sustainability issue has at its core the phenomenon of market failure and its correction via "proper" resource pricing. The concept of sustainability, according to Mohan Munasinghe[4], has evolved to encompass three major points of view: economic, social and ecological as shown in Figure 6.

Figure 6: Trade-offs among the three main objectives of sustainable development



Adapted from: Munasinghe (1992)

Nevertheless, theories about the growth prospect of the economy and their impacts either on the environment or more broadly on the welfare of society, are firmly anchored to earlier economic foundations and have always been the stumbling block to the economist's debate. It is therefore essential to succinctly consider past economics doctrine. Primarily, two schools of thought, the classical and neo-classical stream; have influenced environmental economists on the debate of how to manage resources that are in scarce supply, such as the oceans, the atmosphere and troposphere, rivers and lakes and land-based waste sites.

---

[4] Mohan Munasinghe is chief, Policy and Research Division, Environment Department, the World Bank.

3.2 Classical economist and their legacy to present environmental reflections

The current debate on the relationship between natural resource scarcity and economic growth was also a central issue for the classical economists such as Adam Smith, Thomas Malthus, Ricardo, John Stuart Mill and to a certain extent Karl Marx. At the time that Adam Smith published his Inquiry into the Nature and Causes of the Wealth of Nations, 1776, it was generally admitted that the poor should remain poor.

The shrewdest and most wicked social commentator, Bernard Mandeville, wrote in the early eighteenth century :

> *To make the Society Happy ..., it is requisite that great numbers should be Ignorant as well as Poor.* (In Braudel, 1967, 135)

More importantly, those economists were not greatly optimistic about the prospects of long-term economic growth and believed that in the long run economic growth would dry up because of the scarcity of natural resources. In 1798 an anonymous treatise of fifty thousand words appeared. It was entitled *An Essay on the Principle of Population as It Affects the Future Improvement of Society*, several years afterwards the Reverend Thomas Robert Malthus claimed the authorship of this essay. The essay on population reported that there was a tendency in nature for population to outstrip all possible means of subsistence. For Malthus, the finite amount of land available leads the population to remain stable in order to maintain the same standards of living. *Taking the whole earth*, Malthus wrote in his Essay:

> *... and supposing the present population to be equal to a thousand millions, the human species would increase as the numbers 1, 2, 4, 8, 16, 32, 64, 128, 256, and subsistence as 1, 2, 3, 4, 5, 6, 7, 8, 9. In two centuries the population would be to the means of subsistence as 256 to 9; in three centuries as 4096 to 13, and in two thousand years the difference would be incalculable.*

Hence, while the number of mouths to feed grows geometrically, the amount of cultivable land grows only arithmetically. Necker the French financier and statesman, confirmed this opinion and stated at the turn of the century:

> *Were it possible to discover a kind of food less agreeable than bread but having double its substance, people would be reduced to eating only once in two days.*

In the *Principles of Political Economy in 1817* Ricardo, as Malthus, argued that the primary constraint to economic expansion resided in nature itself. In Malthus' model the constraint was a fixed supply of arable land, in Ricardo's, it was declining land quality as production expanded. Ricardo introduced the idea that the economic world was constantly tending to expand. Consequently, more mouths would demand more grain, more grain would demand more fields and quite naturally, the new fields put to seed would not be so productive as those already in use. Thus, as the growing population caused more and more land to be put into use, the cost of producing grain would rise and ultimately natural resources became increasingly scarce with time; that scarcity was a force which opposed and ultimately halted economic growth.

John Stuart Mill, in the Principles of Political Economy published in 1857, retreads the paths that had been first mapped by Smith, Malthus and Ricardo. However, Mill considered the long-term in a more optimistic manner and expected that the working classes could be educated to understand their Malthusian peril, and that they would thereupon voluntarily regulate their numbers. Mill became the respectable economist of his day; he was talked of as Ricardo's rightful successor and heir. Principles of Political Economy was a tremendous success and published into seven further editions.

Another nineteenth century author, Karl Marx, made a substantial contribution to the current environmental debate in spite of the fact that environmental issues were not tackled in his theory. Karl Marx, with the collaboration of Friedrich Engels, published a pamphlet in 1848 entitled *The Communist Manifesto* and opening with threatening words:

> *A spectre is haunting Europe - the spectre of Communism. all the powers of old Europe have entered into a holy alliance to exorcise this spectre: Pope and Tsar, Metternich and Guisot, French Radicals and German police spies. ... Let the ruling classes tremble at a Communist revolution. The proletarian have nothing to lose but their chains. They have a world to win.* (Marx, 1848)

Marx's theory lies in the extensive work, *Das Kapital*[5] (Capital), which comprises 2,500 pages. Despite his hostility towards classical economics, Marx's debts to his classical forerunners were particularly marked in the analytical framework he adopted. In short, Marx stressed that capitalists are continuously under pressure to increase the rate of profit (surplus value) and to revolutionise the labour process.

> *Accumulate, accumulate ! That is Moses and the prophets ! ... Therefore, save, save, i.e. reconvert the greatest possible portion of surplus-value, or surplus-product into capital ! Accumulation for accumulation's sake, production for production's sake ...* (Marx Karl,1963, 652)

[5] Marx took more than eighteen years to produce Volume I and when he died in 1883 three volumes still remained. Engels published Volume II in 1885, the third in 1894 and the fourth volume did not emerge until 1910.

Marx's intention was to demonstrate that the capitalist goal is to increase production at the expense of the others (workers and more broadly countries). Some modern Marxian writers have expanded this concept and have come to the conclusion that capitalist systems are not sustainable, and one source of non-sustainability is environmental destruction. However, Marxist ideology encourages the view that the natural resource base would be sufficient to support any population level, given advanced forms of production and provided that society is organised on socialist principles. In particular, goods should be "rationally valued" (in terms of labour power) so that use value and exchange value are equivalent and alienation and exploitation absent. Finally, Marxians pointed out the transnationality of the modern economy and consequently the incurable affect of the development of the Northern economies on the environment of the South. Environmental degradation will therefore continue to increase until the Northern countries have the will to decide an international redivision of labour.

3.3 Neo-classical thought and the marginal revolution

The importance of the "iron laws of economics" as the driving force behind contemporary human society has now reached a level where there is now a more general acceptance of free market economics throughout the world than ever before. The failure of communism as a political system and the continuing expansion of the free-market economy into underdeveloped countries has left proponents of the free competition philosophy claiming that this approach is the only rational system that will create a better future. The underlying assumption, led by neo-classical economists, is that a market economy is an atomistic isolated entity which is self-regulating and self-sustaining. This claim underpins many of the assumptions used on a daily basis for economic decision-making, and therefore, it is interesting to analyse the arguments presented by partisans of this thesis.

The fundamental principles of neo-classical economics is the analysis of the behaviour of the market system and the mechanisms within it through which an equilibrium could be produced. For the defenders of this theory, for Smith, Say and Senior, commodities have value because they are wanted, and wanted because they have usefulness (technically named "utility") for individuals. The principal difference with Classical thought is that the neo-classical restored a temper of optimism to economic discourse that had been suppressed since Malthus. Progress, they held, appeared to resolve social tensions rather than to aggravate them. The main neo-classical postulate is that men acted rationally in pursuit of their own advantage. Consumers were held to seek maximum satisfaction; similarly, suppliers of productive services were expected to seek maximum reward.

In the early 1870s, William Stanley Jevons (1835-82), a British economist, Carl Menger (1840-1921), a professor of economics in Austria-Hungary and Leon Walras (1834-1910), professor of economics in Lausanne, Switzerland, all published books exhibiting ideas which were apparently worked out independently, and yet which bear striking similarities. These three writers appear as the fathers of the neo-classical movement often called Marginalism and also the founders of the three "schools" within the neo-classical stream:

- the Vienna school and the theory of marginal utility;
- the Lausanne school and the theory of general equilibrium;
- the Cambridge and the theory of the partial equilibrium.

Between 1870 and the outbreak of the First World War, Vienna was the site of one of the most flourishing schools of neo-classical teaching. Though this tradition of neo-classicism was launched by Carl Menger - who was among the first to bring marginal concepts to bear on the analysis of market equilibrium - the towering figure of this period was Eugen von Böhm-Bawerk (1851-1914). Menger as Walras saw utility as only relative, something preferred to something else, with relative utility indicated by relative prices. Eugen von Böhm-Bawerk, in line with neo-classics, assumed that economic man was motivated by the desire to maximise utility. In this case, however, the maximisation problem had to be viewed over a span of time in which present and future satisfactions were weighted against one another. Böhm-Bawerk maintained that most men were likely to prefer the bird in the hand to the one in the bush - i.e. to over-value the present relative to the future and to underestimate the strength of future wants. For these reasons people had to be rewarded - through the payment of a rate of interest - for saving and parting with present satisfactions. The other side of this coin was the willingness of those who purchased capital goods to pay for the means to acquire them. The existence of a rate of interest thus assured an equilibrium between saving and investment.

Leon Walras a Frenchman who spent his professionally most productive years in Switzerland and was concerned with pure theory which he defined as:

> *the theory of determination of prices under a hypothetical régime of perfectly free competition.* (Walras, 1954, 40)

Walras, sought to establish the manner by which an equilibrium solution could be reached in all markets simultaneously. His target was a statement of the process by means of which a "general" equilibrium was established. A later commentator has described the Walrasian perspective on economics as one in which "no blade of grass can move without altering the position of the stars". Walras attempted to explain the concept of "General Equilibrium" in the *Elements of Pure Economics* published in 1874. Walras' principal concept was that perfect competition maximises the satisfactions of all the member of society.

Finally, in 1890 the *principle of Economics*, the main corpus of Marshall's teaching was published. Marshall's formulation of the concept of demand contrasted sharply with the classical interpretation of demand. He demonstrated that buyers would be prepared to purchase more of a particular product at lower prices than at higher ones. He stressed the point that quantities would vary in response to changes in market prices. In Marshall's formulation, a consumer entered the market-place in order to acquire satisfactions (or utilities) from his purchases. Marshall, in so doing insisted that the point of an economic system was not the production of commodities, but the production of satisfaction.

> *Man cannot create material things. In the mental and moral world indeed he may produce new ideas; but when he is said to produce material things, he really only produces utilities; or in other words, his efforts and sacrifices result in changing the form or arrangement of matter to adapt it better for the satisfaction of wants.* (Marshall, 1961, 63)

While the market system as portrayed by Marshall was largely benevolent, his analysis also demonstrated that in certain situations unregulated markets could not be relied upon to yield socially desirable results. Prominent among the exceptions were the cases in which, for technical reasons, competition would prove to be wasteful and inefficient, if not a practical impossibility. Precisely, it should be public services which face natural monopolies such as water supply, however, Marshall was reluctant to recommend government intervention. Intrinsically, intervention would be especially justified whenever the markets are not maximising collective welfare. Marshall was also prepared to entertain the possibility that governments could play a useful role in improving the allocative efficiency of markets and furthermore could encourage a re-allocation of resources.

The neo-classical contribution to the present environmental debate lies in the theory that increasing resource scarcity would always generate price signals which would engender compensating economic and technological developments, such as resource substitution, recycling, exploration, and increased efficiency of resource utilisation. Thus, the neo-classical "solution" has been - and continues to be - to seek ways of commoditising everything, of assigning the right values to all externalities and then applying a cost/benefit analysis. Therefore, the neo-classical model, long-run resource scarcity, impinging on economic growth, is a near impossibility because rising scarcity is assumed to automatically sow the seeds for its amelioration. The opponents of this approach, adduce that it is not always feasible to assign a price to every item, for instance what is the value of a species becoming extinct, an ecosystem being damaged such as soil erosion, salinisation, deforestation, and toxic overloads or the culture and language of a race being destroyed. However, a solution to tackle environmental degradation - even defective - has been initiated not only by local, state, national and international organisations, but also by non-governmental organisations. The following section examines policy instruments commonly instituted to ensure intergenerational sustainability.

4. ENVIRONMENTAL COMPLIANCES - A BRIEF TAXONOMY

Maintaining the competitiveness of domestic industries is a paramount objective of any country which trades internationally. It is, of course the concern of government officials to achieve, through environmental policies and regulations, a balance that makes economic growth and environmental protection compatible, rather than competing, whether within their own societies or globally. Indeed, the underlying economic goal of environmental policy is to induce structural change in advanced and developing economies so as to lessen their impact on natural resources and the environment. Properly designed environmental regulation may trigger a number of different advantages. It may induce companies to develop products with lower production costs, improved attributes, lower operating costs, or, in a more general form, to develop products with an 'early mover' advantage over competing foreign products or a relative competitive advantage, and cause a positive trade effect. These early mover advantages are a way of turning the static competitive disadvantages, relative to foreign competitors which are not yet subject to similar regulations, into dynamic advantages of international competition. This argument was clearly supported by the Harvard Business School Professor Michael Porter who argued that:

> *... strict environmental regulations do not inevitably hinder competitive advantage against foreign rivals; indeed, they often enhance it. Properly constructed regulatory standards, which aim at outcomes and not methods, will encourage companies to re-engineering their technologies. The result in many cases is a process that not only pollutes less but lowers costs or improves quality* . (Porter, 1991, 35)

Indeed, at a micro-economic level, environmental policies and regulations have more significant impacts on the competitiveness of particular sectors or companies, especially traditional sectors which are often pollution-intensive and low-tech. Structural change is a process familiar to open economies. To a certain degree, it is welcomed, even though it exacts a social price as some benefit while others experience disruptions at best and in certain cases suffer real losses. Structural change is in many ways a sign of economic vitality and an essential component of future economic strength and competitiveness. Environmental policies and regulations may have negative marginal impacts on companies or sectors which have competitive weaknesses in other areas relating to labour, capital or technology, leading either to the relocation of the business in countries with weak environmental regulations (and also often with low-cost labour) or in the extreme to bankruptcy. The literature on the international relocation of polluting industries distinguishes two types of hypotheses on the relationship between relocation and governmental environmental policies:

- **the exodus hypothesis** focuses on the push effect leading to "out-migration" of polluting industries from countries with strict environmental regulations.

- **the pollution haven hypothesis** represents the pull effects. It builds on the economic theory of comparative advantage. It comprises two elements; that developing countries should actively attract polluting industries to obtain comparative advantages; and that developing countries are afraid of tightening environmental standards for fear of disrupting current investment patterns.

Historically, legislative instruments have formed the bulk of environmental policy and in Europe most legislation originates from the late 1960s or early 1970s which was based on the principles of command and control. During the 1980s, it became obvious that a change was needed to develop a more integrated approach in environmental legislation and increasingly it is being complemented by the application of economic instruments. Legislation creates standards and therefore in theory at least offers some certainty regarding the level of protection established. However, it does not generally establish incentives for reducing emissions above the standard. Throughout the last twenty years the range of policy instruments applied by government in order to respond to the growing level of environmental concern has increased significantly. Policy instruments can broadly be divided into four categories according to the WRR (1992) :

- legislative or regulatory approach;
- economic or Incentive-based approach;
- communicative approach and
- self-regulated approach

4.1 Regulatory approach

The first category is referred to by environmental economists as the command-and-control, or regulatory approach. It includes instruments such as emission standards, which require economic agents to set one or more output or input quantities at some specified level or prohibiting them from exceeding (or falling short of) some specified levels (Baumol and Oates, 1971). Regulation-based instruments (R-BIs) (Artis *et al*, 1994) are mechanisms of direct regulation which can be defined as :

> ... *institutional measures aimed at directly influencing the environmental performance of polluters by regulating processes or products used, by abandoning or limiting the discharge of certain pollutants, and/or by restricting activities to certain times, areas, etc.* (OECD, 1989, 15).

This approach consists of relying on standards and to use whatever enforcement machinery - courts, police, fines etc. - necessary to get people to comply with the law.

Environmental standards are usually based upon one of two principles: either on available scientific knowledge of a dose-response relationship, or the availability of one or more technologies. The "dose-response" relationship has two parts: the introduction of polluting materials into an environment at a certain rate or concentration (dose), and the physical changes to environment receptors that result from the specified dose (response). Examples of dose-response relationships are the effect of heavy metals discharges on plant and animal life, or the effect of air pollution on the physical depreciation of material assets such as buildings.

The main criticism inherent in regulatory standards is that once a standard has been met, regulation provides no incentive to reduce environmentally harmful behaviour any further beyond this. This contrasts significantly with economic instruments for environmental protection which provide continuing incentives to reduce environmentally harmful behaviour.

Finally, having determined the desire to use a particular standard and the necessary environmental effectiveness, policy-makers must also determine the impact of the new regulation upon business. Compliance with a regulation will normally affect a firm's production costs, either directly or indirectly. This will alter product prices, and therefore, the competitiveness of the firm's products. As a result the quantities of the product traded will change. This is the direct price effect. The quantity of trade may also be affected independently of the price of the product. For example, product content standards may discriminate against certain imports because of their characteristics. This will effect a quantitative restriction on relevant products. Since the benefit of the environmental policy has ultimately to be weighed against any burdens placed upon industry and consumers, it is a standard practice to undertake a Cost of Compliance Assessment (CCA) before finalising legislation.

Five types of regulatory standard exist:

- **Target-based standards** are set with reference to the possible harm to particular receptors. Thus a standard may establish concentrations of pollutants in living tissue, above which harmful effects might arise. Permitted levels of lead in the blood stream would be an example.

- **Ambient quality standards** are established at two levels. Limit (or emission) values can be established for the protection of human health at the point of ingestion or inhalation (for instance, air quality limit values). Alternatively, such quality standards can also be established as indicators of environmental pollution, although (at the level established) harm may not necessarily be caused to humans.

- **Emission/discharge release standards** are often linked to ambient quality standards, particularly when applied to point source polluters. As their name suggests, they determine the quantity or concentration (or both) of a pollutant released into an environmental medium. Release standards normally imply the use of at least on available (commercial) process control technology. This may be a "clean technology" for a new investment but, more likely, is an "end-of-pipe" solution for both new and, in particular, existing sources of pollution. Further controls are often provided, including the power of regulators to limit the output of production of a polluting process, in order to control total volumes of emissions.

- **Process standards** specifically state what may or may not be used in a polluting process (unlike emission standards which are based on the premise that it does not matter how the pollution occurs so long as it does not exceed a certain value). Thus, for example, a process standard may define what a polluting process must use by way of clean technology or end-of-pipe controls or, perhaps, a material that must not be used in the process (For example, lead in the tableware industry).

- **Product standards** are established when the use or disposal of a product may lead to pollution or environmental harm.

In addition, as part of the inspection and monitoring of these standards, a series of testing protocols have been established in order to ensure a uniform approach to measurement.

4.2 Economic or Incentive-based approach

The term economic or Incentive-based instruments(I-BIs) (Artis *et al*, 1994) is applied to a range of policy measures which are used to improve or maintain environmental quality using a price mechanism rather than direct regulation.

> *Economic Instruments (EIs) work by affecting the costs and benefits of alternative actions open to economic agents, influencing behaviour in a way that is favourable to the environment.* (OECD, 1991)

Instruments within this category also conform to the 'Polluter Pays Principle[6]' (PPP); those who pollute pay tax at a level related to the amount of pollution they generate. These instruments have in common the capacity to raise production costs, and cannot be refunded at the border, hence harming a firm's competitive position if no similar measures are applied in competing export and import markets. However, it has also been shown that environmental compliance can contribute to the competitiveness of firms in encouraging the adoption of advanced technologies, conserving on Inputs, and generally increasing efficiency and productivity.

This is in contrast to traditional policy which has operated through emissions standards, prescription of technology and abatement targets, backed up by sanctions for non-compliance. The potential of EIs to deliver cost-effective environmental protection has long been recognised in the academic literature but it is only recently that they have become a significant tool for environmental policy in the EU and other OECD member states.

The arguments in support of a greater use of EIs generally relate to their greater cost-effectiveness in securing environmental objectives than other, especially regulatory, approaches. EIs operate on the principle that the polluter should face all the costs of its polluting activity, including those costs that fall on others. This process is known as internalisation of external costs, since it brings environmental damage into the set of costs faced by the polluter, who is assumed to be interested in minimising expenditure. The optimal position is for pollution to be reduced up to the point where abatement of one more tonne of pollutant will cost society more (in abatement equipment etc.) than it will deliver in reduced damage to health, crops, trees etc. This is the theoretical optimal level of pollution output. For the regulator to set the tax or permit allocation to reach this optimal point requires information on how incremental damage costs and abatement costs change with pollution output. Moreover, as well as achieving the same environmental quality at less cost, economic instruments have other benefits. For example, they produce a continuing incentive for innovation (i.e. they have what is known as "dynamic efficiency). Firms that develop new ways of achieving cheap abatement can reduce emissions and thus reduce their tax bill, or

---

[6] The Polluter Pays Principle (PPP) was first adopted in the 1973 Council Declaration on the First Environmental Action Programme of the European Union. The 1987 revision of the Treaty establishing the European Economic Community and eventually the Maastricht Treaty marked explicit legal recognition that EU and environmental policies must be based on the principle that "the polluter shall pay" (Article 130r in the treaty).

sell surplus permits. By contrast a firm that achieves compliance with existing emissions standards has little incentive to further reduce its impact on the environment.

Economic instruments used in environmental policy include emission, product and administrative charges, tradeable permits and deposit-refund systems. Some of the instruments currently in use have explicit environmental objectives, others have an environmental impact but are directed at some other goal, normally the raising of revenue. Examples of the latter include excise taxes on fuels, and value added tax on domestic energy usage.

The discussion that follows will deal primarily with instruments which have environmental protection as their main objective, and will exclude subsidies, fines and liability insurance. Subsidies are generally incompatible with the 'Polluter-Pays Principle' upon which environmental policies are now founded. Fines play a part in the enforcement of regulations and economic instruments (European Environment Agency, 1996).

4.2.1 Charges and taxes

Charges and taxes include those paid pro rata on discharges to the environment (emission charges or taxes), fees which added into the price of products which are polluting in their manufacture or consumption, and fees on products for which a specific disposal system has been organised (product charges).

An emission tax is an instrument by which a charge is levied for each unit of pollutant released to the environment. By providing a direct association between pollution output and the firm's costs, the tax provides an incentive to reduce emissions up to the point where further reductions costs more than payment of the tax. Emissions charges are best suited to stationary sources where the pollution monitoring is feasible.

Monitoring of emissions entails costs which form part of the administrative burden of the tax - either to the regulator or to the polluter. Technological advances have mean that monitoring is now becoming cheaper, but in practice, costs are often minimised by requiring direct measurement only for large polluters, and applying charges to smaller polluters on the basis of expected emissions or a flat rate. It is, furthermore not always possible or practical to directly measure pollution output and calculate the tax due.

As a general case, the more remote the tax is from the actual emissions, the less efficient it will be as a means of reducing pollution. Similarly, the less discriminating a tax is between products of differing environmental impacts, the less effective it is. For example, a general tax on packaging would encourage companies to reduce packaging on their products, but would not necessarily produce the greatest reductions in those types of packaging which produce the largest environmental impact.

4.2.2 Tradeable permits

Tradeable permits operate on similar principles to environmental taxes - forcing polluters to consider the costs of the pollution they generate and allowing the economics of individual firms to determine where abatement occurs. The regulator sets a constant or declining, level of emissions for a given pollutant within a set geographic area and time period. Permits for this level of emissions are distributed, either by straight allocation to existing producers, or by open auction, or by a combination of the two. Permits may be given a limited life or be open.

Firms are then able to buy, sell or lease permits and a market price for these emerges. Faced with a gradual reduction in total permitted emissions and availability of permits, firms have the choice of buying abatement equipment or buying permits. Those firms that can abate cheaply have an incentive to do so, and sell their permits. Alternatively, if they cost less than further abatement, the firm will increase its holding of permits.

Tradeable quotas have been used for common air pollutants, and to facilitate compliance with agreements to phase out production of substances, such as CFCs. They allow flexibility and savings between manufacturers as production is scaled down.

As well as inter-firm systems, regulators have also created arrangements that allow internal "trades" between different sources of emissions within one company's site or sites. These allow flexibility, and thus cost-effectiveness, in a firms' operations without increasing the load placed on the environment.

Certain conditions are required for a successful permit trading scheme. Firms must be confident about the rules and longevity of the scheme in order to trade. Transaction costs must also be as low as possible, and having a significant number of players reduces the risk of monopolistic practices by large companies. The credibility of the system also relies on effective monitoring and high fines for transgressors.

One advantage of permits over taxes is that they automatically adjust for inflation and economic growth, whereas the incentive effect of taxes and charges can devalue over time as inflation erodes their real value. To maintain efficiency, non-ad-valorem taxes need to be increased periodically, which may be politically difficult.

Another distinction between permits and taxes is the effect on uncertainty. With permits, emissions are fixed and the environmental impact is known. However, if abatement costs are uncertain there is a risk of major costs being imposed on industry. With taxation, there is no risk of punitive abatement costs for industry[7] but the impact on the environment is less certain.

4.2.3 Deposit-refund systems

This type of EI involves a surcharge on a potentially polluting product which is returned to the purchaser when the item is delivered to a specific waste collection system. The instrument is suited to products which can be reused, recycled or must be returned for destruction. Systems have long been operated for bottles by private companies, since returnable bottles were cheaper than non-returnable ones. The advent of cheap, light, disposable packaging has introduced some conflict between private incentives to cut costs and public interest in minimising waste and littering. Deposit-refund systems are also operated for batteries, pesticide waste and other potentially environmentally-damaging products.

4.3 Communicative approach

The third category is that of communicative instruments. Apart from general education and awareness raising initiatives for companies and consumers there is growing interest in the provision of information on the environmental impacts of processes and products. A prime example of a communicative instrument is that of eco-labelling.

Eco-labelling has been adopted by the EC's Fifth Environmental Action Programme in 1992 (EAP) to promote products with reduced environmental impacts throughout their life cycle and to provide consumers with reliable information about the impact of products on the environment. Products that are deemed to be more environmentally friendly than their competitors are identified by a single, distinctive eco-label. The Fifth EAP marked a significant change as it recognised that, in the drive for a better environment, producers and consumers need to accept responsibility for the consequences of actions they take regarding the production and purchase of goods (Scholl, 1994).

---

[7] If the marginal abatement cost exceeds the tax rate, companies will chose to pay the tax rather than abate.

4.4 Self-regulated approach

Finally, Driven by the application of legislative, economic and communicative instruments, there has been a growing interest in the role of self-regulation within a framework established or promoted by government. For the industry sector, this process resulted in the development of various voluntary (VAs) agreements between government and industry (covenants) and a wider interest in self-regulatory frameworks such as EMAS. This change in emphasis and approach was unavoidable as it is clear that reliance on the command and control method alone has its limitations. With restricted resources governmental bodies alone are commonly not able to develop, implement, enforce and monitor relevant legislation. A degree of co-operation with the target groups involved is therefore required.

Voluntary agreements have grown rapidly in number over the last five years but they are not uniformly distributed around the EU. Awareness of VAs and their potential applications still varies considerably between both companies and regulators. The most active countries in Europe include the Netherlands (with more than 70), Germany and Austria.

There is no standard definition of "Voluntary Agreement" and it is recognised that this general label does not really capture the true nature of many agreements. Terms such as "negotiated agreement" or "covenant" are used to reflect more accurately the nature of this instrument. In general, in environmental policy a voluntary agreement is defined as :

> *an agreement between a public authority and a coalition of firms whereby industry commits itself to pollution reduction.* (Glachant, 1994)

These commitments can however exhibit various degrees of precision, for instance:

- a commitment to setting a reflection process to design a future regulation;
- a commitment to reach an objective without specifying the means;
- or a very comprehensive set of commitments specifying an environmental goal and the measures which are required to reach it.

These institutional arrangements are the subject of increasing interest from policy makers and industrialists as an innovative way to address environmental issues. They are seen as flexible instrument well adapted to the increasing complexity of environmental policy making. Consequently, at least in Europe, as their use has grown, a debate has emerged regarding their benefits and disbenefits relative to other environmental policy instruments. Despite this however, they have not yet been subject to in depth analysis by economists, especially with respect to their efficiency and nature, many questions therefore remain. The key actors involved in this debate are industry, the regulators and the environmental pressure groups. The main issues are highlighted in the SWOT analysis overleaf (Table 3). This analysis lists and analyses the main Strengths of "Voluntary Environmental Agreements", their Weaknesses and the likely Opportunities and Threats that they will face in the future.

Table 3: Arguments for and against "Voluntary Environmental Agreements"

Strengths	Weaknesses
• Flexible/tailored to circumstances • Devolves responsibility to local level • Based on consensus • Potentially more efficient • Potentially quicker to implement • Provides greater stability in long term requirements • Based on positive incentives • Encourages innovation	• May not be perceived to be demanding enough • May seem inconsistent • Require long term planning • Open to abuse by the less scrupulous • Need some checking of compliance • Can be costly, time-consuming and bureaucratic • Can cause problems with free competition
Opportunities	**Threats**
• More efficient environmental improvement • Better targeted regulation • Integration of environmental improvement into business planning cycle	• Free riders • Excessive bureaucracy • Short-term thinking • Not sufficiently credible with the public

As a general principle, VAs are welcomed by industry as a complementary instrument to the regulatory approach since they offer more flexibility and encourage a collective answer to specific issues. VAs tend to be conceived on a medium-long term basis (5 to 10 years) and enable companies to undertake environmental investments as a coherent part of other planned investments. The emergence of co-operation between firms is as important as the co-operation between the public authority and the industries concerned. It should be noted however that there are both advantages and disadvantages to Voluntary Agreements.

The advantages of Voluntary Agreement are that they allow a collective learning in order to reduce genuine uncertainty. The establishment of organisational links (e.g., consortia) tend to stabilise the interaction between actors (firms, municipalities) and thereby reduces another dimension of uncertainty due to complexity (viz., the diversity of the involved actors). It is, therefore more simple to manage a VA when a sector is cohesive, has a modest number of firms and is accustomed to working as a unit in co-operation with the regulator. Such cultural factors help to explain why VAs are more common in countries such as Denmark and the Netherlands, as opposed to the UK or France. The larger the number of firms involved, the more complicated, bureaucratic (and therefore costly) the VA approach becomes. The sector's general attitude to the environment is also relevant. Where SMEs, which tend to be less environmentally-aware, dominate (such as in the ceramics industry) or there is a history of reactive rather than proactive environmental management, the negotiation of agreements is likely to be more difficult. Finally, since the agreements concerned not only have the content of a contract but also require revision procedures (given that the contract is unavoidably incomplete) this provides the Voluntary Agreements with evolutionary features which fit well with a very uncertain and complex environment.

Concerning the disadvantages of the Voluntary Agreement it must be recognised that it favours collusion between firms which may be detrimental to intense competition. For instance, in the case of Eco-Emballages[8], fees to be paid by packagers are not differentiated according to the nature of the material. Thus the impacts of the development of recycling on the market shares of the different materials are frozen. In addition, as Voluntary Agreements are well adapted to an uncertain environment, they are of a transitory form given that uncertainties will (hopefully) tend to disappear. Finally, there is always the danger that united monolithic consortia of companies may have an intimidating effect upon the regulatory authority. The uniformity of the consortia's position and views may even compromise the speed, form, scale and perceived potential of regulatory compliance. This last aspect raises important questions relating to the competence and political or environmental "will" of regulatory agencies and public authorities in general. Many commentators consider that Voluntary actions only result in cosmetic effects.

> *Self-regulatory schemes involve regulation of the industry, by the industry, for the industry.* (Gunningham, 1995)

In the case of the ceramics industry Voluntary Agreements tend to be inappropriate in the reduction of environmental impact because of the large number of small firms, which might be tempted to adopt a "free-riding" position. Some firms may be enticed not comply with the prescribed rules and avoid the compliance cost whereas they will simultaneously continue to benefit from the collective gain (e.g. reputation effects or network economies).

---

[8] On 12 November 1992 the French Government granted approval to Eco-Emballages, a private company with a role in the public interest, for a renewable period of six years. In line with the European directive on Packaging and Packaging waste, Eco-Emballages' role is to valorise household packaging waste. The decree of 1st April 1992 defined this task as the duty to help all companies who put domestic packaging on the French market to fulfil their legal obligations of organising the post-consumer management of their packaging. The target is to achieve 75% recycling by the year 2002.

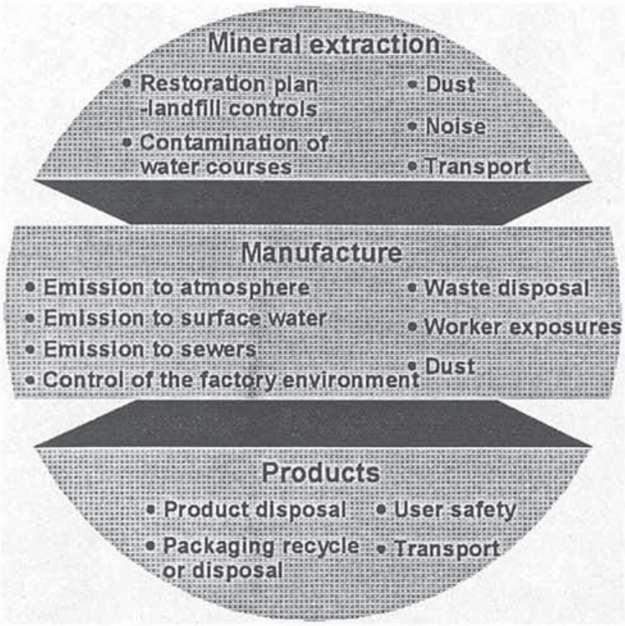
5. ENVIRONMENTAL LEGISLATION & REGULATION

For a long time the development of environmental legislation was relatively "piecemeal" , not always effective and often reflected a response to specific incidents rather than being a co-ordinated policy. However, since the 1990s, countries have aspired to a more proactive and global approach to environmental protection in order to reduce industrial pollution more effectively. Furthermore, Governments have realised that in general, industry does not install pollution control equipment unless it is required to do so through legislation, imposing a requirement to meet for instance, an emission standard. In principle, at least, there are many different policy options available to government covering a broad spectrum from "carrot" (financial incentives) to "stick" (strictly -enforced regulations).

Industries are now facing tougher environmental regulations, new taxes and higher costs, therefore the immediate challenge is how to save money by reducing their environmental impact at source. The vast majority of new environmental regulation promotes the 4R strategy - to reduce, to reuse, to recover and to recycle - as a "win-win" opportunity for companies to curb their environmental impact - a win for the environment and a win for the companies' operating efficiency. Most economists stress the fact that long-term economic considerations and integrated solutions are now essential if the goals of protecting the environment for ourselves and for the future generation is considered.

The discussion that follows examines more specifically the national and international regulatory requirements facing the UK and French ceramics industry. Five media sectors namely air, water, land, waste, and noise are examined in-depth. Figure 7 outlines the major harmful impacts of the ceramics industry on the environment at all level of the ceramics life cycle. For more detail information on the production process in terms of process components that are common to the ceramics industry sub-sectors and the impacts of solid and liquid wastes, gaseous and noise emissions on the environment reference should be made to chapter 5.

Figure 7: Scope of environmental impacts in the ceramics life cycle



5.1 Regulatory requirements relating to air pollution

The abatement and treatment of air pollution is becoming an increasing concern, and industrialists are facing pressure from both public opinion and legislation, to avoid all unnecessary contamination. While only a minority of industrial operations routinely discharge contaminants into water courses, or into the soil, nearly all have some contaminating effect on the surrounding airshed.

Table 4 summarises the wide range of emissions that are now recognised as dangerously contaminating the air.

Table 4: Major prescribed air pollutant: what, why and from where?

What is prescribed?		Why is prescribed?	Where does it come from?
Definition	**Example**		
Sulphur compounds	Sulphur dioxide SO_2	The prime "acid gas", contributing to "acid rain" pollution world-wide	Burning most forms of fuels, particularly high-sulphur coals and oils
Nitrogen compounds	NOx	Harmful both as "acid gases" and as "photochemical ozone precursors" causing smogs	Burning all forms of fossil fuels, with a special contribution from vehicle exhausts
Oxides of carbon	Carbon dioxide CO_2	Notorious as the largest volume "greenhouse gas" contributing to global warming	Burning all forms of fossil fuels, as well as incinerating all manner of organic materials
Organic compounds and partial oxidation products	CHCs, CFCs, PCBs, PAHs, dioxins	CHCs and CFCs act as "ozone depleters", threatening the benign upper-atmosphere ozone layer; VOCs act as "photochemical ozone precursors", promoting malign lower-ozone; PCBs, PAHs and dioxins are highly toxic	CFCs from e.g. refrigerant leaks and aerosol-can production; VOCs from use of all kinds of organic solvent in industrial processes; PCBs, PAHs and dioxins from out-of-date processes or incomplete combustion of plastics
Metals, metalloids and their compounds	Lead, cadmium mercury, etc.	Extremely poisonous neuro-toxins	Not only all forms of metal smelting and forming but also burning and incinerating many materials
Halogens and their compounds	Hydrogen chloride HCL	Major acid gas	Not only many chemical processes but also burning of plastics etc.
Mineral fibres and particles	Asbestos, glass fibre	Highly dangerous materials	Many industrial fabrication processes
Particulates	Dust etc.	Nuisance value, also increasingly implicated in medical effects including lung damage, asthma and allergies	Practically all mechanical and chemical processes

Source: Environment Business Magazine (1994, 14)

To reduce air emissions, new air pollution regulations have recently been introduced at both the national and international level, requiring progressively higher standards of emissions control, and enforcing compliance with new emissions standards much more tightly. For example, an international agreement to reduce emissions of VOCs was signed by most of the countries of Europe and North America under the auspices of the UN Economic Commission for Europe (UNECE) in November 1991. Countries which ratified it had a number of emissions control options, including a 30% overall reduction in VOCs by 1999; a 30% reduction only in the tropospheric ozone management areas (TOMAS), which contribute to ozone pollution in other countries; or the stabilisation of VOC emissions by 1999. The European Commission has responded by implemented a series of directives aiming to control and curb VOC emissions, as well as increasing the use of cleaner materials and processes.

For the ceramics industry the main concern on emissions to atmosphere is kiln emissions. Closely connected with this, is energy efficiency and energy use. For instance, the EC proposed carbon tax which would impose the obligation on member-states to levy a tax of progressive severity on the use of fossil fuels will directly impact on the ceramics industry.

5.1.1 European Level

In the 5th[9] Action Programme, acidification and air quality are specifically targeted and the measures necessary to guarantee levels of air quality which are not detrimental to health and the environment, are identified along with targets and instruments to tackle acidification.

Limit values and air quality standards for a number of specified substances in the air which contribute to atmospheric pollution have been adopted in a series of directives. Relevant examples to this study include unit values for lead in the air and air quality standards for nitrogen dioxide.

The council can also, if necessary whilst acting unanimously, adopt relevant emission limit values, to be fixed after consideration of the best available technology not entailing excessive cost (BATNEEC), and of the nature, quantities and harmfulness of the emissions. Moreover, in accordance with national law, member states are to make available for public inspection the applications for authorisation and the resulting decisions of the competent authority. Member states must ensure emissions are monitored for continual compliance.

In September 1993, the Commission published its proposal for a Framework Directive on Integrated Pollution Prevention and Control ("IPPC"). This aims to provide an integrated approach to pollution control to achieve as high an overall level of protection as possible for

---

[9] A proposal for a decision that seeks to ensure a mid-term retargeting of the provisions in the EU's Fifth Action Programme on the Environment and sustainable development entitled "Towards sustainability", was tabled by the European Commission on January 24, 1996. Five themes have been singled out for granting priority to between now and the year 2000. One overriding concern is to ensure the environment is reflected in all areas of EU policy-making.

the environment and human health, in particular, by preventing or minimising emissions from certain installations. If adopted the IPPC Directive will gradually replace Directive 84/360 on Combating Air Pollution from Industrial Plants.

5.1.2 Britain and Wales

Britain can boast what is normally considered the world's first national public pollution control agency, the Alkali Inspectorate, which was established by the Alkali Act 1863 to control atmospheric emissions primarily from the caustic soda industry.

For England & Wales (Scotland has its own legislation and enforcing authorities) regulation is via the Environmental Protection Act 1990 (EPA 1990). The whole EPA 1990-based anti pollution system was last largely amended in 1994, to cover more industrial operations, requiring progressively higher standards of emissions control, and enforcing compliance with new emissions standards much more tightly.

Under the Environmental Protection (Prescribed Processes and Substances) Regulation 1991 (SI 472), the Secretary of State for the Environment specifies both the processes and the polluting substances that are currently covered by the EPA 1990 regulatory framework. Already some 30,000 specific industrial processes are covered by the regulations, and other processes or substances can be brought under the control of the EPA 1990 at any time by a simple ministerial order. Theoretically, processes and substances can also be de-controlled but the general trend is towards tighter controls. In the case of the most polluting processes, HM Inspectorate of Pollution (HMIP), regulates air pollution under integrated pollution control. Local authorities are responsible for administering air pollution control over less polluting releases into the air under the EPA.

The EPA provides that certain matters which are prejudicial to health or a nuisance constitute statutory nuisances. These include :

- the state of the premises;
- the emission of smoke, fumes, gas or noise from premises;
- dust, steam, smell or other effluvia arising on industrial, trade or business premises;
- the accumulation or deposit of substances.

Where a statutory nuisance exists or is likely to occur or recur, the local authority must serve an abatement notice requiring the abatement or the prohibition of the nuisance within a specified period. Failure to comply with the notice is a criminal offence subject to an unlimited fine in the crown court and a fine up to ECU 28,500 in the magistrate's court.

5.1.3 France

The law of 2 August 1961 defines air pollution as any pollution of the atmosphere or fumes which are dangerous to public health or safety, to agriculture or to conservation of sites and monuments. The principle underlying the 1961 legislation is that all sources of pollution should be designed, operated and used in such a way as to minimise pollution.

This law has been modified on several occasions, notably recently by the decree of 25 October 1991 which fixes concentration levels in the air for certain products and institutes measuring networks on sites where the pollution is presumed to be worst. Economics means have been used to fight air pollution. For instance, special rates of payment have been introduced for the purchase of materials aimed at saving energy.

France is unique in Europe in operating a system of emission charges for air pollution. Under this system, first introduced in 1985, a levy is applied to all combustion plants of 20MW capacity and to all other installations emitting more than 150 tonne per year of specified pollutants. The taxable pollutants are sulphur dioxide, nitrogen oxides, hydrogen chloride, particulates and VOCs. Emissions of acid gases are charged at the rate of ECU 23/tonne, raising total revenues of around ECU 28m per annum. The levy is administered by the National Environment Agency (ADEME), which allocates the revenues to research, monitoring networks and investment subsidies.

A major new piece of air legislation was recently enacted by the parliament (04-11-1996) defining 5 major principles:

- the duty to keep a close eye on the air quality and informed the public;
- to establish a regional plan on the air quality;
- the option for the Préfet to limit the traffic some days in case of a pollution peak;
- the establishment of urban traffic plans integrating all modes of transportation;
- a tax relief for non-pollutant petrols.

All actions aimed at improving air pollution control techniques, reinforcing air quality monitoring and providing adequate information to public and private bodies are undertaken by the Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME) which was founded in 1991. At the local level, the préfet ensures that the regulation are implemented.

5.2 Regulatory requirements relating to water pollution

National and international regulations on water have been tightened in the last decade, as it is quite clearly an ethical imperative that current use of fresh water should not undermine the global ecosystem, as this is likely to have catastrophic consequences for future generations. The water stock has two obvious, physical, dimensions: quantity and quality. These two parameters are the main principals of any new water regulations.

There are commonly two approaches to defined water pollution and to, subsequently, enact an appropriate regulation. The first is to say that water is polluted when any of its natural characteristics are changed. The second approach is based on water's capacity to purify itself and says that water is polluted only when the use to which it is put is or will be jeopardised.

5.2.1 European Level

Management of water resources is one of the issues specifically targeted by the 5th Action programme and long term objectives are identified in the Programme for water quantity and quality. The bulk of existing Directives on water protection date from the late 1970s.

Member States are required to ensure that:

- measures taken to implement the "Drinking Water Directive" do not lead to a deterioration in the present quality of water intended for human consumption or an increase in the pollution of water used for the production of drinking water;

- when water is made available to the public any substances used to treat water for human consumption do not remain in the water in concentrations higher than the maximum admissible concentrations contained in the Directive;

- drinking water quality is monitored regularly according to the specifications contained in the Directive;

Member States are required to protect groundwater against pollution caused by certain dangerous substances ("the Groundwater directives). This directive controls contamination of groundwater sources by limiting or prohibiting emissions of certain substances.

5.2.2 Britain and Wales

The Rivers Pollution Prevention Act 1876, first established a Water pollution controls, although these proved to be virtually unenforceable in practice. There has been an obvious shift in the emphasis of the law since then to reflect newer environmental concerns.

The **Water Act of 1989 (WA)** includes most of the law on water pollution. It established the authority of the National Rivers Authority to regulate and charge industry for its extraction and discharge of water into *controlled waters*, i.e. surface waters such as rivers and lakes.

The **1991 Water Industries Act (WIA)** is the principal piece of legislation affecting the ceramic industry's discharges of water and waste-water. The Act established the authority of the regional water companies to set industry discharge consents containing limits on the volumes and quality of discharges to the *sewer*, which then pass into the Water Companies' own water treatment works.

Since conditions for discharge to surface waters are far stricter than those to sewers, the vast majority of ceramics manufacturers discharge to sewers only, and must therefore comply with discharge consents issued by water companies, such as Severn Trent and North West Water. This makes WIA 1991 the more relevant piece of legislation.

In the past Severn Trent (the water company covering the Stoke area) laid down a uniform set of discharge limits for most companies. However, they now tailor limits for different companies and factory sites, according to volumes discharged, the site's waste-water treatment capability, and the capacity of the relevant Severn Trent sewage treatment works.

Typical standards set by Severn Trent for ceramic manufacturers' discharges to sewer require that levels do not exceed:
total metals of 30 mg/litre
pH in the range of 6 - 10
COD < 70 (g/m^3)
BOD < 70 (5 days, g/m^3), and
max. volume limit of, for example, 220 m^3/day.

In particular Severn Trent aim to reduce the discharge of metals entering the sewer, especially lead and zinc. Limits are also set for other metals including copper, chrome and nickel. Cadmium processes are prescribed processes under Integrated Pollution Control (IPC) and so are regulated by HMIP. Discharge metal limits are set either as a blanket figure for all the metals combined, (e.g. a total limit of 30mg/l could consist of 10 parts Pb and 20 parts Zn), or specific limits for specific metals.

The costs levied on a company for its discharges are calculated using a factor involving volume and discharge quality characteristics. The quality factor is made up of suspended solids, COD and BOD. It is therefore in the manufacturer's financial interests to minimise the quantity and potential polluting quality of the water discharged. Sewer discharge costs are approximately ECU 1.15/m^3 (assuming COD of 100 mg/m^3 and 2500 mg/l), while costs of water supply from mains water are typically ECU 0.85 per m^3.

5.2.3 France

Water pollution is essentially regulated by the Law of 16 December 1964 and more recently by the Water Act of 3 January 1992 which institutes a "balanced management" of water resources. Furthermore, an arrêté (order) dated 1 March 1993 regulates water consumption and discharges of any nature by authorised classified facilities. The approach is global in that it tries to make operators as well as the préfets who grant authorisations aware of the environment, in order to enhance the operators' sense of responsibility toward the environment when operating a facility.

The environmental constraints established by the 1992 "Water Act" make the councils:

- request an authorisation for water withdrawal;
- set up protective perimeters for this water intake;
- display the analyses of the quality of water they consume in proportion to the volume used as measured by an individual meter.

This Act tries to adopt a global approach and introduces a new planning system comprising the "Schémas d'aménagement et de gestion des eaux" and the "Schémas directeurs d'aménagement et de gestion des eaux" (SAGE and SDAGE) which define general objectives for use of water and for the protection of the quality and quantity of surface and underground waters and of under water ecosystem and wetland.

Industrial waste water treatment in France is regulated by the Préfets whose powers stem from the "1976 Law". Companies are granted operating permits and effluent quality standards are set for the discharges to public sewer and natural watercourses. Disregarding permitting requirements or failing quality standards can lead to fines and/or imprisonment.

5.3 Regulatory requirements relating to land contamination

According to the International Chamber of Commerce, contaminated land is:

> *land containing substances, be they liquids or solids, which when present in sufficient quantities or concentrations, can cause harm directly or indirectly to man and the environment.*

Three categories of polluted sites might also be defined:

- Firstly, there is historic contamination which pre-dates current technical legislation. In particular, discharges made in areas of vulnerable subsoil leading to groundwater pollution.

- The second category is waste deposits, or deposits of chemical products, which were abandoned following a company failure - or which result from illegal import or waste disposal practices.

- The final category covers soil polluted by fall-out, infiltration, or the tipping of polluting substances, linked to a previous (or existing) industrial installation - or to some major transportation accident.

With a diminishing industrial base, the UK and France's heritage of contaminated land is becoming ever more apparent - as is the clean up cost. Some of the worst sites are those where several polluting industries, such as brickworks, tanneries and engineering workshops, have been located in one place - perhaps over a period of decades. Regulations dealing with contaminated land have become more stringent over the past five years. The impact of these regulatory changes has been a substantial increase in landfill costs reducing subsequently reliance on landfill and increasing the promotion of recycling and other form of "recovery".

5.3.1 European Level

The EC has adopted a wide range of legislation on contaminated land. In July 1991, the Commission published a proposal for a Council Directive on the disposal of waste by landfill. The proposed Landfill Directive notes the need to minimise the use of landfill operations because of concerns over possible contamination of groundwater supplies from landfill leachate. Reducing as far as possible the use of landfill operations should be accompanied by measures to prevent the production of waste and to encourage the recycling of waste. Taken together, these ideas apply one of the fundamental principles of EC environmental policy set out in Article 130R of the Treaty, namely :

- to preserve, protect and improve the quality of the environment;
- to contribute towards protecting human health;
- to ensure a prudent and rational utilisation of natural resources.

Finally, landfill operations should be regulated to avoid the uncontrolled dumping of waste.

5.3.2 Britain and Wales

5.3.2.1 Contaminated land

Landfill engineering standards have risen considerably over the past 10 years in reply to a number of pressures. Tighter planning controls have made it more difficult for developers to obtain permission for new sites unless the development incorporates high standards of engineering and environmental protection. Regulations on groundwater protection, liability, landfill gas control have also significantly affected landfill design and operational practices.

Section 143 of the Environmental Protection Act 1990 was the Government's first attempt to legislate on contaminated land in general. But in 1992, just before the deadline set for implementing this section, the government retreated. However, in November 1994 a new statutory framework of identifying and dealing with contaminated land was created by the new Environment Bill. Contaminated land is defined as any land appearing to a local authority "to be in such a condition, by reason of substances in, on or under the land," that "harm" or water pollution "is being, or is likely to be, caused". In turn, harm is defined as "harm to the health of living organisms or other interference with the ecological systems of which they form part and, in the case of man, includes harm to his property". These definitions amount to a considerable extension of current nuisance law and also underline why it has so rarely been invoked to deal with land contamination problems and to impose "producer responsibility obligations" .

The effect of these regulations have been bolstered by the landfill tax which came into effect in October 1996 (ENDS Report, 1996). This tax should raise approximately ECU 8,500 million per annum of the 100 million tonnes of waste which currently goes to landfill. Most waste sent to landfill in 1996 were taxed ECU 10 per tonne, but "inactive" waste attracted a lower rate of ECU 3 per tonne (ENDS Report, 1996). A levy of around ECU 10 per tonne should act as a stimulus to increase recycling and to divert waste from landfill to incineration which many regard as an environmentally preferable disposal route. This will directly affect the costs of waste disposal to landfill by ceramic manufacturers.

Staffordshire County Council's Waste Management Plan is also of relevance to the county's many ceramics producers, in that it points to a shortage of accessible landfill capacity. There are currently three principal sites in Staffordshire, one to the north, one to the south, and one to the east. The latter has only 6 years of usable life remaining. It is our understanding, that Staffordshire County Council's Local Authority Waste Disposal Company (LAWDC) does not wish to encourage the use of their landfill sites for the disposal of the ceramics industry's waste. The industry will therefore have to look elsewhere (as it does already) to private contractors operating private landfill sites. This service is likely to become increasingly costly, even before the introduction of the landfill levy.

5.3.2.2 Mineral Extraction

The UK Government has been under considerable pressure to require and encourage the mineral extraction industry to improve its environmental performance. There have been numerous legislative changes to this end. Two in particular are of significance. The first is the extension of planning controls to permissions known as Interim Development Order permissions. These are planning permissions granted before July 1948, which (to date) have escaped the rigours of the planning regime. Recent legislation has required all such permissions to be registered, and conditions for working, restoration and aftercare to now be determined by the Mineral Planning Authority within a period of 12 months of registration. Details of the extent of such conditions have been the subject of protracted debate between the Government and industry. The Government has announced that the new regulations regarding updating planning consents will be introduced in the "Environment Bill" due for introduction over the next year.

In addition, the UK Government intends to review the Town and Country Planning (Minerals) Act 1981, in relation to mineral extraction permissions. The Government is seeking ways in which the permissions granted in the 1950s, '60s and '70s can be updated, and also a mechanism for ensuring the periodic updating of mineral permissions on a more widespread basis. Stricter conditions are certain to affect the economics of mineral working and thus costs of clay raw materials to the industry.

5.3.3 France

The 1975 Law declares that any person producing or holding waste is responsible for its disposal, irrespective of its nature and of its effects on the environment. An amendment to the 1975 Law provides that from January 2002, waste disposal sites may only receive so-called "ultimate" waste (i.e. waste from which all recyclable material has been extracted) which will lead to the closure of 6,000 landfill sites by the year 2002. This law limits the volume of waste stored, and the amount of land used for landfill, reducing number of uncontrolled disposal sites. This legislation together with the forthcoming EU landfill directive is also likely to result in the closure of many authorised landfill sites.

France first introduced a waste disposal tax in 1993, following the 1992 Act. The 1995 Act increased the landfill levy to ECU 5.3/tonne with further increases of ECU 0.8/tonne each year up to 1998. The levy is collected by the site operators on behalf of the Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME). The 1995 Act stipulated in the title IV, that the tax will contribute to the upgrading of household landfill sites and to the decontamination of polluted sites.

5.4 Regulatory requirements relating to waste generation

At the end of the 1980s waste management regulation in the industrialised countries entered a new phase spured by public concern as well as pressure of green parties and environmental groups (possibly more influential than ever before or since). Environmental policy becomes more targeted, often with initiatives aimed at developing recycling, re-use, waste minimisation and implementing the principle of polluter pays principle.

Historically, a significant percentage of all wastes have been disposed of via landfill sites. Only a small percentage of total waste is incinerated and an even smaller amount is incinerated in facilities with an energy recovery capability.

The drive to reduce hazardous waste, or waste from packaging affect all industries including the ceramics industry to some degree. Here again a complete set of regulations have been introduced at national and international level.

5.4.1 The European level

The EC has adopted a wide range of legislation on waste management based on the Waste Directive 75/442 as amended ("the Framework Waste Directive"). This framework applies in many of the key principles of EC such as to minimise the need to dispose of waste created. This is to be achieved by developing clean technologies and products as well as techniques to dispose of dangerous substances contained in recoverable waste.

The next stage in the waste disposal process is to ensure that the waste which still, arises despite steps taken to prevent it is recovered or disposed of in a manner which does not damage human or animal health or cause harm to the environment.

In December 1991 the Council adopted Directive 91/689 on Hazardous Waste. The Hazardous Waste Directive lays down requirements to control the disposal, recovery, collection or transport of hazardous waste. In addition it encourages EU Member States to take measures to ensure that, as far practicable, different categories of hazardous waste are not mixed with other wastes. Again, the net effect will be an increase in disposal charges - and a greater incentive to minimise the production of hazardous "special" wastes.

Under the EU Eco-labelling Directive, award criteria are currently being developed for two of the ceramics industry's product groups; ceramic floor & wall tiles and ceramic tableware products. Criteria for the former are being developed by the Italians, and research into the latter jointly by Portugal and the UK was due to commence in January 1995. This has been delayed since the feasibility of the label for tableware is still being investigated. Award criteria in the ceramic floor and wall tile study currently includes the manufacturing processes' consumption of energy, gaseous emissions of fluorine and particulate matter, water consumption, wastewater quality, and reuse recycling of wastewater and sludges.

In December 1994, the Council adopted a Directive on Packaging Waste aims to increase the volume of packaging waste that is recycled or recovered, sets packaging volume limits, and lists substances that should not be contained in the packaging material. Representatives of the ceramics industry unsuccessfully argued for the exemption of ceramics from consideration as a packaging material. This means that ceramics used as "packaging" have come under stricter concentration limits for metals, such as lead, included in some ceramic glazes. However, this is unlikely to have serious commercial repercussions for most of the industry since few companies produce such goods and most of these will find it straight-forward to use lead-free glazes in the future. Furthermore, these goods may be exempted under an exemption clause for "luxury packaging" included in the Directive.

5.4.2 Britain and Wales

The principal legislative powers relating to waste management were embraced within the Control of Pollution Act 1974 (part 1), which has now been replaced by the provisions of the Environmental Protection Act 1990. The 1990 Act changes provide the framework for potential improvements as it clarifies many areas of uncertainty and strengthens the powers of the enforcing authorities.

5.4.2.1 Solid Waste

The EPA 1990 introduced the Waste Management Licensing Regulations and a Duty of Care upon "any person who imports, producers, carries, keeps, treats, disposes or acts as a broker in respect of controlled waste, to take all measures applicable to him in that capacity as are reasonable in all circumstances to ensure that the waste is properly dealt with", as described in a Code of Practice. Failure to comply with the Duty of Care is a criminal offence. The introduction of Duty of Care was designed to ensure that waste producers use reputable contractors and take greater care in ensuring that their waste is disposed of in an appropriate manner. This legislation applies to UK ceramic manufacturers.

The new Hazardous Waste Directive was implemented in the UK in June 1995. It replaces the 1978 directive on toxic and dangerous wastes, and has created a revised list of wastes regarded as hazardous, including some wastes produced by the ceramics industry not previously classified as hazardous. The directive also elaborates on some of the elements of the EU Framework Directive on Wastes, covering such areas as inspection of sites, licensing, record keeping, and consignment notes.

Part V of the Environment Act 1995 introduces a national waste strategy by inserting provisions into the Environmental Protection Act 1990. Section 93 of the Environment Act 1995 gives the Secretary of state the power to make regulations to impose obligations on producers of packaging waste. This is as a result of the EC Directive on packaging and packaging waste (94/62/EEC), which requires all Member States to ensure that between 50% and 65% of all packaging waste is recovered by the year 2000.

5.4.2.2 Metal Release from Glazed Product

National, European and international limits have been set for the amounts of metals (principally lead and cadmium) which can leak out of the glazed ceramic product under acid conditions. These limits were first introduced in the US by the Food & Drug Administration (FDA) in the early 1980s. They are complemented by state legislation such as the State of California's "Proposition 65" on "Safe Drinking Water & Toxic Enforcement Act", which set limits for lead (Pb) and cadmium (Cd) leached from glazed ceramic goods coming into contact with food. These do not apply to highly decorated, commemorative or hand-painted plates provided that they are labelled "Not for Food Use - Plate May Poison Food. For Decorative Purposes Only." Europe followed with similar lead and cadmium limits. UK manufacturers exporting to the US and other overseas markets have to comply with the national standards of the importing country. Examples of limits set are shown in Table 5.

Table 5: National limits for metal release form glazed goods

Country	Ceramic Product	Pb Limit	Cd Limit	Reference
EU	Flatware<25 mm Internal depth Hollow-ware & Cooking-ware; Packaging & storage vessels>3l	$0.8 mg/dm^3$ 4.0mg/l 1.5mg/l	$0.07 mg/dm^3$ 0.3mg/l 0.1mg/l	Council Directive 84/500/EEC. Off.J.Eur.Commun. (L.277)12, 1984
UK	Flatware<25 mm Internal depth Hollow-ware & Cooking-ware; Packaging & storage vessels>3l	$0.8 mg/dm^3$ 4.0mg/l 1.5mg/l	$0.07 mg/dm^3$ 0.3mg/l 0.1mg/l	The Ceramic Ware (Safety) Regs 1988. S.I. 1647, 1988 BS 6748: 1986 limits of metal release from ceramic ware, glassware, glass ceramic ware and vitreous enamel ware
France	Flatware<25 mm Internal depth Hollow-ware & Cooking-ware; Packaging & storage vessels>3l	$0.8 mg/dm^3$ 4.0mg/l 1.5mg/l	$0.07 mg/dm^3$ 0.3mg/l 0.1mg/l	Installations classées, arrêté 1 March 1993.
USA (FDA)	Flatware Small Hollow-ware Cups and Mugs Large Hollow-ware Pitchers	3.0 mg/l 2.0 mg/l 0.5 mg/l 1.0 mg/l 0.5 mg/l	0.5 mg/l 0.5 mg/l 0.25 mg/ml 	FDA 16/4/92 Compliance Policy Guide: Domestic - lead contamination FDA 27/6/88 Compliance Policy Guide: Domestic - Cadmium contamination

Source: CERAM RESEARCH, "Special Publication 136", 1993

5.4.3 France

Waste management policy in France was first established in the 1970s, and concentrated principally on ensuring the effective control, transfer and disposal of waste. During the 1990s the French environmental authorities have been particularly active in enacting and implementing environmental regulations. The main regulation regarding waste in France is the 1975 Law modified by the Law of 13 July 1992. The 1992 Law (No. 92-646) has set four main objectives in that field:

- prevention and reduction of waste;
- promotion of recycling and reuse;
- organisation of waste disposal and information for the public on the environmental effects of waste; and
- on its disposal without causing nuisance.

A new Law, concerning reinforcement of the protection of the environment and modifying the Law of 1975, was made legal on 2 February 1995(Law No. 95-101) and provides the local authorities, particular the 22 regions, more extensive powers and responsibilities. Under this new law, each region has to develop and implement a waste disposal and reduction plan. This requires the creation and maintenance of a waste inventory so that waste disposal and reduction measures can be effectively monitored and modified where necessary.

Furthermore, it creates a new tax which is levied on dangerous waste. The proceeds of the tax will be used to clean up contaminated soils.

Concerning industrial packaging waste, the decree of 13 July 1994 imposed obligations on holders of industrial packaging waste to re-use and recycle packaging waste. Reuse includes energy generation by incineration. Holders of industrial packaging waste can contract with an authorised organisation (ECO-Emballage or Adelphe) which complies with the requirements to reuse and/or recycle.

5.5 Regulatory requirements relating to noise emission

In many cities of the industrial world there is a rising concern about noise pollution. Noise is often responsible for productivity losses caused by an inability to concentrate at work or disrupted sleep resulting in tiredness. Extreme exposure to loud noise can cause stress and even hearing difficulty. As with other industrial manufacturing processes, the production of ceramics goods emits noise. However, this aspect of pollution is tackle very superficially by either domestic or international legislations.

5.5.1 The European level

At the European level, noise is not specifically regulated but the Commission has adopted an Action programme on safety, hygiene and health at work. EC legislation on health and safety at work is generally adopted under Article 118a of the Treaty which requires Member State to pay particular attention to encouraging improvements, especially in the working environment, with regard to the health and safety of workers.

5.5.2 Britain and Wales

Under the common law, if a landowner is suffering from the consequences of noise as a result of an activity on his neighbour's land, he may be able to sue in tort and obtain an injunction to prevent the continuation of the activity.

5.5.3 France

Until the law of 31 December 1992 (the "1992 law"), noise pollution was not regulated by any specific text but by various provisions in a number of different regulations. The 1992 Law reinforces the powers of préfet and the maire, deals with the means of reducing noise generated by land transport infrastructures and strengthens the available administrative and criminal sanctions.

6. THE FIRM'S ENVIRONMENTAL BEHAVIOUR MODEL CONSIDERED

The overall aim of this study is to assess the corporate strategy and managerial attitudes of "traditional" businesses compared with high tech industries vis-à-vis the environment. More precisely, traditional implies industries rooted in the craft who are producing low tech and conventional products. Some of their basic processes and practices have remained essentially unchanged for many decades and even centuries. Such firms often continue to operate in regions whose traditional location was based on the availability of raw materials. As a result, these companies are may be resistant to change.

The study also sought to learn more about the strategic environmental attitudes of Small and Medium-sized Enterprises compared with large companies operating within the same market characteristics. It is usually accepted, according to the definition established by the European Commission, that in order to be considered as a SME, a company should employ less than 250 people, be independent and have an annual turnover below ECU 40 million. However, for the purpose of this study the SME segment has been divided into micro (1-49 employees), small (50-99 employees) and medium size (100-250 employees) in order to conduct further in-depth analysis.

The intention of this section is to briefly outline the model examined in this study.

6.1 Environmental awareness and management of SMEs

Since the 80s, it has been observed that the proportion of employees in Small and Medium-sized enterprises (SMEs) in the industrial sector has increased across Europe. There are three main reasons for this trend:

- First, the decline in manufacturing employment has meant that certain larger firms have fallen into the SME category.
- Secondly, larger firms tended to reorganise some of their activities by setting up subsidiaries or using sub-contractors.
- Thirdly, a range of support measures at regional, national and European level have been introduced, including payments to the unemployed who start their own business, improved access to finance, and special tax relief for investors in small firms. These measures, in combination with changes in markets, technology and business organisation, undoubtedly contributed to a significant change in the size structure of enterprises though encouraging the establishment of small firms.
- Structural changes due to closures in large manufacturing centres.

In the same way that the cumulative impact of SMEs in terms of employment is large, so too is their cumulative impact in terms of environmental degradation. This is particularly important as many SMEs perceive their business to have little, if any, environmental impact at all. Many studies concerned with raising industry's environmental awareness came to the conclusion that the larger the company the more likely it would be to find environmental issues important. As ironically underlined by Hutchinson *et al* (1994), an environmental solution applicable to a large multinational may not have the least relevance to a corner shop in Barnsley. This could be due to a number of reasons, for instance, larger companies have more time and money available to address these issues than their smaller counterparts, therefore realising the significance of the environmental debate. Or it could be due to a fear of adverse publicity, which would be more likely to concern a larger organisation (Hutchinson *et al*, 1994). However, more significantly, the reason why large firms have more interest in environmental issues than SMEs is because the environment is ultimately a strategic issue that requires proactive planning to deal with it. The larger the firm the more likely that the organisation will have strategic management in place (Storey *et al*, 1987) allowing for proactive environmental management to take place more easily. The existence of a strategic management framework allows a larger base of concerns to be addressed of which the environment is one.

SMEs face a number of other problem which exarcebate the pressures for environmental action. For example, smaller firms often work on an *ad hoc* basis with little or no long term corporate objectives except to survive week by week and maximise profits (Hutchinson *et al*, 1994). This sort of reactive management structure is therefore not conducive to effective strategic environmental management. Research indicates that SMEs[10] are not simply smaller versions of larger companies, but are fundamentally different in their make up (Rice, 1983; Storey et al 1987; and Dilts and Prough 1989). In addition, they also generally have limited access to finances, environmental information and expertise while they often have to comply with short pay-back periods, particularly in times of recession.

---

[10] For instance, in 1991 the Cambridge University Small Business Research Centre (SBRC) undertook the first coherent, integrated and up-to-date nation-wide profile of Britain's SMEs sector since the Bolton inquiry 21 years ago.

6.2 Attitudes of "traditional businesses" vis-à-vis the environment

Since the eighties, numerous research programmes on behalf of the European Commission[11], the European Foundation for the Improvement of Living and Working Conditions, the UNCED, the World Bank and National Governments have examined traditional sectors. As a whole, they observed that a traditional manufacturing sector is more inclined to undertake operational changes that do not require too much investment in time and capital. Indeed, practices that are in place are far more operationally orientated than strategic in nature. Many of these studies, concerned with raising the environmental awareness of traditional small and medium sized enterprises, revealed that a very large number of SMEs have done **little or nothing at all** toward improved environmental management due to difficulties in complying with environmental standards owing to a lack of resources, time to allocate to environmental training and general expertise. This confirms previous research which suggested that the SMEs sector has little or no strategic management inclinations (Gibb *et al*, 1990; Perry, 1986) and suggests that SMEs are dealing with the environment in an *ad hoc* manner based on critical incidence situation management. A recent survey on small firms and the environment (British Chamber of Commerce, 1994) found that **legislation** rather than any other factor was the **driving force** for environmental management in the SME.

Furthermore, during recent years the relationship between business and the environment has become a matter of great public concern and has therefore considerably influenced the companies' attitudes vis-à-vis environmental issues. Human health and welfare, as well as wider environmental matters, are now regarded as a central issue in the definition and practice of the corporate responsibility of many businesses. Nearly a decade of "green" initiatives in the world's corporations has given rise to a more optimistic mind-set, which promises the ultimate reconciliation of environmental and economic concerns. In this new world both business and the environment can win. Being green is no longer a cost of doing business; it is a catalyst for constant innovation, new market opportunity such as environmentally-friendly products or services and wealth creation. This win-win solution was personally championed by the US Vice President in 1993, Al Gore, (Al Gore, 1993) who argued that making environmental improvements is often the best way to increase a company's efficiency and, therefore, profitability.

---

[11] The European Commission (DGXVI) was concerned that the concepts of sustainable development should find expression in the development programmes for Objective 2 regions, i.e. those regions experiencing problems as a consequence of industrial decline.

Indeed, international managers seemed to demonstrate a very positive and pro-active commitment to the protection of the environment. However, as Smith (1992) points out, many of the proposals on corporate approaches to 'greening' have largely been cosmetic and have been more concerned with the short-term marketing advantages that can be obtained through appearing to be 'green'. At present, many people in the environmental movement remain sceptical as to the extent and implications of the rhetoric of the business community to the acceptance and practice of a higher degree of environmental awareness and behaviour.

6.3 Can the environmental impact of a traditional sector dominated by SMEs be reduced?

A significant number of companies still consider the environment as a constraint, a financial burden which reduces their competitiveness and profitability. This view is shared by Noah Walley and Bradley Whitehead, who argue in the Harvard Business Review (Walley *et al*, 1994) that the popular notion that environmental initiatives will inherently increase profitability is unrealistic; responding to environmental challenges has always been a costly and complicated proposition for managers. In fact, environmental costs in most companies are skyrocketing, with little economic payback in sight. According to Albert ten Houten (Waldrop, 1994) founder of ATHMO, Environment and Management, in Wageningen, the Netherlands, only 1% of world-wide companies may be in the right condition to profit from environmental issues and approximately **80 % of small businesses** are unaware of or are unwilling to recognise environmental problems.

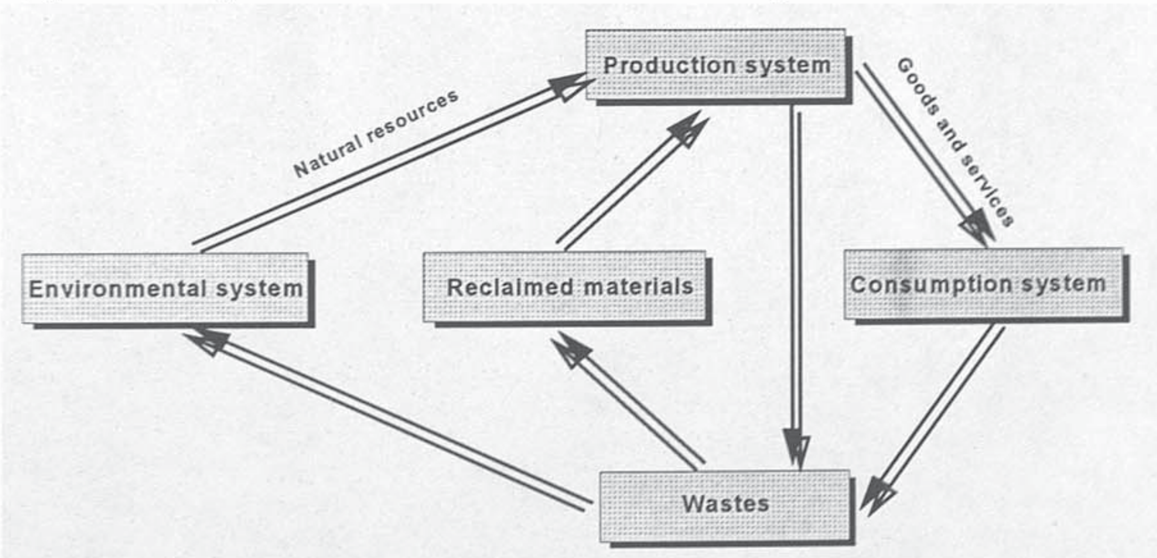
However, at this stage and further to various studies mentioned above it is foreseen that environmental impact can be reduced in the SME sector through models based rather on best practices than generic model developments. Increased environmental regulation would certainly level the playing field but would not change the fundamental attitudes towards the environment. The level of awareness of environmental legislation and regulation is often very low in the traditional sector. Therefore, one can say that this sector has a laggard approach to environmental legislation and regulation, which encourages reactive management of the environment as a business issue. In other words, on the one hand companies feel that environmental issues are important to their business practices and on the other they are unaware of relevant legislation and regulation. This may well be due to the lack of relevant resources and stringent time constraints that apply to smaller firm as well as lack of information on environmental issues and clear perceived benefit in improving their environmental performance. Self regulation is certainly the ultimate goal, where individuals and businesses recognise and respect the environment on a more integrated way.

7. CRITICAL ANALYSIS

This chapter has identified corporate strategy and attitudes towards environmental issues, reviewed environmental policies facing industries and outlined specific areas in which legislation will impinge on the ceramics industry's activities. As reviewed, there have been many attempts to analyse the strategy of companies and to propose workable ways forward which both maintain or increase profitability and provide for the improvement of corporate environmental performance. Indeed, for moving one's business towards sustainability companies must take a more ethical and long-term approach towards the environment.

As underlined, environmental and economic systems of natural resources are inextricably linked (see Figure 8). Production entails the abstraction of natural resources (water, minerals, etc.) which, depending upon the rate of abstraction, renewability, etc., may result in a resource-conservation problem. Production and consumption involve the transformation and use of materials which create wastes (gaseous, aqueous, solid, etc.) which, when returned to the environmental system, may result in an environmental pollution problem.

Figure 8: Linkages between environmental and economic system



The traditional approach to problems of over-use of natural resources and of excessive pollution has been to curb these excesses by regulation. These regulations take a variety of forms which include:

- prohibiting the abstraction, use, or disposal of particular substances, products, processes, etc. which are considered to be environmentally damaging. (e.g. the use of prescribed chemicals as lead);

- setting of maximum limits for the abstraction of particular natural resources (e.g. water extraction, mineral extraction);

- setting of maximum limits (i.e. emission standards) for discharges of pollutant to air, water, or land;

- prescribing the technology or the materials which may be used for particular processes of production (e.g. cement manufacturing processes);

- establishing ambient quality standards (e.g. minimum water quality standards to be achieved in a river receiving polluting discharges).

Fundamentally, the regulatory approach tends to be directed at the symptoms of the environmental problem (i.e. observed pollution and resource-use levels) rather than at its underlying socio-economic causes (i.e. failure of those engaging in environmentally damaging activities to take the externalities for which they are responsible into account in their own decision-making). Moreover, the major constraint is that there is neither the need, nor the possibility, to impose indefinitely stringent standards to address the different forms of pollution. The challenges for globalisation, of a more comprehensive - and preventive rather than remedial - approach to the protection of the environment and also the awareness of the dangers involved in over-regulation pushed by policy actors and economists to find new and more efficient tools to achieve environmental objectives. So as to reach this goal, an increasing range of economic instruments has been developed using financial incentives and disincentives to encourage more "environmentally friendly" behaviour by producers and consumers such as:

- Environmental charges or taxes, are a straightforward way to cost the use of the environment. In practice, they are calculated either as emission or effluent charges or as product charges;

- subsidies, i.e., a financial assistance provided to polluters by means of grants (non-repayable) soft loans (repayable but with low interest rate) or tax allowances (accelerated depreciation of anti-pollution investments);

- financial enforcement incentives are fines to be paid for non-compliance behaviour (non-compliance fees) or payment returnable upon compliance (performance bonds);

- marketable or tradeable permits are environmental quotas, allowances, or ceilings on pollution levels that, once initially allocated polluters exchange their right to pollute (emissions trading system) or their recycled materials (by means of price intervention); legal liability insurance of polluters for environmental damages (which induce an insurance market) can also be put in the same category;

- Deposit-refund systems, a deposit is paid on potentially polluting products refunded when the product is adequately treated or returned.

Environmental economists support the use of economic incentives as they see them as more efficient. Unlike command-and-control, these instruments orientate pollution reduction actions according to their relative costs. With a tax, pollution reduction takes place first for the part of the pollution which is less costly to reduce, whereas in the case of a uniform standard each polluter has to limit their emissions to the same level, whatever their cost. The cost of achieving pollution abatement of one unit, say a tonne of CO_2, is higher with a uniform standard. Economic instruments also present a dynamic advantage: they allow a greater freedom in selecting abatement method and provide stronger incentives for the development of new pollution control technologies. In short, economic instruments have a clear advantage in terms of their additional effects.

For the last 20 years, national and European environmental legislation have been strengthened with the intention of achieving sustainable development. Article 2 of the Treaty on European Union (TEU) clearly states that one of the community's task is to promote sustainable and non-inflationary growth respecting the environment. Similarly, Article 130R(2) of the TEU develops and reaffirms the concept of integration established in the Single Act, stating precisely that environmental protection requirements must be integrated into the definition and implementation of other Community policies, as a central principle in order to achieve the key objective of sustainable developments. Thus, to achieve this objective the European Union established in 1992 the Fifth Environmental Programme "Towards Sustainability". The basic strategy of the programme is to achieve full integration of environmental and other relevant policies through the active participation of all the main actors by society in a broadening and deepening of the range of instruments for control and behavioural change, including, in particular greater use of market based instruments. Until the Fifth Programme, environmental policy was overwhelmingly a matter of attacking a problem with legislation. Whilst the approach satisfied some, it was not fully effective and there is a recognition of the need to simplify regulations and make them more coherent. A model is the Directive on Integrated Pollution Control which aims to regulate industrial emissions as a whole rather than by individual environmental media.

It will probably take time before this new integrated approach would be fully accepted by the business community. However, acceptable policies and instruments for acquiring, protecting and improving a sustainable environment require full commitment from all parties. In the achievement of this objective a particularly important economic concept is that of Pareto improvement. This suggests that policies are most likely to gain acceptance if they can be designed so that there are no losers, or alternatively so that the gains from the policy are great enough to compensate the losers.

CHAPTER 3

METHODOLOGY

1. INTRODUCTION

From the early stage of this study, the main attempt was to assess corporate strategy and managerial attitudes towards environmental issues. Principally because it appears that it was of interest to combine theoretical discussion and expected consequences with the view of the people directly concerned. First and foremost, an extensive review of published sources on company attitudes and corporate strategy towards environmental issues and environmental legal requirements companies have to conform with have been analysed. Moreover, qualitative and quantitative secondary sources of the ceramics industry have been thoroughly reviewed so as to present the market dynamics of this sector. Finally, primary data on managerial attitudes have been collected in the expectation that the limitations of various approaches will be observed. The following table (Table 6) presents the research plan adopted for this research.

Table 6: Research plan

Sources of information	• Secondary or published sources (Internal sources, government publications, periodicals and books, etc.); • Primary sources
Research approach	• Quantitative
Research instrument	• Questionnaire
Contact method	• Telephone

There are different ways of collecting and analysing empirical evidence and each strategy has its own advantages and disadvantages. Nevertheless, Yin argues (1994, 4):

> *this does not imply that the boundaries between the strategies are always clear and sharp, there are large areas of overlap among them.*

The intent of this chapter is to review the grounds for opting for a quantitative approach and to present in a concise way the research methodology embraced.

1.1 Objectives

The objectives of this chapter are fourfold:

- to briefly review research approaches;
- to present advantages and drawbacks of quantitative and qualitative methods;
- to present the data collection approaches used
- to provide a statistical overview of the companies investigated.

Some background information which was essential for this research have been annexed as follow:

- **Appendix B:** List of British and French ceramics manufacturers
- **Appendix D:** The survey questionnaire (English and French)
- **Appendix E:** Data tabulations

2. RESEARCH APPROACHES

Reflecting the author's background, applied research was the approach used to conduct this study. Applied research has its roots in the experimental method (Hedrick *et al*, 1993), but it uses scientific methodology to develop information aimed at clarifying or confronting an immediate societal problem. Some of the major differences between basic and applied research are highlighted in Table 7 (adapted from Bickman, 1981).

Table 7: Comparison of the purposes of basic and applied research

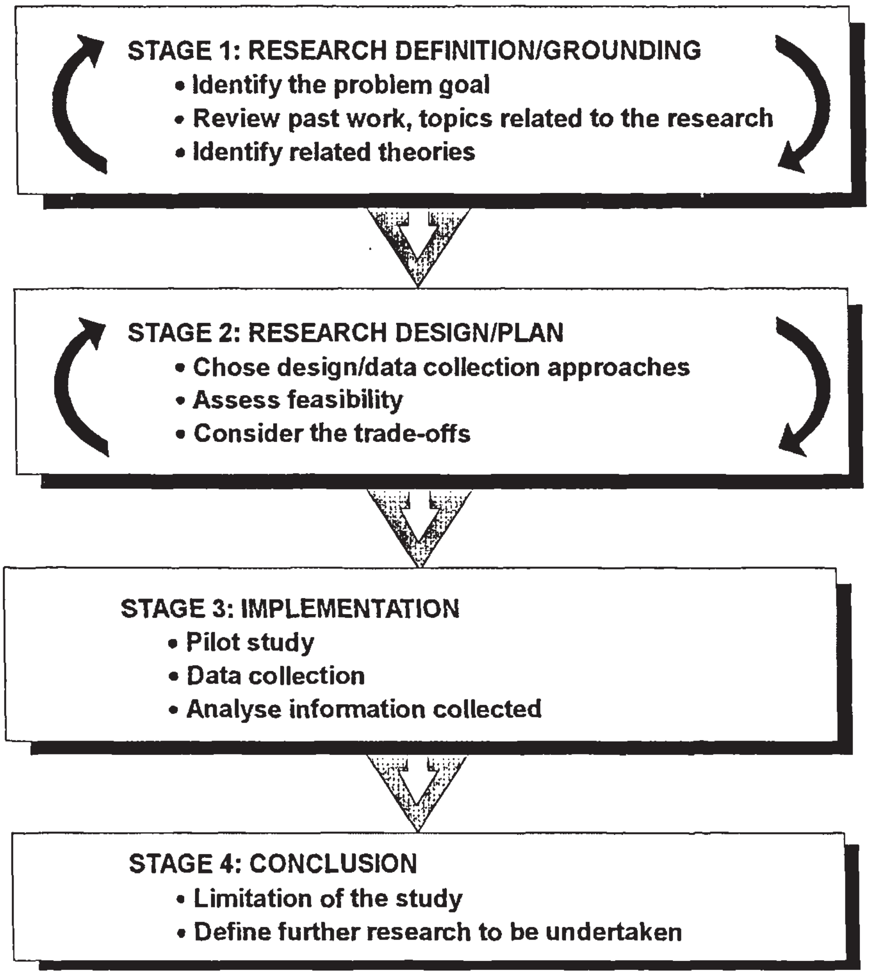
Basic	Applied
Develop universal knowledge	Understand/address problems
Answer single questions	Answer multiple questions
Discover statistically significant relationships or effects	Discover practically significant relationships or effects

However, for Hedrick *et al* basic and applied research have many more commonalities than differences. In applied research both practical and statistical significance criteria are important. Basic and applied research are concerned with determining if a causal relationship exists, but when studying causal relationships, applied researchers tend to study variables that they hope will produce societally significant results, i.e. effects that are of sufficient size to be meaningful (Hedrick *et al*, 1993, 4).

It should not be surprising that the previously described differences in purpose and context result in differences in research approaches. A key difference between basic and applied research is the relative emphasis on internal and external validity. Whereas internal validity (the extent to which a causal relationship can be established soundly) is essential to both types of research, external validity (the extent to which the study results are generalisable) is much more important to applied research (Chen *et al*, 1992).

A research planning model was developed in the early stage of the research with a clear consciousness that this process is an iterative one (Figure 9). Indeed, the development of a research plan is constantly informed by new information that may result in changes to even the earliest working assumptions of the study - the specification of study question.

Figure 9: Framing the research study



adapted from Everston and Green (1985) and Hedrick *et al* (1993)

Leedy (1980, 53) stresses that understanding the nature of the problem which qualifies it to be considered as suitable for research is at the very heart of every research project. Moreover, a clear problem statement must be produced.

> *Problem statement must do better than produce merely a splutter of wordy and meaningless fragments... Each word of the problem should be expressive, sharp, indispensable, definitive.* (Leedy, 1980, 55)

Hence, it is, equally important to delimit precisely the problem area and to present what will and will not be included in the research endeavour.

> *The problem should be as carefully bounded for research activity as a parcel of land is for a real estate transfer.* (Leedy, 1980, 62)

The first stage of research planning aims, therefore, to clarify and refine the research scope in order to ensure that research is planned ethically and accurately. The second stage, the research design, is for Hedrick *et al* a key decision which serves as:

> *...the architectural blueprint of a research project. It ensures that the data collection and analysis activities used to conduct the study are tied adequately to the research questions and that the complete research agenda will be addressed.* (Hedrick et al, 1993, 38)

It provides a clear explanation of the phenomenon under study and controls all possible biases or confounds that could cloud or distort the research findings. As illustrated in Table 8, four types of validity are typically considered when designing applied research.

Table 8: The four types of validity

Construct validity	the extent to which the constructs in the conceptual framework are operationalised successfully (e.g. measured) in the research study
Statistical validity	the extent to which the study has used appropriate design and statistical methods to enable it to detect the effects that it presents
Internal validity	this concept applies to impact (cause-effect) questions and refers to the extent to which causal conclusions can be drawn
External validity	the extent to which it is possible to generalise from the data and context of the research study to broader populations and settings (especially those specified in the statement of the original problem/issue)

adapted from Bickman, 1989; Cook & Campbell, 1979

Concurrently with the design decisions, the researcher is investigating possible data collection approaches. Indeed, a wide variety of data collection instruments exist. However, these instruments fall into two categories: quantitative and qualitative methods. The section below aims to present the advantages and disadvantages of these two methods.

2.1 Quantitative versus Qualitative Methods

Commonly, two distinct methods, quantitative and qualitative, are opposing methodology for conducting evaluation research. Cook *et al* (1979, 7) defined these two methods:

> *By quantitative methods, researchers have come to mean the techniques of randomized experiments, quasi-experiments, paper and pencil "objective" tests, multivariate statistical analyses, sample surveys, and the like. In contrast,*

> *qualitative methods include ethnography, case studies, in-depth interviews, and participant observation.*

Each of these method-types has acquired its own advocates who argue that it is their preferred methods which is the best suited to evaluation. Campbell and Stanley (1966) and Riecken *et al* (1974) are often cited as staunch proponents of quantitative methods. Campbell and Stanley (1966, 2) describe the quantitative experiment as :

> *the only way of establishing a cumulative tradition in which improvements can be introduced without the danger of a faddish discard of old wisdom in favor of inferior novelties.*

Riecken *et al* (1974, 6,12) are only slightly more moderate in their claims about quantitative experiments and no less enthusiastic:

> *Experiments not only lead to clearer causal inferences, but the very process of experimental design helps to clarify the nature of the social problem being studied... When conditions are not problematic or when the creativity and ingenuity of the research designer can resolve difficult problems, then experimentation is the method of choice for obtaining reliable and valid information upon which to plan social programs.*

Among others, Weiss and Rein (1972), and Bryman (1989) are on the side of the debate supporting qualitative methods. Weiss and Rein (1972, 243) suggest several alternative research strategies deriving from the qualitative tradition which they believe:

> *in general to be superior to experimental design as a methodology for evaluating broad-aim programs.*

Bryman (1989, 141) adds:

> *The proximity of the qualitative researcher to organizational phenomena contrasts sharply with the distance between researcher and subject that much quantitative research involves.*

The debate on quantitative and qualitative methods is not only viewed as a disagreement over the relative advantages and disadvantages between method-types but as a fundamental clash between methodological paradigms. Indeed, at the heart of the distinction between the quantitative and qualitative paradigms lies the classic argument in philosophy between the schools of realism and idealism. According to this view, each method-type is associated with a separate and unique paradigmatic perspective and it is these two perspectives which are in conflict. As Rist (1997, 43) states the case:

> *Ultimately, the issue is not research strategies, per se. Rather, the adherence to one paradigm as opposed to another predisposes one to view the world and the events within it in profoundly differing ways.*

As reproduced in Table 9, Cook *et al* (1979, 10) outline the prominent attributes of each paradigm. In brief, the quantitative paradigm is said to have a positivistic, hypothetico-deductive, particularistic, objective, outcome-oriented, and natural science world view. Quantitative thinking derives from an empiricist tradition established by such authorities as Comte, Mill, Durkheim, Newton, and Lockes (Smith, 1983). In contrast, the qualitative paradigm is said to subscribe to a phenomenological, inductive, holistic, subjective, process-oriented, and social anthropological world view. It began as a countermovement to the positivist tradition in the late 19th century through such writers as Dilthey, Weber, and Kant (Smith, 1983).

Table 9: Attributes of the quantitative and qualitative paradigms

Quantitative Paradigm	Qualitative Paradigm
Advocates the use of quantitative methods	Advocates the use of qualitative methods
Logical-positivism; "seeks the facts or cause of social phenomena with little regard for the subjective states of individuals" (Cook & Campbell, 1979, 7)	Phenomenologism and verstehen; "concerned with understanding human behaviour from the actor's own frame of reference" (Bogdan & Taylor, 1975, 2)
Obtrusive and controlled measurement	Naturalistic and uncontrolled observation
Objective	Subjective
Removed from the data; the "outsider" perspective	Close to the data; the "insider" perspective
Ungrounded, verification-oriented, confirmatory, reductionist, inferential, and hypothetico-deductive	Grounded, discovery-oriented, exploratory, expansionist, descriptive, and inductive
Outcome-oriented	Process-oriented
Reliable; "hard" and replicable data	Valid; "real", "rich", and "deep" data
Generalizable; multiple case studies	Ungeneralizable; single case studies
Particularistic	Holistic
Assumes a stable reality	Assumes a dynamic reality

Source: adapted from Cook *et al* (1979, 10)

However, Glasser and Strauss (1967, 17-18) generally acknowledged to have written the 'Bible' on grounded theory argue:

> *There is no fundamental clash between the purposes and capacities of qualitative and quantitative methods or data. ... each form of data is useful for both verification and generation of theory, whatever the primacy of emphasis. ...qualitative methods need not only be used to discover which questions are interesting to ask and quantitative procedures need not only be used to answer them. Rather each procedure can serve each function.*

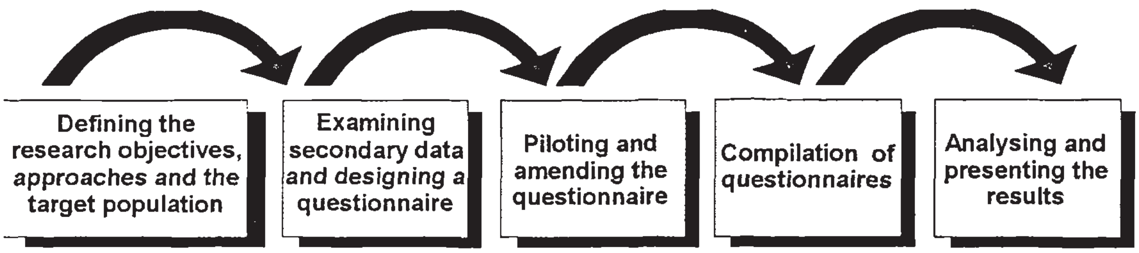
On the basis of the above discussion, quantitative method appeared to be the best suited approach to evaluation environmental awareness within the ceramics sector. Indeed, the main objective of this research was to take a snapshot of this sector to draw ultimately conclusions on managerial attitudes towards environmental issues. The design stage of the questionnaire was informed by a qualitative approach in order to determine which questions were pertinent to survey. The following section discusses in more details the approach embraced.

3. METHODOLOGICAL APPROACH ADOPTED

The aim of this research was to assess corporate strategy and environmental awareness within the ceramics sector, through the collection of primary data elicited by a telephone survey. For the purpose of this study it was necessary to collect a variety of behavioural, interactional, economic and political data. These data were collected through personal interviews, field research and a telephone questionnaire. The personal interviews and field research were of benefit to the design of the questionnaire. Indeed as suggested by Sieber (1973) the field methods can serve as a background to a survey by providing familiarity with the setting being surveyed, by developing rapport with those being surveyed, and by performing exploratory work that is necessary for pre-testing a survey. Field observation can also be used to illustrate findings and to clarify ambiguous or provocative responses.

The quantitative methodological approach adopted in this research involves five steps. These are illustrated in Figure 10.

Figure 10: The research process



A survey design provides a quantitative or numeric description of some fraction of the population -the sample- through the data collection process of asking questions of people (Fowler, 1988). This data collection in turn, enables a researcher to generalise the findings from a sample of responses to a population (Creswell, 1994).

Several handbooks discuss how to conduct surveys (Frey *et al*, 1995; Creswell, 1994; Babbie, 1990; Fowler, 1988; Fink & Kosecoff, 1985; Cook *et al*, 1979; Dillman, 1978) and generally agree on five typical components to examine. The discussion below follows these five steps.

3.1 Research objectives, approaches and target population

As noted by Beaumont and Stray (1984, 13) it is fundamental to carefully define the research objectives:

> *... vague notions of the "problem" are likely to result in data being collected which is not salient. Actually sitting down and considering the problem may, in a number of instances, be all that is required, although generally it has to be viewed as the necessary first step in an orderly investigation.*

As an old adage says, "A problem well defined is half solved". Concurrently, it is essential to develop the most efficient plan for gathering the required information and devising a target population. The target population consists of the institutions, employees, problems, and systems to which or whom the survey's findings are to be applied or generalised.

In the present context, the primary objective was to identify barriers to and opportunities for the improvement of environmental performance in the ceramics industry and to reveal whether environmental issues are perceived as a hindrance or a stimulus by the management of the companies in this sector. The target population has been defined as the British and French ceramics manufacturers. This population has in turn been divided into two mutually exclusive groups or "strata" - sectors and sizes:

By sectors	By sizes
• Bricks;	• Micro companies (1-49 employees);
• Industrial & Refractory(including advanced ceramics);	• Small companies (50-99 employees);
• Sanitaryware & Tiles;	• Medium companies (100-250 employees);
• Tableware.	• Large companies (251 + employees).

A sample frame was then taken with a view to making general statements about the whole population. Selkirk (1978, 17) stressed that:

> *... proportionate sampling should be employed when the researcher is interested in the population as a whole, and in obtaining parameters for it, while equal group size sampling should be employed when one is interested in highlighting the differences between groups of subjects.*

In both the UK and France, to characterise and break down the whole ceramics industry population by sub-sectors proved to be more complex than anticipated as it often emerged that the sources of information were rarely identically defined and therefore did not compare. For instance, some sources characterise the whole industry by the number of business units or sites and not the individual company and moreover the vast majority of sources exclusively account for companies with over 25 employees. In order to be consistent, it was decided to base the sample on the structure of the ceramics companies employing over 25 employees as illustrated in Table 10. For more information on market size, company numbers and sizes referral should be made to chapter 3, section 3.2.1 (the UK and French ceramics sector outlook).

Table 10 : Number of UK and French ceramics industry with over 25 employees

	Micro (25-49)	Small (50-99)	Medium (100-250)	Large (+251)	Total	UK		France
Bricks	55	14	9	14	**92**	**(49**	**+**	**43)**
Industrial & Refractory	36	8	27	16	**87**	**(47**	**+**	**40)**
Sanitaryware & Tiles	8	12	12	16	**48**	**(12**	**+**	**36)**
Tableware	48	33	22	30	**133**	**(40**	**+**	**93)**
Total	**147**	**67**	**70**	**76**	**360**	**(148**	**+**	**212)**

Adapted from: BCC's estimates (1993) of companies with over 25 employees, SESSI (1995), DAFSA (1995)

Based on the above population, sample groups of equal size were selected (100 UK companies and 100 French companies) consistent with the objective of the study which was to highlight the differences between groups of subjects between and within each country (Table 11). Furthermore, the micro segment was expanded in order to take into account companies employing fewer than 25 employees which represent a significant number of businesses in both countries. However, this decision has led to an under-representation of the micro segment in terms of the number of companies compared to the whole industry whilst the other sectors were over-represented. This deviation from the whole population (number of companies) should however not affect the validity of the sample as the number of companies in each size band is large enough to make significant conclusions which should not differ from the "true" population result. Indeed, 95% of the total number of employees in the UK and 85% in France were in 1994 working for a company with over 25 employees.

Table 11 : Sampling frame for survey

	Micro (1-49)	Small (50-99)	Medium (100-250)	Large (+251)	Total
Bricks	15	4	3	4	**26**
Industrial & Refractory	10	2	9	5	**26**
Sanitaryware & Tiles	2	3	3	4	**12**
Tableware	13	9	6	8	**36**
Total	**40**	**18**	**21**	**21**	**100**

Practically, a database regrouping all ceramics manufacturers, the population, in both countries was developed. Data recorded included company name, address, telephone, facsimile, directors' names, turnover, holding company, product groups, number of employees, and nature of business. This database was set-up on Microsoft Access format in order to be able to:

- store in only one place the data so as to make it easier to find, analyse, handle and maintain;
- draw the sampling frame at random for each group (sector and size);
- organise by criteria (company name, turnover, number of employees, sector, etc.);
- link automatically the information collected on each industry with its source questionnaire and therefore to be able to check the accuracy of this information i.e. the sector or size, and to modify when required.

The information collected in this database is from a variety of sources, mainly trade association directories, industry directories such as Kompass, European directories; it covers approximately 80% of the UK and French ceramics industry with over 5 employees. Appendix B lists the full details of the 798 British and French ceramics manufacturers included in this database.

3.2 From secondary data study to questionnaire design

Secondary data consists of information that is publicly available, including internal sources (company profit-and-loss accounts, balance sheets, prior research reports), and external sources (government publications, on-line data banks, periodicals and books, and commercial services). Secondary data for Kotler (1991, 105):

> *provide a starting point for research and offer the advantages of lower cost and quicker availability.*

The research of secondary data and the literature review contributed to the identification of important areas requiring more detailed investigation and revealed specific and pertinent questions. Those questions, defined as open-ended, were used in the exploratory stage of the study as the objective was to search for an insight into how people think rather than in measuring how many people think in a certain way. Several face to face and qualitative interviews and discussions with key players were conducted e.g. government representatives from the Ministry of the Environment, Department of Trade and Industry, members of the European Commission, company executives, and trade industry representatives, in order to understand the issues facing this sector and subsequently to develop a pertinent and appropriate questionnaire. As stressed by Youngman (1978, 3), it is important to take a global approach at the very beginning:

> *... assuming that analytical considerations are irrelevant at the initial stage. Such an approach will almost inevitably result in the introduction of difficult, and even insurmountable, problems during analysis. The solution lies in accepting that the initial and concluding stages of a survey are not independent; the questionnaire structure must include all the facilities deemed to be necessary for a successful analysis.*

In line with this argument, in the early stages of the questionnaire design extra care was taken with the structure of the questions. The aim was to opt for specific questions or closed-end questions where the respondents select a response from a pre-set list of alternatives. Foddy (1993, 8) argues that respondents are more likely to endorse an answer if it has been explicitly listed for them than if it has not. Furthermore, closed-end questions are essential for the study of large surveys as the information collected can be coded and processed on a computer. In this case the sample frame was 200 companies and could therefore be considered as a large survey. Furthermore, in order to avoid low or slow response rates (Frey *et al*, 1995) it was decided to contact people through a telephone interview. The questionnaire was, therefore designed to this end.

3.3 Piloting and modifying the questionnaire

Prior to the main telephone interview a pilot study was undertaken during the winter of 1996, involving 32 companies (16 British and 16 French) with a company selected from each pre-established sub-sector as indicated in Table 12.

Table 12 : Pilot survey

	Micro (1-49)	Small (50-99)	Medium (100-250)	Large (+251)	Total
Bricks	1	1	1	1	**4**
Industrial & Refractory	1	1	1	1	**4**
Sanitaryware & Tiles	1	1	1	1	**4**
Tableware	1	1	1	1	**4**
Total	**4**	**4**	**4**	**4**	**16**

The requirement for a pilot study was inspired by three considerations. The first, was the need to test the questionnaire length, and the validity and relevance of the questions. The second, was the need to gain experience of the interview process. Finally, there was the need to evaluate the response systems, and the coding and analytical procedures established.

Frey *et al* (1995) argue that a lengthy interview by telephone is not perceived as a problem.

> *Interviews of up to 50 minutes in length can be successfully conducted by telephone.* (Frey *et al*, 1995, 37)

The pilot interviews, however, highlighted that people were not prepared to spare more than 30 minutes for questionnaire completion and the level of respondents was essential to the success of the interview. It was found that after a certain time or number of questions, both interviewer and respondent fatigue affects the data quality. Furthermore, it was observed that French managers were more prepared to conduct an interview in the evening (often after 6.00 p.m.) compared to their British counterparts who seemed to be more available in the morning. Finally, on several occasions, interviewees requested that a questionnaire be faxed, in order to allow preparation, and a mutually convenient time was then scheduled for undertaking the telephone interview.

The principal benefit noticed during this pilot study by telephone was the key importance of the "introductory statement", which aimed in a very little time to convince the respondent to participate.

The introductory statement describes the survey and attempts to enlist participant cooperation. (Frey *et al*, 1995, 43)

As expected, the main advantage of conducting interviews by telephone was the possibility of being pro-active and the ability to clarify questions if not understood, as well as the high response rate. The pilot procedure demonstrated its usefulness by highlighting the need to modify and clarify several of the questions so as to avoid as far as possible 'socially desirable responses' and therefore to minimise the potential problems of closed questions which may limit individuals comments. Despite the design of this questionnaire, it proved to be a more complex and time-consuming process than originally envisaged, this was due principally to the requirement for revision and fine tuning which was compounded by virtue of the amount of time required to translate it into both languages.

3.4 Implementation of the survey

The French and English versions of the questionnaire used in the survey are presented in Appendix D.

The main survey was undertaken during the spring and summer of 1996 and consisted of an intensive programme of telephone interviews over a limited period of time. On telephoning a target company, the call was transferred to the person responsible for environmental issues or to senior executives. The respondent was then asked if this was a convenient time to proceed with a questionnaire interview. Alternatively, the respondent was asked to provide an appropriate call-back time when the interview could be undertaken. If the appropriate respondent was not available (after four attempts), the company was abandoned.

Interview responses were classified, coded and entered onto a spreadsheet as the interview programme progressed. This ensured that data were entered while the interview were still fresh in the memory, thus minimising the possibility of error and maximising the benefit gained from any qualitative information that had been provided; for instance, names of people to contact, articles or books relevant to this study and also appointment to visit the production site.

3.5 Analysing and presenting the results

The final step was to extract relevant information from the data and to present them in a graphical form. The process of data display involves the organisation, compression and assembly of information to permit accessibility to the data and aid conclusion drawing (Miles and Huberman,1994). As such it is not separate from analysis but part of analysis, since the designing of any data display is an analytic activity. There exists a variety of types of data display that may be adopted, including text, matrices, graphs, and charts. Miles and Huberman (1994, 11) argue that:

> *looking at displays helps us to understand what is happening... [and thus] better displays are a major avenue to valid an analysis.*

The adoption of graphs rather than the use of "standard" formats or procedures throughout has proved invaluable to this research project. Indeed, data presentation in graphical form revealed immediate similarities and differences of attitudes between British and French manufacturers.

Finally, conclusions have to be drawn in the latter stages of the research process despite early assumptions; as Miles and Huberman (1994, 11) argue:

> *The competent researcher holds these conclusions lightly, maintaining openness and scepticism.*

As the data analysis proceeds, the researcher seeks to verify these early conclusions in order that they become increasingly explicit and grounded in the data. This is indeed the manner in which the process of conclusion drawing and verification proceeded in this research project, beginning prior to the stage of data collection.

4. OVERVIEW OF THE COMPANIES SURVEYED

The analyses of responses has been undertaken, when statistically relevant, both in relation to the four sub-sectors identified and company size.

4.1 Overall sample

The actual programme of valid interviews carried out totalled 185 (94 for the UK and 91 for France) compared to a target of 100 for each country. This must be regarded as a satisfactory outcome, since in many cases the sample represents a relatively high proportion of the relevant population, particularly for the medium and large band which represents half of the existing companies of this segment. The deviations with the sampling frame were not expected to influence the statistical significance of the conclusions to a great extent. Furthermore, the size of each sample is very similar, 94 against 91, which enabled non bias conclusions to be drawn. The breakdown of the valid interviews carried out is given in Table 13 for the UK and in Table 14 for France.

Table 13 : Interviews carried out in the UK

	Micro (1-49)	**Small (50-99)**	**Medium (100-250)**	**Large (+251)**	**Total**
Bricks	11	3	2	3	**19**
Industrial & Refractory	13	2	9	6	**30**
Sanitaryware & Tiles	2	3	2	4	**11**
Tableware	11	9	5	9	**34**
Total	**37**	**17**	**18**	**22**	**94**

Table 14 : Interviews carried out in France

	Micro (1-49)	**Small (50-99)**	**Medium (100-250)**	**Large (+251)**	**Total**
Bricks	10	2	2	2	**16**
Industrial & Refractory	12	3	10	4	**29**
Sanitaryware & Tiles	2	2	2	2	**8**
Tableware	16	8	7	7	**38**
Total	**40**	**15**	**21**	**15**	**91**

4.1.1 Breakdown by sector

The greatest number of companies interviewed, 39% (see Figure 11), were in the Tableware sector (34 UK companies and 38 French companies = 72 companies), with the smallest number, 10%, being in the Sanitaryware & Tiles sector (11 UK and 8 French = 19). Of the remaining companies, 32% were located in the Industrial & Refractory sectors (30 UK and 29 French = 59) and 19% in the Brick sector (19 UK and 16 French = 35).

For the UK (Figure 12), it is in the Brick sector (19 companies interviewed) that small and micro companies are the most represented, accounting for approximately 75% of the total surveyed population. Medium companies represent 30% of the Industrial & Refractory sector sample (30 companies interviewed) and micro companies account for 43% of this sector. In the Sanitaryware & Tiles sector (11 companies interviewed), large companies account for 36% of the total surveyed companies.

In the Tableware sector (34 companies interviewed) the balance of micro, small and large companies is approximately the same each making up about 25% of the sample.

For France (Figure 13), 75% of the Brick sector (16 companies interviewed) is represented by micro or small companies. The micro companies also account for 41% of the Industrial & Refractory sector (29 companies interviewed) while medium sized companies account for approximately 35% in this sector. The company sizes are equally represented in the Sanitaryware & Tiles sector (8 companies interviewed). Finally, 40% of the Tableware sector (38 companies interviewed) are micro companies.

Figure 11 : Companies interviewed in the UK and France vs. sector

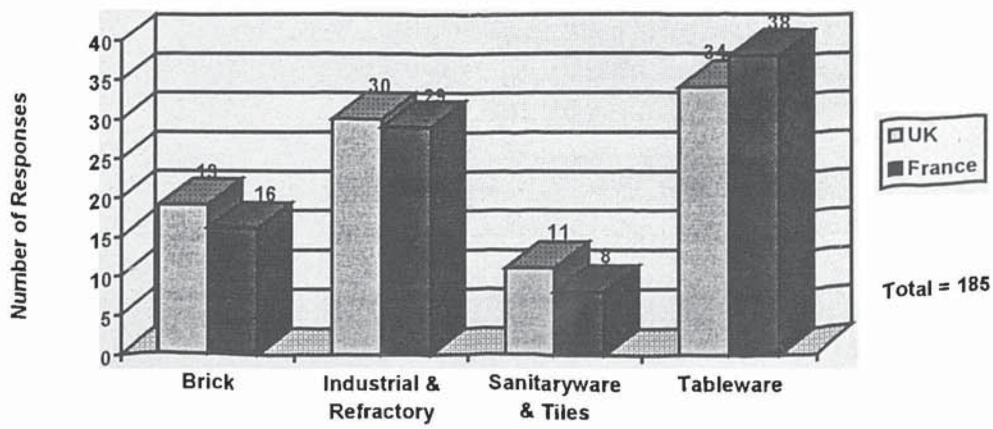


Figure 12 (UK) : Company sizes vs. sector

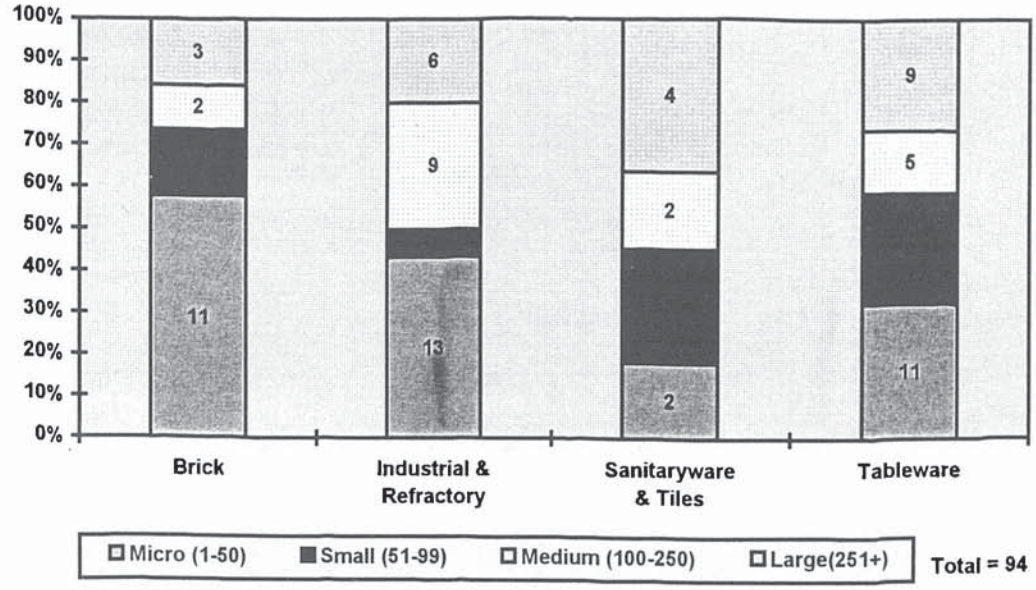
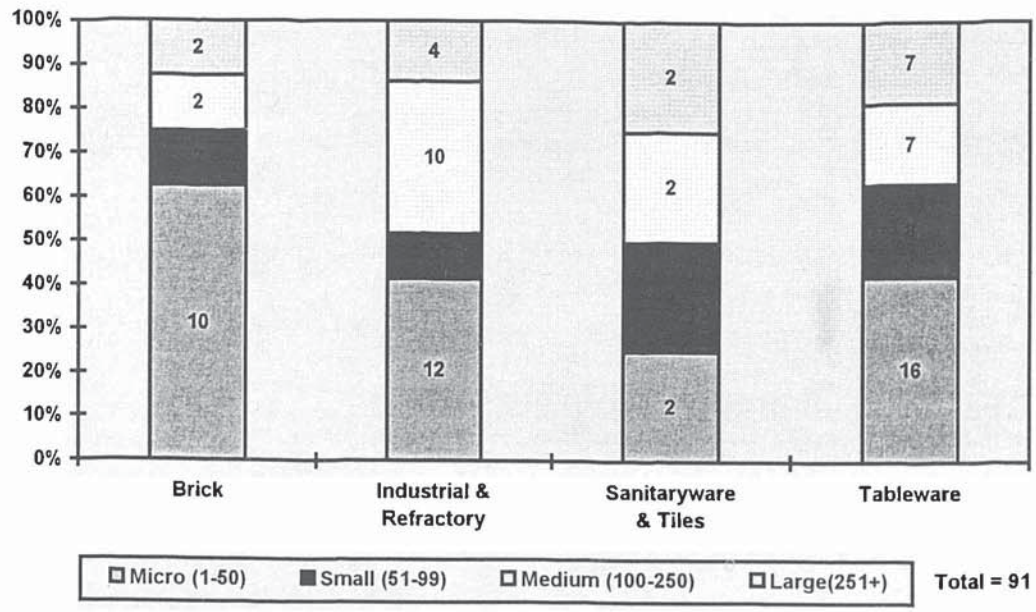


Figure 13 (France) : Company sizes vs. sector



4.1.2 Breakdown by company size

Approximately, 42% of the respondents were micro-sized companies, 17% small companies, 21% medium-sized companies and 20% large companies (Figure 14). This reflects the very limited population of larger companies in comparison with the relatively large number of micro and small companies.

For the UK (Figure 15), of the micro companies (37 companies interviewed in total) 65% are Brick and Industrial & Refractory manufacturers, while over 50% of the small companies (17 companies interviewed) are represented by Tableware manufacturers. The Industrial & Refractory sector accounts for 50% of the medium-sized company segment (18 companies interviewed). Finally, the tableware sector represents around 40% of the large company segment (22 companies interviewed).

For France (Figure 16), the micro company segment is the largest with 40 companies interviewed, with 16 (40%) of these from the tableware sector. Within the small company segment (15 companies interviewed) tableware accounts for 50%. In the second largest segment, medium-sized companies (21 companies interviewed) 48% is accounted for by the Industrial & Refractory sectors. Finally, 47% of the large-sized companies (15 companies interviewed) are tableware manufacturers.

Figure 14 : Companies interviewed in the UK and France vs. size

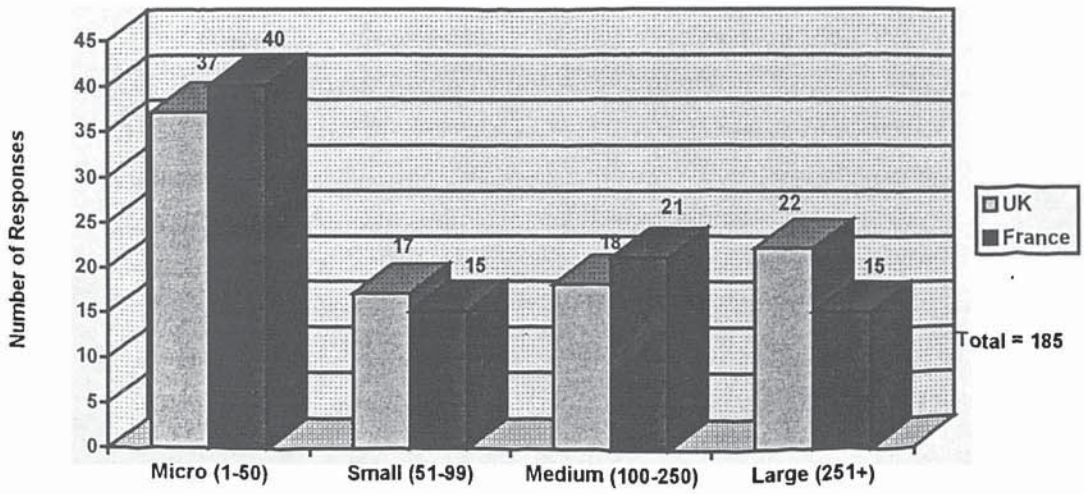


Figure 15 (UK) : Company sectors vs. size

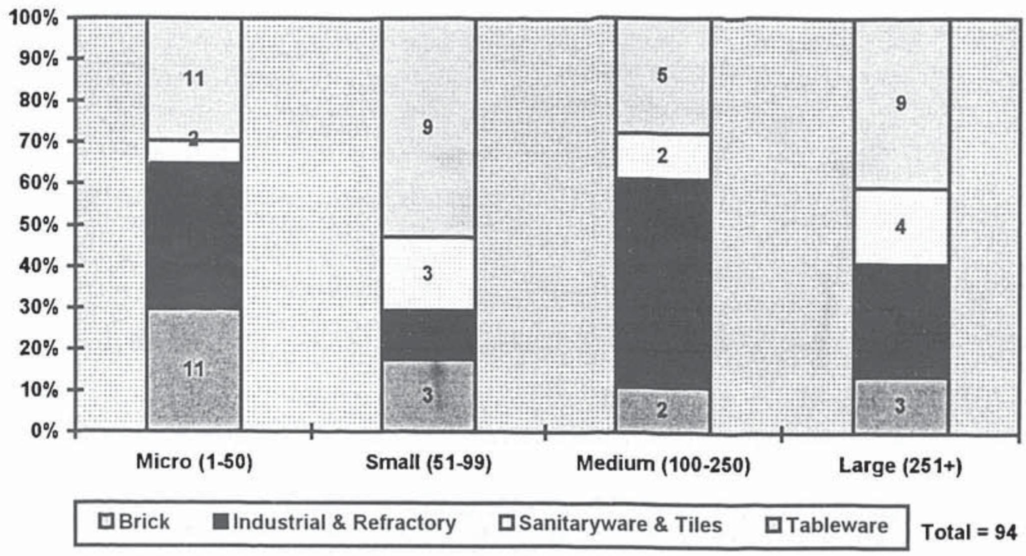
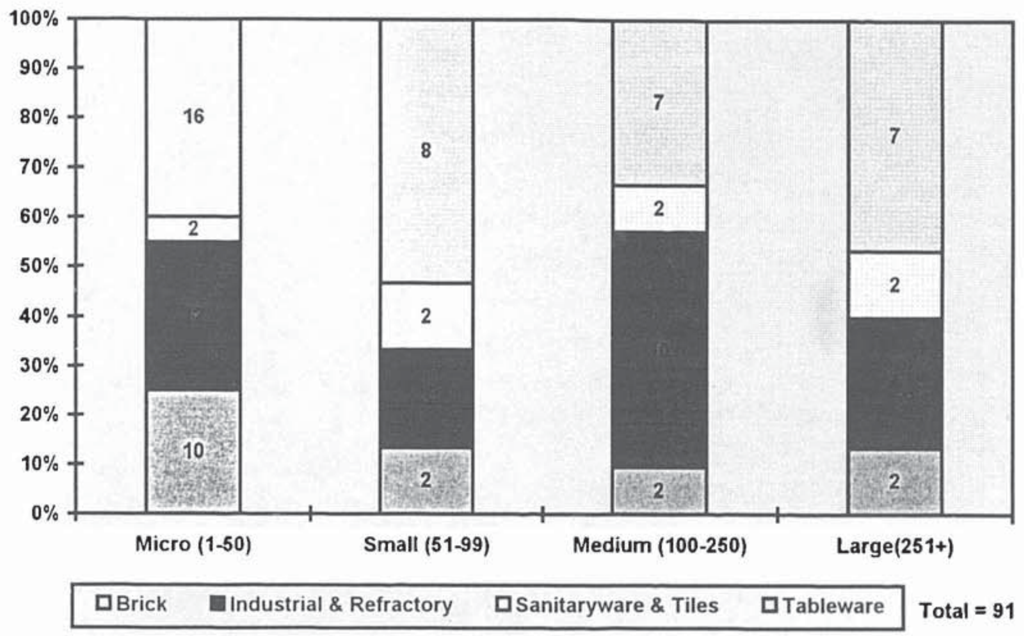


Figure 16 (France) : Company sectors vs. size



4.2 Position of respondent and responsibilities

4.2.1 Position of respondent (Question 1)

The positions of respondents were classified according to whether they were Senior manager, Line or Operational manager or Technical staff.

4.2.1.1 Breakdown by sector

For the UK, the proportion of senior managers responding was greatest in the Brick sector and the Tableware sector, approximately 50% each. The number of line/operational managers responding was high in the Industrial & Refractory sectors accounting for 70% of the respondents in this sample. Line/operational managers also accounted for 54% of respondents in the Sanitaryware & Tiles sector, although this was a small sample (11 companies interviewed). Technical managers accounted for the smallest proportion of respondents by a considerable margin (did not exceed 10%).

For France, senior managers responding were highly represented in the Brick sector (approximately 75%) compared to none in the Sanitaryware & Tiles sector. Whilst, the number of line/operational managers responding was extremely important in the Sanitaryware & Tiles sector (88%) despite a small sample (8 companies) and significant in the Industrial & Refractory sectors (55%). Finally, as for the UK, the number of technical managers responding was not very significant.

The positions of respondents between the two countries, within sectors or sizes, are similar and should therefore not affect the internal validity of the sample. However, within a specific country the differences of positions between sectors or sizes might explicates variances in judgement and opinion regarding environmental issues affecting the industry.

4.2.1.2 Breakdown by company size

An analysis of the positions of respondents by company size, reveals the underlying reason behind these differences. There was a significant inverse correlation between company size and the proportion of senior managers responding which declined from around 50% in micro and small companies to just over 20 % in medium and large companies. This is mainly due to the fact that in micro or small companies the owner/managing director is not only responsible for a wider range of tasks, but is also more approachable and more likely to respond to a survey in person. Furthermore, in large companies there will inevitably be a greater degree of specialisation .

4.2.2 Role and financial responsibilities (Questions 2 and 3)

The areas of prime decision-making responsibilities were ranked in terms of the percentage of positive responses from respondents (Figure 17 for the UK and Figure 18 for France). In the cases where environmental policy or action was not identified as a primary responsibility, the interviewer asked the respondent whether he/she had sufficient responsibility in this area to justify continuing with the interview. If the respondent did not meet this criterion the interview was terminated at this point and did not form part of the valid sample. In such cases, the interviewer then asked to be transferred to a person who was involved in environmental policy or action.

For both the UK and France approximately half the respondents also had primary responsibility for technical/production/process areas. Surprisingly, for the UK and France respectively, only 22% and 27% of the respondents were responsible for energy policy or action, despite the fact that this may be regarded as one aspect of environmental policy.

Figure 17 (Q2-UK) : Prime role within the company

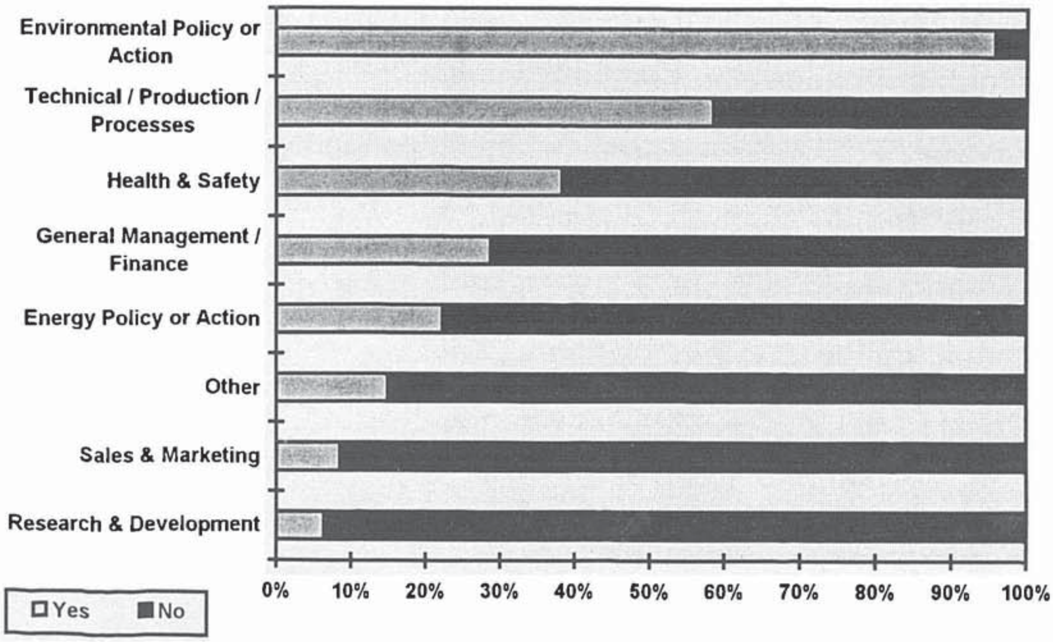
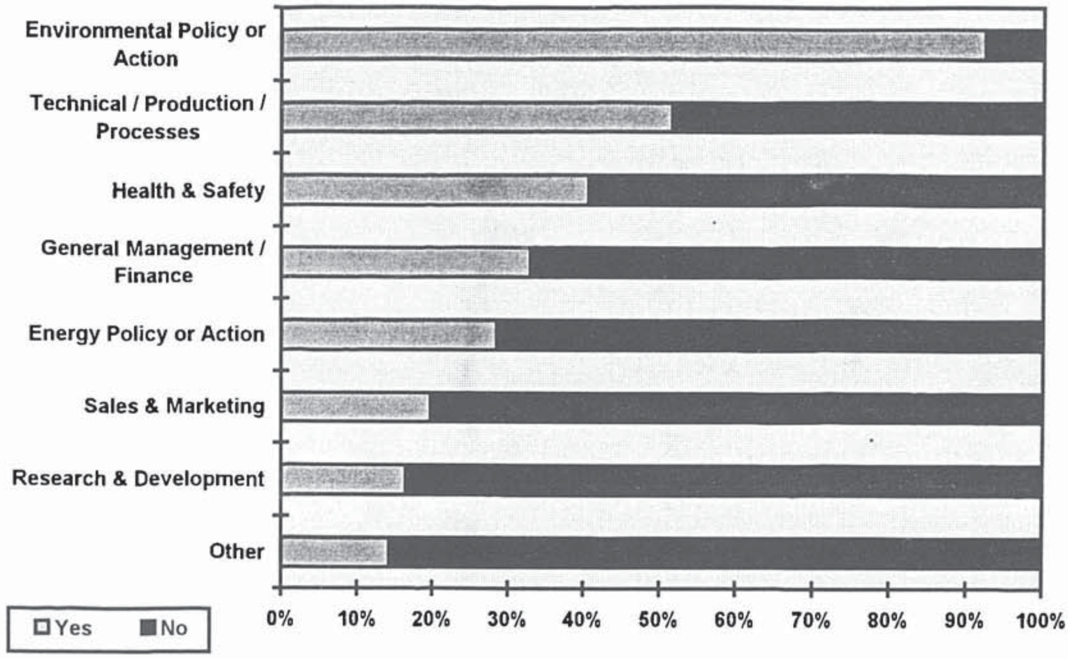


Figure 18 (Q2-France) : Prime role within the company



In answer to the question "do you have any financial responsibility", 72% of the UK respondents were found to be involved in making investment decisions and 70% for France. Among the senior managers interviewed, 100% in both countries had the signing powers for environmental spending, against 60% for line/operational managers and no one for technical staff.

5. CRITICAL ANALYSIS

Although the number of companies interviewed was lower than expected (185 compared to a target of 200), the number of companies in each size band was large enough to make significant and non biased conclusions. Size of company was also reflected in the position of the respondent, with smaller companies more likely to be represented by a senior manager and large companies more likely to be represented by a line/operational or technical manager. Indeed, in micro or small companies the owner/managing directors is more approachable and more likely to respond to a survey in person while in large companies the degree of specialisation is inevitably greater. Company size and the position/responsibilities of respondents are clearly important factors.

While the positions of respondents between the two countries, for sectors or sizes, are similar and should therefore not affect the internal validity of the sample. the differences of positions within the same country, between sectors or sizes segments, might have influenced the results and explicate variances in judgement and opinion regarding environmental issues affecting this particular industry.

CHAPTER 4

INDUSTRY PROFILE AND MARKET CHARACTERISTICS

1. INTRODUCTION

Ceramic products (Table 16, over-page) are used by a multitude of industrial sectors, both high tech industries such as the electrical and electronics industries (insulators), aerospace industries (space shuttle covering), and medical industries (bioactive bone implant), and by more traditional industries, notably the building and construction industries (tiles, sanitary-ware, bricks), domestic and leisure industries (tableware, hotel ware, ornamental ware, etc.), and metallurgy (refractories). However, despite the growth potential of advanced ceramic products, the traditional products still account for 80% of the world-wide turnover. According to the NACE code(NACE 241 and 248) the principal products covered under this heading are tableware and ornamental-ware, sanitary-ware, floor and wall tiles (glazed and unglazed), refractories, bricks, industrial and advanced ceramics.

Undoubtedly, the main characteristic of this industry is the broad range of technologies and companies encountered. It is, therefore important to position each sub-sectors in relation to the evolutionary path of the market. As illustrated in the following table (Table 15) most of the ceramics products are positioned on a mature or decline market. Thus, it is almost certain that the market for the Industrial & Refractory, tableware, tiles and bricks industry will grow steadily and that these sectors will fierce stronger and tougher competition which will led them to rationalise more their production in order to preserve their market share. Companies which have already modernised and restructured their production and are large enough to sell international wide should benefit of the potential demand for traditional goods of the new developed countries.

Table 15: Ceramics industry market positioning

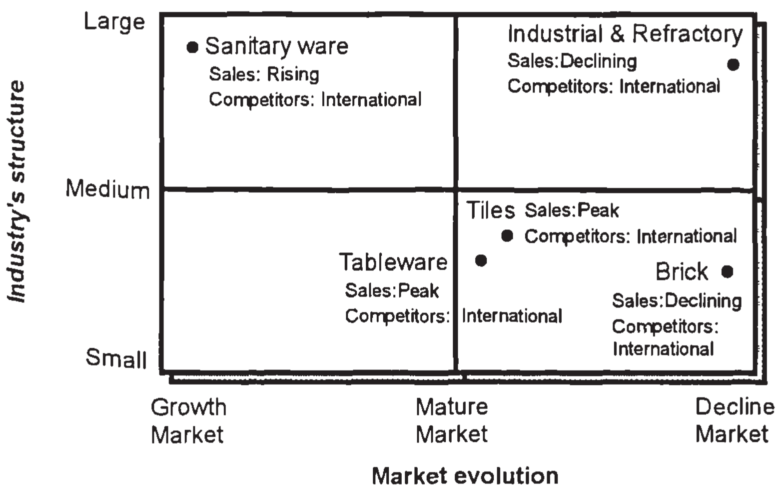


Table 16: A taxonomy of ceramic products

Characteristics		Use
	Terracotta products	
• Raw materials:	marl and clay	• Roofing tiles and Paving tiles
• Firing:	900/1100 °C	• Bricks
• Products:	porous	• Flue, downpipe, draining pipe
• Colours:	brown-red	• Horticultural, culinary and ornamental potteries
	Earthenware	
• Raw materials:	*ball clay, china clay, kaolin quartz*	• Tableware products • Ornamental goods
• Firing:	*950/1150 °C*	• Wall tiles
• Products:	*porous but always glazed*	
• Colours:	*off-white*	
	Stoneware	
• Raw materials:	*ball clay, china clay, kaolin feldspathic minerals, flint or other silica minerals*	• Wall and floor tiles • Sanitary products • Functional tableware goods, ornamental and construction goods
• Firing:	1100/1300 °C	
• Products:	non porous and vitrified	
• Colours:	grey, buff, etc.	
	Porcelain, or china	
• Raw materials:	china clay, kaolin, feldspar, quartz, bone ash	• High quality tableware goods • Ornamental goods
• Firing:	900/1400 °C	• Dental porcelain
• Products:	*hard porcelain and vitreous*	• Electrical goods (insulators)
• Colours:	*Blue-ish white, translucent*	• Sparking plug • Sanitary goods (Vitreous)
	Refractory products	
• Raw materials:	refractory raw materials with: alumina, silica, dolomia, magnesia, zirconia, carbon 1250/2000 °C	• Used in all industries requiring thermal equipment: steel industry, glass and ceramics, cement, lime, petrochemistry, chemistry, energy production, incineration, heating.
• Firing:	*heatproof*	
• Products:		
	Industrial and advanced ceramics	
• Raw materials:	high purity synthetic products: oxide, carbide, nitride, boride, sulphide, etc.	• Electronic & Electrical: semiconductor, magnetic • Aeronautics & Space: brakes, exhaust nozzle, heat shield
• Firing:	up to 2600 °C	
• Products:	high performances	• Automotive: catalytic exhaust • Mechanical: cut tools, abrasive • Biomedical: implant, prosthesis • Optical, nuclear, etc.

Adapted from Industrie Céramique, N. 872 (1992) and Rado (1988)

This chapter aims to provide an in-depth quantitative and qualitative representation of the Ceramics market world-wide, at the European level and more specifically in the UK and France. The overleaf table (Table 17) presents a market-oriented snap shot of the ceramics industry attributes and reviews the competitive advantage of the British and French industry.

1.1 Objectives

Further objectives are:

- to present the market dynamics of the industry sub-sectors such as recent performance, level of competition, international perspectives, and future market prospects for the sub-sectors;

- to set the UK and French ceramics industry back in the international context;

- to undertake a comparison of the UK and French ceramics industry sub-sectors in relation to broader societal forces that affect a company (i.e. demographic, economic, natural, technological, political, and cultural macro-environment forces);

- to review the strengths and weaknesses of the UK and French ceramics industries;

- to assess the UK and French managerial opinions on the key issues affecting the profitability of the ceramics industry.

Table 17: Ceramics industry characteristics

SECTOR	MARKET DEMAND	COMPETITION	MARKET STATUS		COMPETITIVE ADVANTAGE	MARKET OPPORTUNITIES & THREATS
			UK	FRANCE		
Tableware and Ornamental ware	Hotels & catering industry (restaurants, canteens, hospitals, etc.) and private individual buyers	• International • Price • Quality	Large number of small producers and few large companies	Large number of small firms and very few large companies	Very good image among the public for high quality and luxurious products.	Shrinkage of the luxury market in favour of products at much lower prices from low paid countries.
Sanitary-ware	Building and construction mainly for maintenance and renovation	• International • Innovation • Quality	Few and highly concentrated companies	Few and highly concentrated companies	Large international groups which could financially support R&D and advertising campaign.	Niche market which should continue to prosper due to a persistent demand for more furnished "bathroom".
Tiles	Building and construction mainly for maintenance and renovation	• International • Quantity • Quality	Few and relatively small companies	Relatively many companies but small	Production of small batches, complex product options and strict quality standards.	Similar positioning for Italy and Spain with lower production cost due to larger and more automated production plant.
Bricks	Building and construction	• Local • Domestic • Price • Quality	Many small medium-sized companies	Very few companies	The high volume and low value of a brick limits the competition at the local/national level.	Decline in the market demand of low quality bricks due to the increasing competition of concrete products.
Industrial and Refractory	Industries requiring high temperature process as metals, glass, steel, cement, ceramics, etc.	• International • Quality • Price	Few and large companies	Highly concentrated	Creation of large companies which have placed the emphasis on productivity and quality.	Refractories industry depends essentially on the steels industry which is chronically in decline. since the 70s

2. *INDUSTRY PROFILE*

This section examines more thoroughly the market environment for ceramic products by considering two distinct aspects; the key market drivers (which will influence the rate of market growth or decline), and recent market performance (on a world-wide and European scale).

2.1 Ceramics market stimuli

Supply and Demand are the key determinants of a market. Demand in the ceramics market is affected by a number of factors; some being common to any industry, i.e. macro-economic influences, others being more specific to this sector, such as the fall in the number of weddings which has largely contributed to the decrease in tableware production (Gay, 1992, 15). In order to gain a clear picture of the market it is equally important to consider factors influencing the supply side, in particular, the degree of concentration and the entry/exit barriers which influence this market.

2.1.1 The demand side

The building and construction industry is by far the greatest influence on demand for ceramic wall tiles, floor tiles and sanitary-ware (Panorama, 1995). Demand for these products ranks from private dwellings to public buildings and industrial structures. Over the past few years, the maintenance and renovation market for tiles and sanitary ware has become the principle driving force of this market. Numerous companies have successfully penetrated this market and individual consumers are able to locate such products in DIY stores. Fashion trends also constitute a very important element in product replacement.

The demand for tableware and ornamental ware has been substantially modified over the last 20 years and is nowadays more fragmented (Cicorella, 1996). Two sub-sectors are identifiable, private individual buyers and professional buyers, i.e. hotels, restaurants, hospitals, canteens, etc. On the one hand, private buyers traditionally purchased the complete dinner service (56 or 72 pieces) for a wedding. This was only used for special occasions and was a one-off purchase. The consumer society and the decline in weddings[1] has overturned this habit, and the tendency at present is to change tableware more frequently and to purchase goods for everyday use with added features such as dishwasher resistancy or microwave suitability. European manufacturers, and more specifically English and French bone china manufacturers, have encountered difficulties in adapting to new

[1] In France, for instance, the number of weddings dropped from 287,100 in 1990 to 257,000 in 1993 (Forestier, 1994, 11).

consumer requirements. On the other hand, the demand by professional buyers has increased over the last decade due to a change in life style; people are eating out more often thus making canteens and restaurants increasingly more popular. Indeed the special requirements of the hotel and catering trade has given rise to the "hotel ware" sub-sector with specially designed hard-wearing ceramics (Von Boch, 1993).

The refractories segment continues to lose market share in favour of technical ceramics (Mark, 1993). This is due to the fact that the technical ceramics segment is, to some extent, based on materials and techniques developed by the refractories industry and adapted towards engineering applications. The principal demand for refractories products is for the production of goods requiring high temperature processes as metals, glass, steel, cement, ceramics, etc.. The demand for 'advanced ceramics', also known as 'technical ceramics' or 'engineering ceramics', is becoming of increasing importance given the enormous possibilities and potential for development. Some commentators forecast that this market will be among the most lucrative in the world between now and the beginning of the next century. This is largely because they are providing technologies for high-growth fields such as health care, telecommunications, electronics, transportation, infrastructure and packaging (Lucas, 1990). Significant expansion of structural ceramics into new market areas is constrained principally by two factors; reliability and cost. Thus, ceramic products are not only consumer items but are also vital to a whole range of industrial processes.

As a whole, the demand for the majority of European ceramic goods is very elastic, implying that close substitutes are readily available (from countries in the Far East) and that a small price increase will cause many consumers to transfer to these substitutes, resulting in a large fall in European demand (Panorama, 1995). This phenomenon was observed during the economic recession of the 1980s, when competitors decided to penetrate the European market and initiated a price cutting strategy in a drive to dominate the market through lower costs.

2.1.2 The supply side

In the previous section we considered the demand side of the market. We now turn to a consideration of the factors influencing the supply side of the market. The degree of concentration, or the number of firms operating in a market and the market share held by them allows a level of competition to be determined. The situation of the ceramics market in the 1960s and 1970s was close to the economic definition of 'a pure competitive market'. Indeed, the market was supplied by many small companies, with none large enough to have any significant influence on prices. However, this situation has begun to change in the

1990s, since financial and multinational groups have decided to merge companies in order to increase market power, improve efficiency through rationalisation and economies of scale. It now appears that this strategy has enabled several multinational groups in each sub-sector of this market to be created.

In 1994, the Europe ceramics good sector, including the Western European countries, employed approximately 435,000 people in 5,500 companies, with a turnover of nearly ECU 23 billion (Schmidt, 1995). Over the last 10 years the most significant degree of concentration has taken place in the refractories sector, where five companies account for about 65% of total European (EU plus EFTA) production (Panorama, 1995). These companies are :

- Didier-Werke (D);
- Oesterreichische Magnesit (A);
- Hepworth Refractories (UK);
- Sanac (I);
- SEPR (FR).

The tableware and ornamental ware sector contains a handful of large companies amongst a myriad of small ones. Seven major groups account for 50% of total EU output; three German (D), two British (UK) and two French(FR) companies, namely:

- Villeroy & Boch (D);
- Rosenthal (D);
- Hutschenreuther (D);
- Wedgwood (UK);
- Royal Doulton (UK);
- Bernardaud (FR);
- Deshoulière (FR).

In the sanitary ware sector the three major groups operating on a European level are:

- Ideal standard (I) of the American Standard group of the USA;
- The Sanitec group of Finland whose interests now include Allia (FR), Keramag (D), Pozzi-Ginori (I), and Eurocer (P) in addition to its Scandinavian activities;
- Blue Circle Industries (UK) through subsidiaries Armitage Shanks (UK) and Ceramica Dolomite (I).

The EU wall and floor tile industry is dominated by medium sized producers in Italy and Spain with annual turnovers in the 40-80 million ECU range (De Gioia *et al*, 1995).

2.2 Market performance

The world-wide recession has not spared this sector and the common dictum "when the construction sector catches a cold, the ceramic sector sneezes" has been confirmed over the last ten years. However, the ceramic industry has been affected to varying degrees by the downturn, since the different markets served have behaved differently over various time scales. This section presents relevant background data on the market, products, competition, distribution, and macro-environment. The ceramics market performance, world-wide and at the European level, will be considered in succession.

2.2.1 World market performance

On a global level, the ceramics sector is concentrated in North America, the Far East and Europe, and to a lesser degree elsewhere (Panorama, 1995). However, the EU is generally regarded as the world's largest ceramic producing region (Figure 19), and it is well recognised that the fastest growing region is the Far East where Japan, China, and the ASEAN countries have all been displaying spectacular growth during the past decade. Those countries often known as the Asian dragoons have recently been particularly successful in penetrating the tableware and ornamental ware segments of the market (CTTC, 1991). Japan has also achieved a leadership role in the use of advanced ceramics. Japanese manufacturers are particularly strong in the electronic ceramics market, and Japan is the main competitor with the USA in the advanced ceramic component marketplace. However, the US ceramics ware segment has been moribund in the 1990s and the USA is now a major net importer of products such as ceramic tiles and tableware (L'industrie Céramique, 1990).

Figure 19: International production of ceramic goods in current prices

Aston University

Illustration removed for copyright restrictions

Source: DEBA, Census of manufacturers, Nikkei

Estimates both of the exact size of the ceramics industry across the World and the sectoral breakdown by country vary due to the absence of a comprehensive data set and an information system spanning the whole spectrum of the industry. However, the Industrie Céramique (1992, N. 872,1) magazine estimated in 1992 that the World ceramics industry had a total production of around 60 billion ECU and employed approximately 1.3 million people.

2.2.1.1 The world market for tableware and ornamental-ware

Pottery first appeared about 15 000 - 10 000 BC with the dawn of the Neolithic age and was the first synthetic material to be discovered by Man. Paul Rado (1988, 2) defined the process as :

> *...an artificial stone produced by firing clay shapes to a temperature sufficiently high to change the physical and chemical properties of the original clay into a new substance with many of the characteristics of stone.*

Subsequently, mankind strove to improve the quality and the purity of the product. The other important stage in this search was the discovery of porcelain (known as hard porcelain) based on the use of kaolin (from the Gaoling mount in the Jangxi province) under the Han dynasty between the years 206 BC and 220 AD in China and then improved until its perfection under the Tang and Song dynasty (618 - 1278). Europe had to wait until the 13th century and the voyages of Marco Polo to discover the existence of porcelain. However, Chinese porcelain was not imported on a mass scale before 1520. Faced with the craze that this aroused and the problems of understanding the secrets of its manufacture, an imitation known as "soft porcelain" appeared. The first successful attempts to make porcelain took place in Italy in the sixteenth century. Francesco de Medici of Florence was the first to make porcelain in the Western world, this was known as "Medici Porcelain". After Francesco's death the art of making "frit" porcelain in Europe seems to have been lost. Almost 100 years later (1673), Louis XIV and the Marquise of Pompadour reintroduced the Medici porcelain process by granting a patent to Louis Poterat in Rouen. The making of soft porcelain consequently spread to other cities in France via the Royal Manufacture of porcelain founding Manufactures such as Saint Cloud (1702), Chantilly (1720), Mennecy (1737) and Vincennes which in 1756 became the Royal Manufacture of Sèvres. Eventually in 1709 the alchemist Jean-Frédéric Böttger became the first to create a hard porcelain (using kaolin from Saxony) similar to the one created by the Chinese. Later, August the Strong, the great Elector of Saxony appointed him as Director of the Meissen factory. His formula was kept a secret until 1720. At the same time, the secret art of making porcelain in China was revealed by the letters of the Jesuit missionary, Père d'Entrecolles in 1712 and 1722 (Banque de France, 1995).

Pottery, rooted in the craft, is traditional, but this does not necessarily mean that progress is inconceivable on the contrary to survive the tableware industry has had to evolve across the centuries. To day the tableware sector includes the following ceramic ware:

- Artware (ornamental pieces, fancies, figures, figurines);
- Tableware (dinner, tea, and coffee services);
- Cooking ware (ovenware, fireproof ware, flameproof ware);
- Kitchenware.

Of these, tableware is by far the largest market. In 1994, the world market for earthenware and porcelain tableware was approximately 5.5 billion ECU and employed approximately 400 000 people across the world. Figure 20 shows that China, Japan and the USA together produced 50% of the global market for household ceramics, with Europe representing 40% of the total production.

Figure 20: Global market structure for Household ceramics in 1994

Source: Eurostat (1995)

2.2.1.2 The world market for ceramic tiles

From ancient times until the present day, ceramic tiles have accompanied the historical development of mankind as cultural monuments, through, for example, inscribed tiles from Thutmonius, (1539 BC) and building materials - Ishtargate, Babylon (575 BC). Today various types of ceramic tiles are produced: floor and wall tiles for interior and exterior use; tiles of different textures - faience, soft and hard earthenware, stoneware, majolica, porcelain, etc.; tiles of different shapes and sizes; unglazed or glazed, with various glazes and tiles with different properties, uses and produced by different techniques. As presented in Figure 21, 70% of the world tile production in 1994 was produced in either Europe (38%) or Asia (32%). According to figures obtained by Ceramic World Review (Sezzi, 1995, 36-39) world production was estimated at about 2,685 million square metres in 1994 compared to approximately 1,000 million square metres in 1980.

Figure 21: World production of ceramic tiles in million square metres

Aston University

Illustration removed for copyright restrictions

Source: Sezzi (1995, 36)

Ceramic tile manufacture is spread over the entire world (Table 18 and Figure 22). As a whole, the major tile manufacturing countries cover 90% of world production. Compared to 1993, tile manufacture rose by 9% in 1994 and in the two years between 1992 and 1994, by approximately 38%. This growth was due to the increased production in low-cost labour countries such as China, Brazil, Indonesia, Italy, Spain and Turkey.

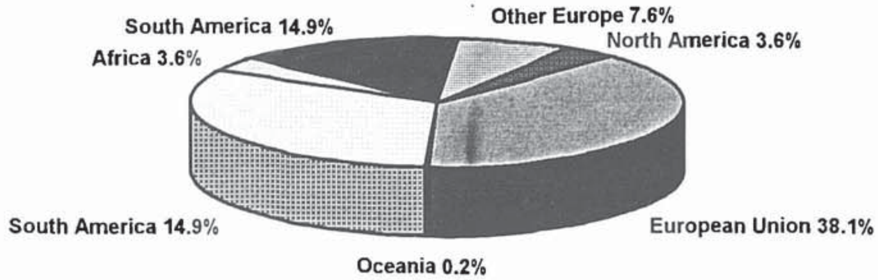
Table 18: World-wide distribution of ceramic tile manufacture

	1992		1993		1994		92/94
	In million m^2	% of world production	In million m^2	% of world production	In million m^2	% of world production	Increase %
Europe	1061	54.4%	1135	46.0%	1226	45.7%	15.5%
Asia	416	21.3%	798	32.4%	860	32.0%	106%
America	400	20.5%	442	17.9%	497	18.5%	24.3%
Africa	70	3.6%	85	3.5%	97	3.6%	38.6%
Oceania	4	0.2%	5	0.2%	5	0.2%	25%
Total	1951	100.0%	2465	100.0%	2685	100.0%	37.6%

Adapted from Sezzi (1995) and Stefanov (1995)

The pie chart below (Figure 22) shows the world production of ceramic tiles; the EU represents 38.1% of the total production, followed by Asia 32% and South America 14.9%.

Figure 22: Percentage of the ceramic World Production in 1994



The increase in ceramic tile consumption has taken place on all five continents, largely as a result of the recovery in the world economy. Table 19 below summarises the world-wide consumption of ceramic tiles. World consumption is estimated at about 2,644 million square meters in 1994. Between 1992 and 1994 consumption rose by 36.2%; Asia, as a result of a recovery in the economy, showed the highest increase in consumption with a rise of 103.5%; in contrast Europe increased its consumption by only 11.9%.

Table 19: World-wide consumption of ceramic tiles

	1992		1993		1994		92/94
	million m^2	% of world consumption	million m^2	% of world consumption	million m^2	% of world consumption	Increase %
Europe	934	48.1%	967	39.5%	1045	39.5%	11.9%
Asia	458	23.6%	872	35.7%	932	35.2%	103.5%
America	445	23.0%	490	20.0%	538	20.4%	20.9%
Africa	90	4.6%	100	4.1%	110	4.2%	22.2%
Oceania	14	0.7%	16	0.7%	19	0.7%	35.7%
Total	1941	100.00%	2445	100.0%	2644	100.0%	36.2%

Adapted from Sezzi (1995) and Stefanov (1995)

However, Europe remains the largest tile market in the world (Table 20). In 1994, tile production was 1,226 million m^2 and consumption 1,045 million m^2. Tile exports amount to

585 million m^2, occurring predominantly between European countries. Europe is the only continent to produce more than its consumes.

Table 20: Production, consumption and exporting in the world

	Production 1994		**Consumption 1994**		**Exports 1994**	
	In million m^2	**% of world production**	**In million m^2**	**% of world consumption**	**In million m^2**	**% of world production**
Europe	1226	45.7%	1045	39.5%	585	21.8%
Asia	860	32.0%	932	35.2%	9	0.4%
America	497	18.5%	538	20.4%	51	1.9%
Africa	97	3.6%	110	4.2%	8	0.3%
Oceania	5	0.2%	19	0.7%	0	0.0%
Total	2685	100.0%	2644	100.0%	653	24.3%

Adapted from Sezzi (1995) and Stefanov (1995)

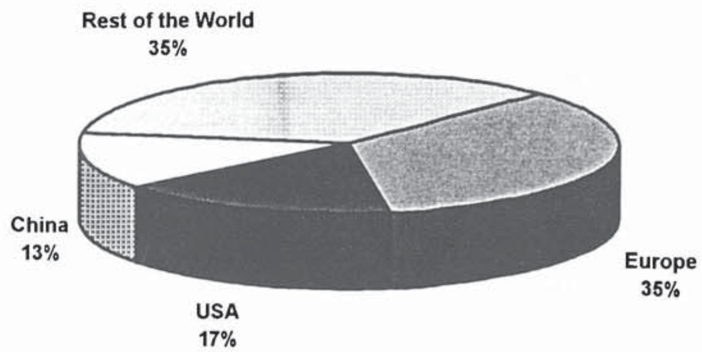
The Far Eastern countries provide the second largest tile market in the world; they produce around 860 million m^2 tiles and consume about 932 million m^2. Because of the large scale investments made recently by China, the Far Eastern market shall soon be able to fulfil its own tile requirements. The American tile market is the third largest, with a production at 497 million m^2 in 1994 and consumption at 538 million m^2, of which Brazil produced 290 million m^2 and consumed 258 million m^2 in 1994.

2.2.1.3 The world market for sanitary-ware

The principal goods manufactured under this heading are : WC, fitted wash-basins, bidets, columns, boxes, urinals and shower-plates. Over the past few years the sanitary-ware industry has seen numerous acquisitions and mergers, which have had a profound effect on the productive structure and market shares in the most important countries (Ceramic World Review, 1996).

The sanitary ware industry is a niche market which has prospered very well over the past 10 years. However, this development has principally be in favour of low labour countries which have been in a position to offer products at a much lower price. The world turnover in 1994 accounted for 3 billion ECU, for a production of 150 billion pieces (Molitor, 1995). As illustrated in Figure 23, Europe, China and the USA accounted for 65% of the total world production. Furthermore, in developed countries a persistent demand for more "furnished" bathrooms has been noticeable which has led to an increase in cabinet rather than column wash basins. It has also been observed that there is a distinct decrease in urinals. At present, the sales are aimed at rebuilding bathrooms but a recovery of the building industry could boost this sub-sector which accounts for only 500 manufacturers across the world.

Figure 23: Sanitary-ware market share by production in 1995



Source: Molitor (1995)

2.2.1.4 The world market for bricks

The world market for bricks and roofing tiles in 1994 was estimated at 16 billion ECU (Eurostat, 1995). The production of clay bricks in the EU is considerably higher than that in the USA or Japan, where other materials such as concrete, wood and plastics are predominant. USA production in 1993 declined by 24.2% compared to 1984, whereas Japanese production increased by 73.2% (Panorama, 1995). However, since 1993, production in the USA has increased as its economy recovered.

Foreign trade in bricks normally represents only a small part of overall consumption since the products are high-volume, low-value products best suited to serve proximal markets. These types of products are also designed to meet particular building characteristics which tend to be of a regional or national nature.

2.2.1.5 The world market for industrial ceramics and refractories goods

The advanced Industrial Ceramics sub-sector is highly diverse and includes the so-called active electro ceramics, condenser resistors, passive electro ceramics, insulators, sparkling plugs and also orthopaedic replacements. This branch deals primarily with new products for new markets, which always incur heavy development and preparation costs. A more detailed examination of the individual sectors of this industry is scarcely possible, as a considerable number of companies are not organised into unions and it is quite difficult to distinguish between advanced ceramics goods and other materials.

Refractory products, like advanced ceramics, are used by a wide range of industries, but the main customer is the steel industry. Refractories are used in the construction of kilns and for "kiln furniture" on which the unfired ware is placed for firing. Refractory materials are able to withstand corrosive and other destructive forces at extremely high temperatures. They are, therefore, used for four basic functions:

- as a *heat buffer* between the hot substance and the walls of the containing vessel;
- as a *chemical barrier* to prevent hot substances eroding the walls of a containing vessel;
- as *physical protection* for the walls of the containing vessel;
- and for *heat retention* of hot substances contained in the vessel, thereby reducing energy requirements.

As shown in the Table 21, five types of refractory can be identified.

Table 21: Refractory types

Refractory Type	Description
1. Fireclay	- essentially hydrated aluminium silicates (bricks & hollowware)
2. High Alumina	- usually containing >47.5% Al_2O_3 - mullite - chemically bonded brick (usually phosphate) containing 75-85% Al_2O_3 - alumina-chrome - alumina-carbon
3. Basic (Mg & chrome)	- dead burned magnesite/magnesia and/or chrome
4. Silica (castables)	- Al_2O_3<1.5%, TiO_2<0.2%, FeO_3<2.5%, CaO<4%.
5. Specialised	- carbon/graphite - zircon and zirconia (a type of imported sand from, e.g. Australia) - silicon carbide (obtained from ground rock) - fused silica - fused cast refractories

Adapted from Rado (1988)

Only fireclay products are actually formed from clay-based materials, the remainder are produced from crushed rocks, sands (e.g. zircon) and synthetic materials. Refractories can be supplied as either bricks, mortar or monolithic material.

Over the last few years, the Far East and more recently, Eastern European countries have successfully penetrated this market due to their much lower priced products. However, as previously mentioned the refractories industry depends essentially on future developments of the steel industry, where the world demand and hence production since 1975 has fallen by almost a half. Specific consumption of shaped refractories is now at 20% of the 1950 level.

There are approximately 1,500 refractory and advanced ceramics producers across the world, with a turnover in 1992 estimated at ECU 40,217 million.

Table 22: Global market for Industrial and Refractories goods in million ECU (1992)

	World	USA	Japan	W. Europe
Refractories	19825	2075	3460	6000
High temperature ceramics	695	230	175	175
Mechano ceramics	700	80	280	230
Electro ceramics	4150	1510	580	810
Nuclear ceramics	25	15	0	10
Chemo ceramics	930	95	560	405
Bio ceramics	55	20	3	30
Grinding & Cutting ceramics	530	140	150	55
Electronic ceramics	13250	2950	8100	1400
Opto ceramics	140	60	35	35
Total	40300	7175	13343	9150

Adapted from Schmidt *et al* (1995)

As shown in Figure 24, Japan is the leader in the production of industrial ceramics and refractories goods with a world market share of 33%, followed by the Western European countries and the USA.

Figure 6: Market share for Industrial and Refractories goods

Source: Mark (1993)

2.2.1.6 Conclusion

Over recent years, high production costs and increasing competition from international -low cost- countries have forced the industry into rationalisation and a re-definition of products and quality with a world-wide domination of Japan, the USA and Europe. Despite this increasing competition, the global ceramics market is expected to grow over the next few years in two directions. Firstly, the potential demand for traditional ceramics goods by new markets, specifically new developed countries should continue to expand and companies that have already modernised and restructured can be expected to successfully penetrate these new emerging markets. Secondly, the ceramic market is expected to expand through new-product development possibilities. The potential for new product development is higher in the advanced ceramics sector than in other ceramics segments. However, new products, including original products, improved products or modified products are highly suitable with customer requirements, i.e. for sanitary ware or tableware goods.

2.2.2 European market performance

The recessionary conditions of the 1970s and early 1980s had a far more significant effect on the European ceramics industry than the recessionary times of the early 1990s. On the whole, during this period, manufacturers resorted to cost-cutting tactics in order to preserve their market share and rationalised production by the closure of sites and the reduction in manpower. If the 1970s and 1980s amounted to two decades of bankruptcy and rationalisation, the 1990s should be more associated with mergers and acquisitions aimed at increasing companies' penetration into international markets, strengthening their position in existing markets and their core businesses, and to satisfying specialist markets neglected by East Asia competitors.

Recent trends in EU production of ceramic goods have shown a healthy steady growth of 2% per annum between 1985-1995 (Panorama, 1995). The sector as a whole, however, has not benefited equally from this growth. Traditional branches such as the whitewares sector and bricks, required intensive labour and were therefore deeply affected by the slowdowns of the economy and the aggressive competition of Far East regions. On the contrary, advanced ceramic branches continued to expand rapidly and the world market is predicted to grow by 10% per annum up to the year 2000. In very specific branches such as the fiberoptic components, a world-wide growth of 25% was observed in 1994. In 1982 about 2,800 companies with approximately 320,000 employees were registered in Europe (Schmidt *et al*, 1995). In 1994 these figures were reduced to 2,000 companies and a workforce of about 220,000 (Figure 24) representing a reduction of 31% in employees for a turnover in 1995 estimated to be 19 billion ECU (Figure 25).

Figure 24: Number of employees in 1995

Aston University

Illustration removed for copyright restrictions

Source: Eurostat estimates

Figure 25: Ceramics goods production in billion ECU, 1995

Aston University

Illustration removed for copyright restrictions

Source: Eurostat estimates & Ecotec

Since 1990 the EU has regained its position as the world's leading producer of ceramic goods (Figure 26). During the 1970s and 1980s the EU domestic market has been attacked by foreign manufacturers offering better products at lower prices. Although European firms were initially slow to respond to US and Japanese inroads, most of them are now mounting counter offensives. European companies have since discovered a number of foreign markets that present higher profit opportunities than those within the domestic market. EU companies also wished to enlarge their customer base in order to achieve economies of scale and reduce their dependencies on any one market. EU companies were saddled with over capacity and the only salvation was to find additional markets for their goods. At present, the EU is a major net exporter of ceramic goods with sales to foreign countries consistently making up approximately 20% of total production.

Figure 26: International production of ceramic goods in constant prices

Aston University

Illustration removed for copyright restrictions

Source: DEBA, Census of manufacturers, Nikkei

Over the last 5 years the European production of ceramic goods has grown by an average 2% per annum in real value, while consumption has increased by 2.7% per annum (Eurostat, 1995). Imports are showing signs of a clear upward trend and Far Eastern producers such as China and the ASEAN countries have been particularly successful in penetrating the tableware and ornamental ware segments of the market.

The EU exports an enormous range of products to destinations throughout the world. The EFTA countries feature prominently across the full range of products whilst the USA is a major customer for wall tiles, tableware, ornamental ware and refractories. Australia, Canada and Japan also feature prominently as markets for these items. The following sections will present for each of the five ceramic sub-sectors the leading European producing countries, and explain how these countries have achieved a competitive advantage.

2.2.2.1 The European market for tableware and ornamental ware

The European household ware industry (earthenware and porcelain) is characterised by a large number of firms (approximately 665), of which three German manufacturers, (Villeroy & Boch, Rosenthal, and Hutschenreuther) and two British (Wedgwood and Royal Doulton) accounts for around 40% of the total production by European countries. In 1994, this industry employed 100,000 people across Europe with a turnover of 2.3 billion ECU, which represents 42% of the world production estimated for the same year at 5.5 billion ECU. Germany leads in the production of household ceramics with a world market share of 18% and a European market share of 47% (Table 23).

Table 23: European market leader for household ware in 1994 in billion ECU

EU market leader	Turnover billion ECU	World Share %	Europe Share %
Germany	1.1	18%	47%
UK	0.6	11%	26%
France	0.3	5%	13%

Source: Eurostat (1995)

In terms of value added, Germany was the European leader of ceramic goods in 1994 closely followed by Italy (Panorama, 1995) with a total production accounting for 26.5% of all ceramic products manufactured in Europe.

After three years marked by a general decrease in the sector's turnover, the market recovered slightly in 1994 and reached 2% growth (Panorama, 1995). Growing competition in the tableware market from Far Eastern countries has led European manufacturers over the last few years to increase the amount of research into possible solutions to the problem of competitiveness of products and, consequently, into ways of reducing production costs and rationalising the workforce. Low paid countries, mainly Far Eastern countries, and former Soviet Bloc countries, have successfully penetrated the European tableware market with products at much lower prices and a strategy of product imitation.

2.2.2.2 The European market for ceramic tiles

In the present climate of world production of ceramic tiles, design, variety and quality are the key factors on which European tile manufacturers will compete. European production and consumption of ceramic tiles has increased considerably over the past few years. The EU, in particular Italy and Spain, continue to lead in quality, while Asia, especially China (the second manufacturing country with a production of 400 million m^2), is set to become the largest volume producer. The world leadership position in terms of both quality and quantity is still held firmly by two European countries, namely Italy and Spain (Table 24), whose production has risen by 12.6% and 13.8% respectively.

Table 24: Top Manufacturing countries in Europe

Country	World ranking	Production 1993 (Sq./Mt. Mill.)	Production 1994 (Sq./Mt. Mill.)	% of world production
Italy	1	453	510	19.0%
Spain	3	281	320	11.9%
Germany	5	71	70	2.6%
France	12	46	48	1.8%
UK	28	13	15	0.5%

Source: Sezzi (1995, 37)

In absolute terms this increase amounts to 96 million m^2, of which 3.6% is world production. This figure represents 43.6% of the increase in world production. Since domestic consumption has risen relatively little in Spain and even less in Italy, the increase in production of these two countries has been almost all geared to export, allowing them to strengthen and even further their position as the only large tile exporters (Table 25). Italian and Spanish exports totalled 487 million m^2 in 1994: 74.6% of all exports and 18.4% of world consumption.

Table 25: Top European Exporting countries in million m^2

Country	World ranking	Production 1993 (Sq./Mt. Mill.)	Production 1994 (Sq./Mt. Mill.)	% of world consumption
Italy	1	277	325	12.3%
Spain	2	131	162	6.1%
France	4	19	22	0.8%
Germany	5	24	20	0.8%
Portugal	6	15	17	0.6%

Source: Sezzi (1995, 37)

While showing a certain degree of variation, the top six European markets absorb around 27% of world ceramic tile production every year, of which 21% is used by Germany, Italy and Spain (Table 26). The top consumer is Germany with 192 million m^2 in 1994.

Table 26: Top European consumers countries in million m²

Country	World ranking	Production 1993 (Sq./Mt. Mill.)	Production 1994 (Sq./Mt. Mill.)	% of world consumption
Germany	3	169	192	7.3%
Italy	4	186	189	7.2%
Spain	5	133	163	6.2%
France	7	88	91	3.4%
Portugal	13	44	46	1.7%
UK	20	35	27	1.0%

Source: Sezzi (1995, 37)

The current strategy in the European ceramic tile sector is the production of small batches, bigger formats, complex product options and the maintenance of strict quality standards whilst containing escalating costs. In other words, design, variety and quality are the key factors on which European tile manufacturers will compete. The increase in productive capacity recorded in 1994 should continue in 1995, and a further increase in production over the next few years is predicted in European countries. A competitive advantage appears to be held by those countries which can already count on a strong level of production and which have areas with a high plant concentration.

2.2.2.3 The European market for sanitary-ware

Italy is the largest producer of sanitary ware in Europe, representing about 20% of total European production. There are 33 companies in Italy which produce sanitary ware employing 5,900 workers in 41 factories. Increasing competition has forced European manufacturers to invest more in automation and robotisation with the aim of reducing the high finished product costs caused by intensive labour. Four countries, namely Germany, Italy, France and Spain represent 73% of the European market for sanitary ware goods (Figure 27).

Figure 27: Distribution of sanitary-ware turnover within Europe in 1994

Aston University

Illustration removed for copyright restrictions

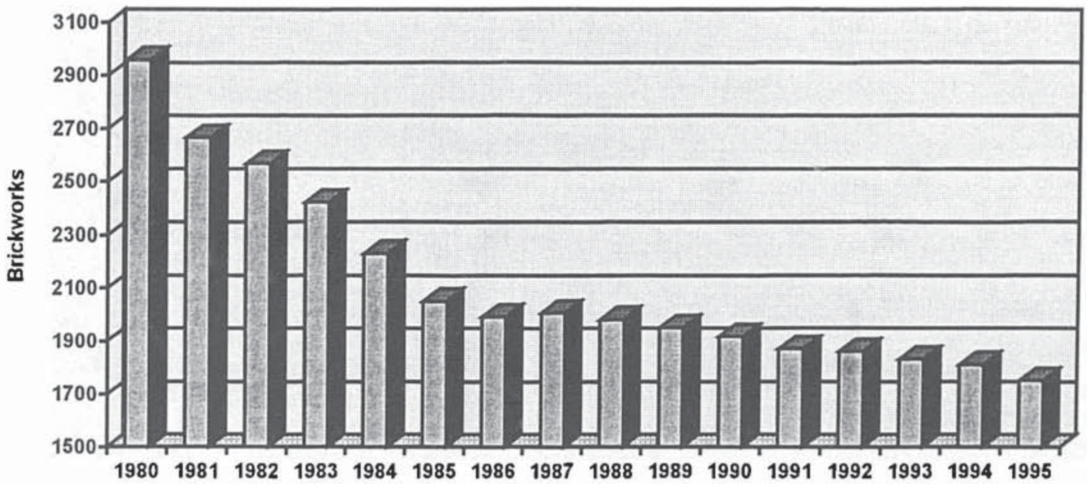
Source: Maurisset (1995, 572)

2.2.2.4 The European market for bricks

The European Bricks industry is one of the biggest sectors of the ceramic industry. It encompasses around 1,700 production plants in Europe, with a combined turnover of ECU 6.1 billion, and with around 64,000 employees(Schulteiss, 1995). Roof-tiles and bricks have helped to shape the outlook of the European landscape, and still are the most widely used construction materials in housing.

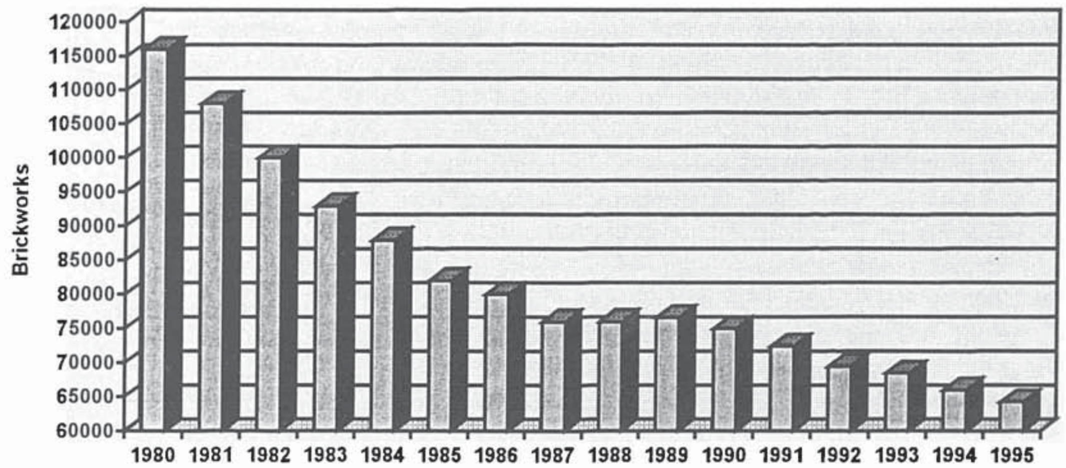
The drastic decline in sales of masonry bricks combined with the progressive concentration of companies within this sector have had major repercussions on the European brick industry during the past ten years (Chorus, 1996). During this period, the number of firms has declined from 2957 to 1750 (Figure 28); the labour force has also been reduced, from 116,033 to 64,250 (Figure 29). This is principally due to the increasing competition of concrete products (Fontaine, 1993) and the economic recession, which has been constantly spreading since 1990.

Figure 28: Number of brickworks in the EU



Adapted from Weller (1992)

Figure 29: Brickworks employment in the EU



Adapted from Weller (1992)

2.2.2.5 The European market for industrial and refractories goods

Western European countries account for 23% of the world's technical ceramics production. In Europe, Germany is the leading producer of advanced ceramics, particularly in engine components, the leading manufacturers being Hoechst Ceram Tec and Corning Keramik. Daimler Benz and BMW are currently undertaking research into ceramic automotive engine components. An important economic role has been gained through engine components, silicon nitride gas turbine components, cutting tools, biomedical, and wear-resistant components. This segment of the market is principally dominated by multinational firms which have invested heavily in Research and Development over the last few years.

Sales figures for shaped refractories produced in the EU have declined continuously over the last two decades (Figure 30). Consumption of refractory shapes in Europe is presently only 22% of the 1970 figure. The further development of process engineering techniques in the steel industry and in particular secondary metallurgy will continue to have substantial influence on the development of the European refractories industry in the future.

Figure 30: European sales figures for shaped refractories

Source: Industrial Ceramics Volume 15, N°2, 1995

2.2.2.6 Conclusion

The size and the maturity of the European market differs considerably from country to country and a "league table" can be defined very clearly.

- The "**DIVISION 1**" countries (namely Germany and Italy), are market leaders in one or more sub-sectors. As mentioned in the previous section, Italy is the European market leader in terms of turnover and employment. Germany, with a share of 10% of the total world market, is the second largest manufacturer and is present in all segments of traditional and advanced ceramics production. These two European countries have over recent decades built a very strong competitive advantage[2] in this field and have invested continuously in the improvement of the quality of products. Competition from both other European countries and the rest of the world (China, Brazil, etc.) has forced German and Italian manufacturers to constantly innovate and increase their productivity.

- The "**DIVISION 2**" countries (UK and France) have a long history in the production of ceramics but with very wide variations in the trading characteristics of the different sub-

---

[2] Refers to Michael Porter's theory developed in his book: "Competitive advantage of nations", (1990), Macmillan, London. According to Porter, nations succeed in industries where their home base advantages are valuable to other nations, and where their innovations and improvements foreshadow international needs. Nations gain a competitive advantage in industries where the home demand gives local firms a clearer or earlier picture of buyer needs than foreign rivals.

sectors of the industry. Notably, the UK and France are very well established in the fine china tableware segment and export up to 75% of their output. Division 2 countries are more "market-niche orientated". Instead of pursuing the whole market, or even large segments of the market, these countries target segments within segments. Niching carries a major risk in that the market niche may dry up or be attacked.

- The "**DIVISION 3**" countries (Spain, Portugal, Greece) serve principally their home market and small size enterprises predominate. Nevertheless, a process of concentration, and an investment emphasis on increased efficient use of the production factors combined with higher quality and design standards has been observed. Division 3 countries are becoming major competitors, and for instance, according to the 1994 Portuguese foreign trade data, the production of Portuguese tableware increased by around 30% in volume and the export of sanitary ware by 115%. Table 27 summarises the market leader for each ceramic sub-sector in Central Europe.

Table 27: Market leaders in the ceramic production sectors in central Europe

Production Sector	Market leader	Production Sector	Market leader
Bricks	Italy	Refractories	Germany
Roofing tiles	France	Sanitary-ware	Italy
Tiles	Italy	Technical ceramics	Germany
Households ceramics	Germany	All Sectors	Italy

3. THE CERAMIC INDUSTRY IN THE UK AND FRANCE

By definition, the competitiveness of an industry is affected by the macro- and micro-environment forces. Firstly, the political and economic environment, often described as the 'macro-environment', refers to the broad shifts in economic conditions, demographics and technological, cultural and environmental forces which may have influenced performance either positively or negatively. Secondly, the micro-environment consists of those actors in the company's immediate environment that affect the market in which the business operates, in particular, the effects of changes in the behaviour of customers, distribution channels, competitive strategies, new products price and cost changes. The following sections will present the macro- and micro-environment forces affecting the UK and French ceramics industry.

3.1 Macro-environment forces

The macro-environment consists of the broader societal forces that affect a company: the demographic, economic, natural, technological, political, and cultural forces. This section examines the above variables for both the UK and France.

3.1.1 The UK

The United Kingdom consists of the countries of Great Britain (England, Scotland and Wales) together with the province of Northern Ireland. It is a constitutional monarchy of long standing. The constitution itself is not a written one, but is formed by elements of statute, common law and convention. The UK electoral system is based on the principle of "first past the post". Each of the country's 650 constituencies returns one member to the Commons, and the leader of the party with the largest number of Members of Parliament at a general election is by tradition asked by the monarch to form a government (Clifford Chance, 1995). Since 1945, the government has been formed by one of two parties - Labour and Conservatives.

Since 1979, the Conservative governments led by Margaret Thatcher and from 1990 by John Major, have pursued policies founded on an economic and political philosophy of free enterprise - emphasis on market based allocation of resources and a rejection of the notion that government should act as a prime mover in the economy. The principal effect of policy stabilisation during this period has been inflation. The main weapon against it has been monetary policy.

As in other EU countries, the rate of UK population growth has fallen drastically over the post-war period. In 1994, the birth rate slipped slightly to 1.62 children per woman, which is well below the replacement rate of 2.1. The latest estimates put the total UK population at 57.7 million (OECD, 1995). Over the last two years the British economy has made a strong recovery from the deep recession of the late 1980s and early 1990s, triggered by an exchange rate propitious to exports which in turn has helped to boost job growth. Registered unemployment began falling in December 1992, and accelerated in 1993-94. Although, the decline slowed in 1995, unemployment still decreased to 2.213 million by March 1996 i.e. 7.9% of the workforce. GDP growth has also slowed substantially, to 2.7% in 1995 compared to 3.8% in 1994, as exports were affected by the slowdown in world activity and as domestic demand responded to monetary and fiscal tightening. As regards inflation, the Government target is set to remain within the range of 1 to 4 per cent maximum (OECD, 1995). In 1995, the inflation rate reached 2.6%. Finally, the Government's fiscal objective is to bring the PSBR to balance over the medium term in order to also satisfy the Maastricht Treaty convergence criterion. Since 1993, fiscal policy has been tightened substantially, in line with this goal.

3.1.2 France

France is a parliamentary democracy in which the administration is largely independent of day to day parliamentary control. It traditionally has a more centralised administration than the UK. Since 1962 the president has been elected by direct universal suffrage and appoints a Prime Minister who selects a Council of Ministers (Clifford Chance, 1995). There are 26 administrative regions (4 overseas territories) comprising of 100 departments (4 overseas departments, three in the Caribbean and one in the Indian Ocean), each administered by an elected general council. The departments are further sub-divided into 38,000 local communities, each with an elected municipal council.

The French population of 57.7 million is distributed across an area twice the size of the UK, giving a population density of half that in the UK. Population expansion is occurring in three areas: the Ile de France (Paris region), Rhône-Alpes (South east), and Provence-Alpes-Côte d'Azur (south). Paris and its region is the home of nearly 19% of the population (11million) (OECD, 1995). The second largest urban centre is Lyon (1.3 million), followed by Marseille (1 million).

Over the past two decades French economic growth has been intermittent by EU standards, but the economy is essentially strong and is the second largest in the EU, behind Germany. Economic growth slackened from 2.9% in 1994 to 2.4% in 1995, and is expected to be around 1-1.5% for 1996. France is traditionally 'pro-European' and further EU integration and monetary union are high political priorities, as is job creation in the face of an unemployment rate in 1996 of 11.8%.

France's traditional industries such as ship building, steel and automobiles have come under increasing competition from lower cost Pacific Rim regions. Over the last 15 years, therefore, the government has promoted the development of high technology industries with good growth prospects, such as aerospace, chemicals, pharmaceuticals (including biotechnology), telecommunications and electronics. This emphasis has provided France with a highly developed industrial technology base.

As shown in Figure 31, which indicates sector sources of French GDP, agriculture and forestry remain mainstays of the French economy. Agriculture generates 2.5% of French GDP, compared with 1.3% in the UK, and the sector employs 5% of the French population, compared with 2% in the UK. France accounts for 25% of the EU's usable farmland, and produces 40% of the EU's cereal and 35% of the EU's wine. Over 26% of the total usable land area is forested. The country is also rich in natural resources, including iron ore, bauxite and potash, and to a lesser extent coal. However, its dependence on oil imports for energy meant that the country suffered heavily during the first oil crisis of 1973-74. As a consequence, France embarked upon an ambitious nuclear programme, and 75% of electricity is now generated from nuclear sources, a pattern likely to continue until at least 2010.

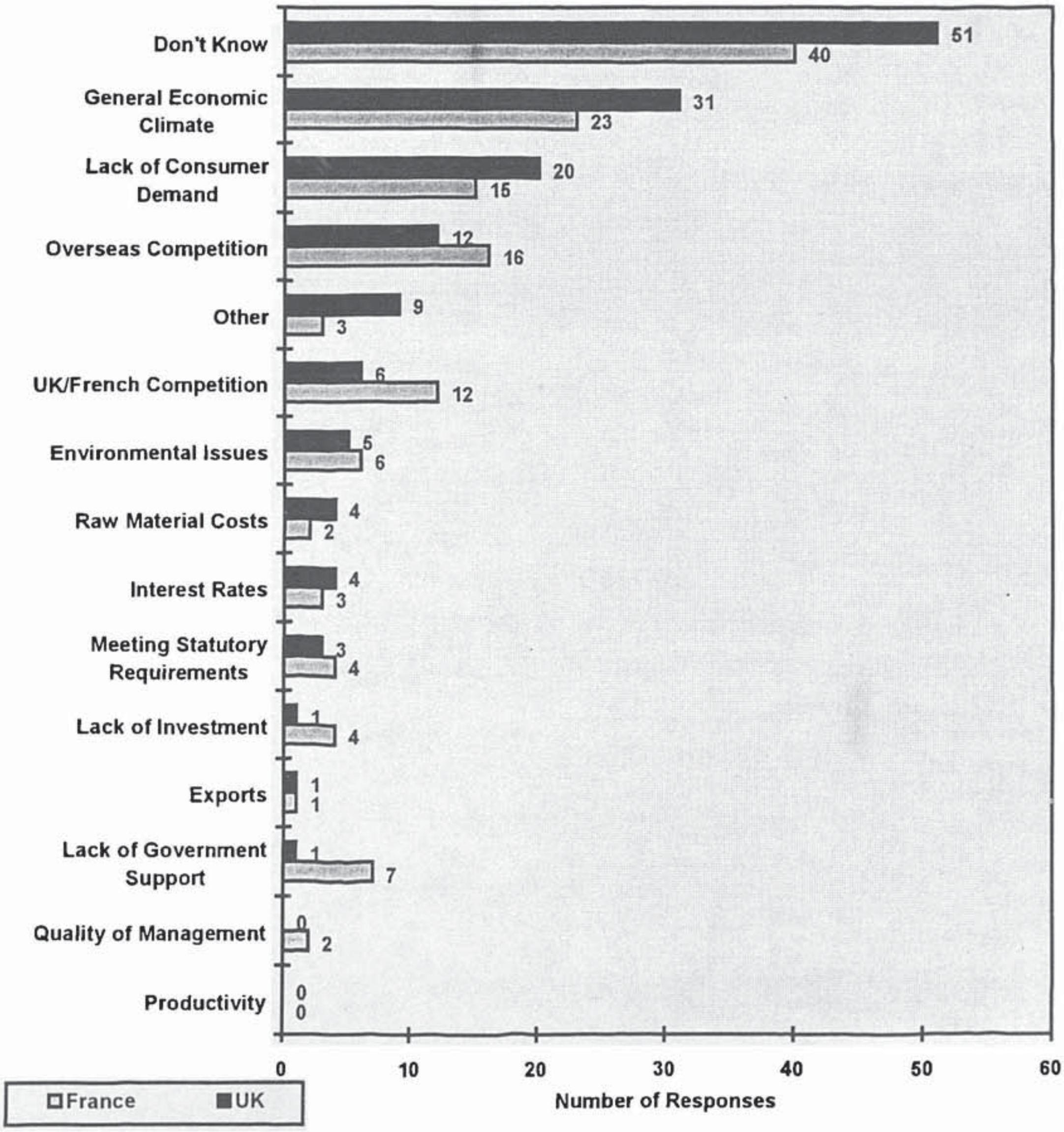
Figure 31: Sector sources of GDP

Source: Comptes nationaux 1994

3.1.3 Current overall issues facing the ceramics industry

Question 4 of the questionnaire inquired specifically about the key issues affecting the profitability of the ceramics industry. The large proportion of respondents in both countries (over 45%) who responded "don't know" to this question; this was due to people interviewed who were, for the vast part, not economic experts but environmental specialists. To a certain extent, this also highlights the high degree of specialism required in today's constantly changing world. If the "don't knows" are ignored, the four most widely mentioned key issues in both countries were (Figure 32) the general economic climate (33% for the UK and 23% for France), followed by lower consumer demand (21% for the UK and 16% for France), overseas competition (13% for the UK and 18% for France)and domestic competition (the UK 6% and France 13%).

Figure 32 (Q4) : Key issues facing French and British business



3.1.3.1 Breakdown by sector

For the UK, the vast majority of respondents (over 40%) from the Brick and the Industrial & Refractory sectors cited lower consumer demand and general economic climate as key influences on profitability. While, for all of the respondents of the Sanitary-ware & Tiles sector, domestic competition was the main issue affecting the company's profitability.

For France, as a whole, the general economic climate was highly cited (between 25% to 50%) by all sectors, reflecting the prevailing economic climate. Respondents in the Sanitaryware & Tiles sector also identified (50%) the domestic competition as a key issue, as did 25% of those from the Brick sector. Unlike the UK tableware manufacturers, the French respondents indicated oversea competition as a key influence on profitability.

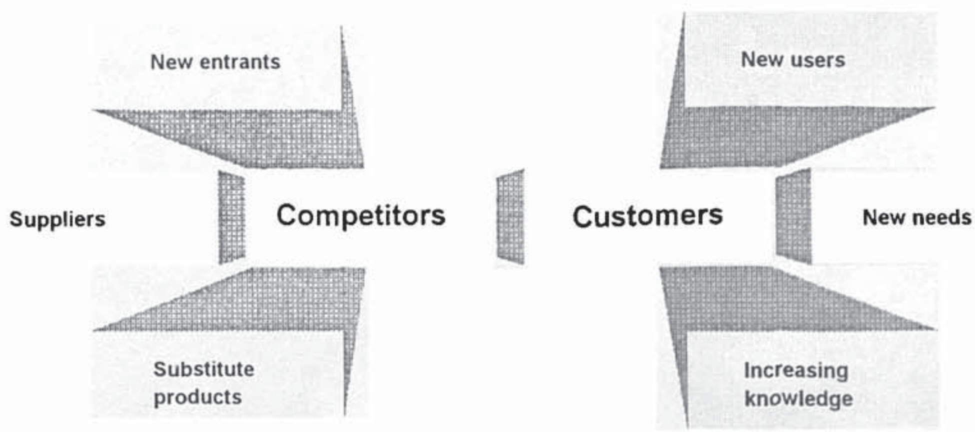
3.1.3.2 Breakdown by size

Both British and French micro companies mentioned primarily general economic climate as a key issue (respectively 55% and 40%); this was also important for small companies (37% for the UK compared to 45% for France). The responses from the medium-sized companies differed from one country to the other. Indeed, for approximately 50% of the medium-sized British manufacturers, lower consumer demand was the main reason while for France it was overseas competition (45%). It is perhaps not surprising, however, that for approximately 50% of the large companies overseas competition was the principal issue affecting profitability.

3.2 Micro-environment actors

The following section explores the ceramics market in both the UK and France and is segregated by product in order to clearly depict their current performance. Furthermore, to complete this analysis the forces influencing competition in each sub-sector of the ceramics industry are examined. As shown in Figure 33, the market dynamics are led by both customers' expectations and the behaviour of current competitors.

Figure 33: Market actors



Adapted from Kotler (1991)

According to various indicators, the ceramics market in the UK and France have reached saturation point. This is principally because sales are sluggish and becoming largely a function of repeat purchasing. Moreover, customer's tastes are becoming more discerning, looking for additional features and becoming increasingly price-sensitive. Furthermore, competition for customers has now become increasingly intense as new competitors have been attracted during the growth phase during the 1960s and 1970s. In such market circumstances companies have to decide which strategy to adopt in order to make profit and survive.

3.2.1 The UK and French ceramics sector outlook

3.2.1.1 Company size

Traditionally, the UK and French ceramics sector tends to be oligopolistic - dominated by few large companies among a myriad of small enterprises, particularly in the tableware/domestic goods sub-sector. Generally, these companies have been long-established in the ceramics industry. They often have connections outside the industry, such as through subsidiaries or holding companies. There is little vertical integration; no porcelain or earthenware companies, for instance, own china clay mines. Companies seem to extend horizontally by purchasing firms similar to themselves in profiles, though offering different designs, in order to achieve economies of scale.

For the UK, VAT data for 1993 indicate that some 23.3% of all ceramics business units have an annual turnover of less than ECU 24,600, 37.3% have an annual turnover below ECU 35,150 and 72.4% generate less than ECU 175,700 in annual sales, while only 4.8% of business units (representing approximately 25 companies) have annual sales of ECU 3.5m or over.

In 1993, there were 794 "business units" (sites, not companies) in the whole of the UK ceramics industry, this represents approximately 400 companies employing 43,027 people against 33,198 for France. Approximately 63% of these units in the UK and 79% of those in for France had less than 10 workers; but they account for only 3.3% of total employment within the industry in the UK and 8.8% in France (Table 28). From the 1991 figure the number of units operating in the industry has fallen by approximately 10.5% in the UK (British Ceramic Confederation, 1994) and for the same period in France by 8% (SESSI, 1995).

Table 28: employment per business unit in the UK and France ceramics sector

	UK - 1993		France - 1994	
No. of staff per Business Unit	**Number of Business Units**	**Total Number of Employees**	**Number of Business Units**	**Total Number of Employees**
1-9	496	1,429	1467	2,934
10-19	77	988	180	2,160
20-49	71	2,187	99	3,324
50-99	52	3,434	50	3,688
100-199	33	4,846	28	4,287
200-499	45	14,313	26	8,326
500+	20	15,830	9	8,479
TOTAL	**794**	**43,027**	**1859**	**33,198**

Adapted from : for the UK Business Monitor (1993) and Keynote (1994)
for France SESSI (1995), DAFSA (1995) and INSEE (1995)
N.B.: Business unit = production site, not individual company

Whilst production and environmental performance does vary within company size banding and within product sub-sectors, it is nevertheless meaningful and practical to frame studies of the industry's performance around company size and product categories. Companies in the same size and product groupings tend to face similar commercial pressures - availability of technologies and regulatory requirements, albeit with varied reactions.

The degree of homogeneity of the individual sub-sectors varies. For instance, in the UK and French sanitary-ware and tile sectors, companies tend to be "large" (turnover of over ECU 11 million), and there are few small operators (turnover of less than ECU 0.35 million). Also the production processes adopted by different companies in this sector are broadly similar. In the table/ornamental-ware sector, however, the variety of company size and production techniques is greater, reflecting the wider range of product types and qualities. The advanced/industrial ceramics sector is even more diverse, reflecting the many different applications of advanced ceramic materials.

3.2.1.2 Industry sub-sectors

The ceramics industry is composed of a range of industrial sub-sectors (Table 29), producing a wide variety of products and serving many different markets.

Table 29: Sub-sectors in the UK and France ceramics industry, 1993

	UK			France		
Product Sub-sector	**Turnover of UK company's (1993) (ECUM)**	**Number of UK Co's[1]**	**Employees in 1993 [2]**	**Turnover of Fr company's (1994) (ECUM)**	**Number of Fr Co's[3]**	**Employees in 1994 [4]**
Table / ornamentalware	825	40	20,289	410	93	7,463
Tiles	150	5	2,187	500	27	4,865
Sanitary-ware	220	7	3,024	420	9	5,073
Refractory products	565	30	4,554	585	28	4,726
Technical/advanced ceramics	90	17	1,518	70	12	900
Bricks/roofing tiles/pipes	600/60/140	35/8/6	10,030	250/345/30	23/12/8	5079
TOTAL	**2,650**	**148**	**41,602**	**2,610**	**212**	**28,106**

Adapted from:
1 - **BCC's estimates of companies with over 25 employees, there are approximately 250-300 co.'s with less than 25 employees.**
2 - **employee figures obtained in a BCC study covering approx. 90% of the industry sub-sectors.**
3 & 4 **SESSI (1995), DAFSA (1995). Companies with over 25 employees in France and overseas department.**

For the UK, the government's system of compiling industry data has changed for 1993 compared to that used for 1992 and in previous years. The 1993 figures, released in January 1995, are published under the "UK Markets" series which has replaced the "Business Monitor". Business Monitor surveys referred to cover approximately 82% of the tableware, sanitary-ware and industrial ceramics companies and 65% of refractories.

3.2.2 The tableware & ornamental ware industry

3.2.2.1 The UK tableware & ornamental-ware industry

UK tableware and ornamental-ware manufacturers produce a wide of range of porcelain, bone china, vitrified hotelware, earthenware and stoneware items such as crockery, plates, cups, teapots, vases, decorative figurines etc.

The UK tableware segment has established a long reputation of quality and up until the late nineteenth century England was the only manufacturer in Europe to incorporate calcined animal bone in a porcelain body (Rado, 1988). The particular fascination of the so-called bone china clay lies in the fact that, unlike all other ceramic products, it contains a material (the main constituent) that is not of mineral origin and which guarantees the whiteness and translucency of the product. The porcelain factory at Bow was the first to use bone china clay and it was soon adopted by all porcelain makers in England. Approximately half (48%) of the UK's employment in the ceramics industry is in tableware manufacture (Table 29). It is a relatively labour intensive sector, demanding high levels of craftsmanship. The UK tableware sector is made up of approximately 40 companies employing over 25 staff, and another 200 companies employing less than a dozen. As such it is characterised by a small number of large companies and many more smaller producers, as shown by Table 29. The 15 largest firms operate internationally and dominate the UK ceramics sector. The majority of these producers, and indeed other sub-sectors of the ceramics industry, are located in the Staffordshire region. This reflects the industry's geographical roots in the Industrial Revolution, close to supplies of raw material and coal fuel. The region's clay reserves are now either mined out or have been built upon; clay raw materials are now mostly sourced from Devon & Cornwall.

Table 30: Manufacturers' shares of the UK china and earthenware market, 1993

Company	**Company Turnover (ECU M)**	**Percentage share by value**
Royal Doulton	232	23%
Josiah Wedgwood & Sons Ltd	180	18%
Staffordshire Tableware	55	5%
Royal Worcester & Spode (Derby Intl Grp)	50	5%
John Tams	37	3%
Churchill Tableware Ltd	36	3%
Portmeirion Potteries Plc	35	3%
Other UK companies	200	20%
Imports	190	20%
TOTAL	**1015**	100.00%

Source: Financial survey (1995)

3.2.2.2 The French tableware industry

Porcelain dinnerware represents 72% of the total production of tableware manufactured in France and generated a turnover of ECU 170 million in 1994 (Offrir, 1995). The word "porcelain" has its origin in the Italian "porcella", literally "little pig", a Mediterranean sea-snail, whose shell is white and translucent. Marco Polo was the first to apply the name to porcelain. Porcelain is thus a collective term comprising all ceramic ware that is white and translucent, irrespective of its ingredients or use. Production is mainly located in the Limoges area and in the Berry region because of the proximity of raw materials necessary for porcelain manufacture. The origins of Limoges porcelain arose from two concurrent events : the revealing in 1720 of the Jean-Frederic Böttger formula to create a hard porcelain and the discovery of a deposit of kaolin near Limoges at Saint-Yrieix-la-Perche in 1767 (Liverani, 1959).

The story goes that this discovery was a fluke. At that time there was a shortage of soap and a Mrs. Darnet, the surgeon's wife, who had been using local clay to lift grease stains from her washing, had the idea of using it as a whitener. Her husband, interested by this brainwave spoke about it to a former colleague, Mr Vilaris and gave him samples of this clay. Mr Vilaris, an apothecary, identified the white clay as a remarkably pure kaolin.

Mr. d'Albis, author of "The history of the Limoges Porcelain", emphasises that the reality is more complex[3]:

> *The Royal court had attached great importance to the prospection for kaolin and the prospecting was being firmly led by Mr. Bertin, a King minister, with the help of the Department of Civil Engineering and the local authorities.*

The combined factors of the presence of kaolin, the proximity of very pure water and the local forests which could be used to fire the kilns enabled Turgot, "the Intendent General of Limousin", to order In 1771 the construction of the factory of Comte d'Artois, the first in Limoges. In fact, it was thanks to his decisive action and the "savoir-faire" of the manufacturers of the period that the porcelain industry crystalised in the Haute-Vienne region, and more precisely in the immediate vicinity of Limoges. In 1907, at the height of its fame, the Limousin (Limoges region) porcelain manufacturers employed over 15,000 people and exported 80% of their production. The First World War, followed by the 1929 slump and then the Second World War, led to a loss of the qualified work force and a decline of foreign markets . Today, Limoges employees 2,130 people (Table 32) on some 41 sites (28 companies) and its production accounts for 52% of the French porcelain turnover and 63% of

---

[3] Boileau, manager of the "Manufacture Royale de Sèvre", had been giving samples of kaolin to important visitors to see if there were similar deposits in their countries (CCI, 1995). The Archbishop of Bordeaux brought back a piece to his diocese and showed it to Vilaris who immediately recognised it as the clay shown to him by Darnet. Bertin sent the chemists Macquer and Millot, directors of the paste laboratory of the Royal Manufacture of Sèvre to Saint-Yrieix-la-Perche. After many adventures, Macquer and Millot found a deposit of "whiteness and beauty so incredible that you could have gone down on your knees before it". A few month later, the quarry was bought on the King's behalf.

French exports (SESSI, 1995). Table 31 presents the geographical distribution of the ceramics industry in France.

Table 31: Geographical distribution of the tableware and ornamental ware industry

Principal regions	Number of company's[1]	Employees in 1994
Limousin	41	2,130
Centre	18	1,457
Bourgogne	4	629
Poitou-Charente	7	469
Sub total	**70**	**4,685**
Other	23	2,778
Total	**93**	**7,463**

1- Company's with over 25 employees in France and overseas region (SESSI, 1995).

Table 32: Size of firms in the Limoges region by staff numbers in 1994

Size of businesses	Number of businesses		Staff
(by staff numbers)	Total	of which decorator	numbers
Less than 10	92	90	38
10 to 49	15	3	456
50 to 99	9	0	633
100 to 199	3	0	348
200 to 499	2	0	655
over 500	0	0	0
Total	**121**	**93**	**2130**

Source: CCI Limoges (1995)

In terms of employees and turnover, the two main companies that have their head offices in Limoges are Bernardaud (Turnover : ECU 31M - 400 employees) and Haviland (Turnover : ECU 13M - 237 employees). However, major competitors such as Phillippe Deshoulières, Guy Degrenne, Lourioux and Borgosesia are also present in Limoges with various production sites.

Unlike porcelain, earthen pottery is produced throughout France and represents 28% of French crockery production. Overall, the industry employs 5,400 people, with a turnover of ECU 240 million in 1994 (Offrir, 1995). Figure 34 presents the production breakdown by sales.

Figure 34: Production breakdown by sales in 1994

Aston University

Illustration removed for copyright restrictions

Source: CCI Limoges

Over the last decade the production of porcelain has decreased by 30%, dropping from 19,000 tonnes to 13,300 tonnes (Figure 35) due to a slowing down of consumption and, more alarming, an inadequacy on the suppliers side to heed consumer demand. Despite a strengthening recovery since 1993, French porcelain suffers from an economical environment unfavourably affected by monetary fluctuations. Between 1991 and 1994, 80 porcelain companies were declared bankrupt. The trade balance for tableware and ornamental ware showed a deficit in 1994, ECU 170 million exported against ECU 251 million imported (Douanes, 1995).

Figure 35: French Production of Porcelain

Aston University

Illustration removed for copyright restrictions

Source: SESSI

3.2.2.3 Strengths and Weaknesses of the UK and French tableware industries

The UK and France have a long tradition of manufacturing and exporting tableware products. The UK is the fourth largest world-wide supplier of tableware goods with a market share of 8%, followed by France with 7% (Figure 36).

Figure 36: Principle exporters of tableware products in 1994

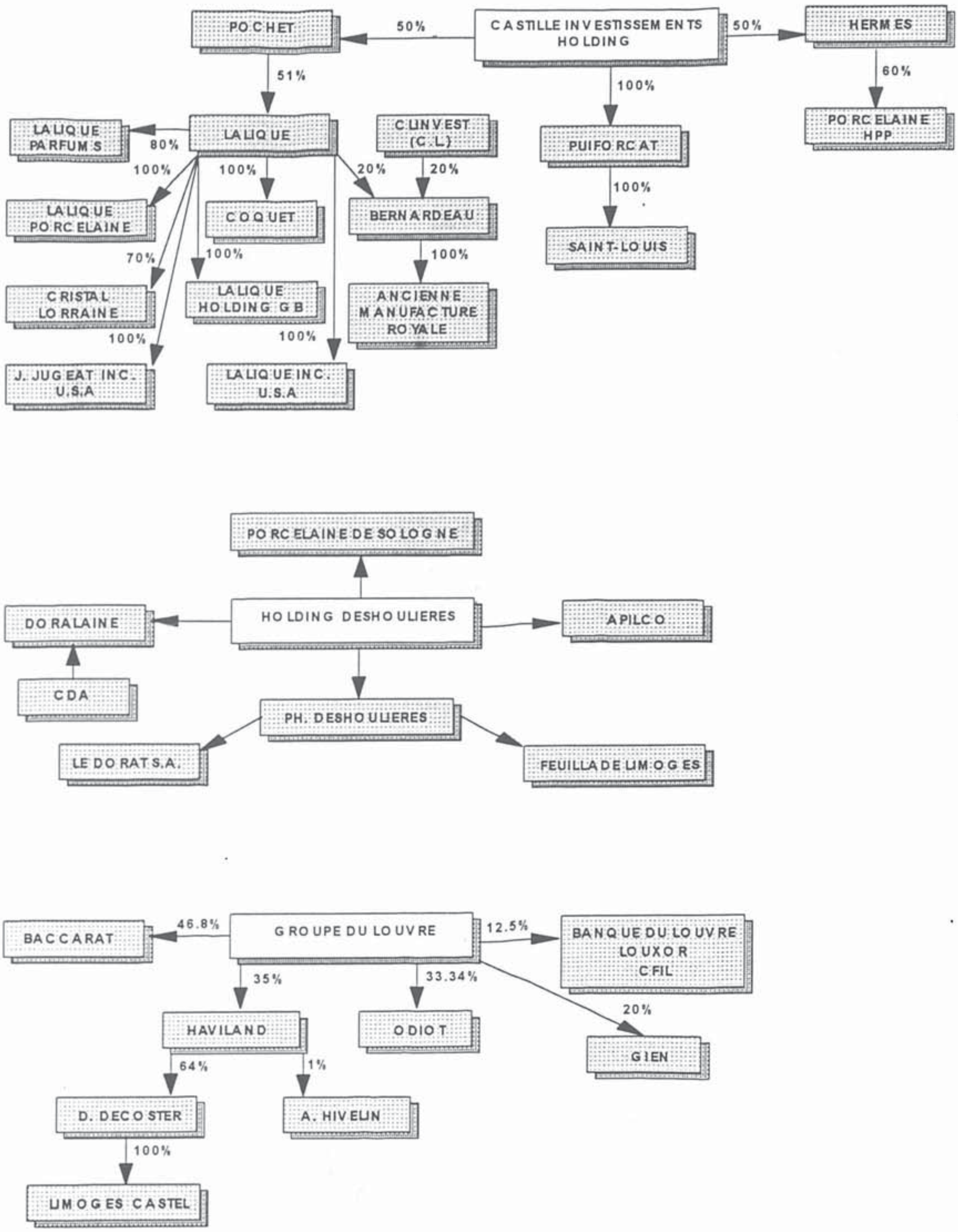
Source: CFCE

Over the last decade products in both countries have evolved to adapt dishware to present service conditions:

- dishwasher resistant;
- sturdy: resistant to scratches from steel cutlery;
- suitable for use in microwave ovens.

The main strength of the UK and French manufacturers is the image among the public of high quality products often combined with high price. This image is essential for the luxury market and is reinforced by brand names known all other the world, such as Wedgwood or Limoges. To strengthen this image, English and French tableware products are often sold only in exclusive retail outlets. However, when the purchase is for daily use this strength could sometimes be perceived as a handicap as people are not willing to spend so much money and fear breakage. Furthermore, year after year the luxury market is losing its market share (minus 10% over the last 2 years) to middle range products made in low labour countries which often adopt a copying policy. These cheaper products represent an increasing share of the market and may be purchased in shops visited frequently by people i.e. supermarkets. So far, the response to these new competitors has been greater in the UK, where larger manufacturers have rapidly created brand names specifically dedicated to supermarkets and which are more affordable. French manufacturers, until very recently, were still owned by founder families who either did not want to merge with other manufacturers to realise economies of scale or refused to accept new shareholders who were able to bring capital i.e. multinational groups, banks, etc.. Over the last few years, prestigious companies have been forced to merge in order to survive and thus international groups have emerged. Merging and acquisition was aimed at strengthening their position allowing them to enter new markets and vertically integrate the tableware market (Cutlery ware, crystal ware, porcelain, etc.) so as to gain a sustained competitive advantage (Figure 37).

Figure 37: Major French tableware groups in 1995



3.2.3 The sanitary-ware industry

3.2.3.1 The UK sanitary-ware industry

Sanitary-ware encompasses all ceramic bathrooms, lavatories and kitchen fittings. There are only 7 UK sanitary-ware producers, of which the largest four manufacturers account for a total of over 80% of the UK sanitary-ware production volume: Armitage Shanks, Caradon

Bathrooms (formerly Twyford Bathrooms), Ideal Standard and Shires. The UK sanitary-ware industry employed approximately 3,000 people in 1993.

Table 33: The UK sanitary-ware manufacturers, 1993

UK Sanitary-ware Manufacturers	**Company Turnover 1993 (ECU M)[1]**	**Percentage Market share by value**
Caradon Bathrooms	57	24%
Armitage Shanks (Blue Circle Group)	50	21%
Ideal Standard	30	12%
Shires	22	9%
Others	61	25%
Imports	23	9%
TOTAL	**243**	**100%**

Source: Financial survey (1995)
1 = approximate turnovers

3.2.3.2 The French sanitary-ware industry

France is the second largest European manufacturer of ceramics for sanitary-ware with 18% of total production. Over the past few years, this sector has faced profound changes and concentration (Le Sech, 1995). In 1994, 83% of the employment was concentrated within five companies (SESSI, 1995). Principally, industrial restructuring activity has integrated most French ceramics companies within international groups. In 1994, only nine manufacturers remained with a combined production of 200,000 metric tons and a turnover of ECU 420 million, namely,

- Allia (Metra group)
- Duravit (Subsidiary of the German Group Duravit)
- Ideal Standard (Subsidiary of the American Group Standard)
- Porcher (Subsidiary of the American Group Standard)
- Jacob Delafon (Kohler Group)
- Selles (Sphinx Group)
- Sarreguemines
- Villeroy et Boch

This sector has been deeply affected by the recession and the decrease in new building programmes. Consequently, within a 15 years period, the number of plants has dropped by 25%. Productivity in the 15 remaining plants has significantly increased (by around 40%

during the same period) employing approximately 5,000 people in 1994 (SESSI, 1995). Figure 5 presents the French sanitary-ware market for 1994 in millions of pieces.

Figure 38: French sanitary-ware market for 1994 in millions of pieces

Source: Société Française de Céramique (1994)

3.2.3.3 Strengths and Weaknesses of the UK and French sanitary-ware industries

The recent and ongoing recessionary pressures have deeply affected the UK and French sanitary-ware industry. The effect of the recession on the sanitary-ware sector and the evolution of demand has forced manufacturers to initiate a drastic change of the production process. Indeed, demand has evolved considerably and bathrooms of the past are barely recognisable with the fitted bathrooms customers aspire to today. Over the last decade, the sanitary-ware market shrank considerably and synthetic products have penetrated the market to directly compete with ceramic goods. However, the main strength of the UK and French industries is that they are integrated into international groups that are more able to face global competition thanks to financial structures which allow them to support Research and Development and advertising campaigns through mass media.

3.2.4 The tile industry

3.2.4.1 The UK tile industry

The UK's ceramic tile manufacturers (excluding roofing tiles) produce a wide range of glazed, unglazed and decorative wall and floor tiles for domestic and commercial use, and supply both the UK and overseas markets. There are approximately 20 companies manufacturing tiles in the UK, of which 5 dominate in terms of size. The sub-sector's approximate total turnover is ECU 150 million. The largest of these producers is H & R Johnson. The UK market absorbs more than 51 million m^2 per year of ceramic floor and wall tiles, representing

2.2 per cent of world production in 1994. The UK production for this period was 20 million m^2 of which 4 million m^2 was exported; and on the balance of 35 million m^2 was imported.

The sector is highly competitive, with Italy and Spain leading the European market and penetrating the UK market.

Table 34 : The UK's ceramic tiles market, 1993

Manufacturers' Shares of the UK Ceramic Tiles 1993 (% by value)	**Company Turnover 1993 (ECU M)**	**Percentage Market share by value**
H & R Johnson Tiles	81	26%
Pilkington Tiles	34	11%
Daniel Platt	9	3%
George Woolliscroft Tiles	7	2%
Candy Tiles	4	1%
Others	15	5%
Imports	165	52%
TOTAL	**315**	**100%**

Source: Dunn & Bradstreet

3.2.4.2 The French tile industry

The French ceramic tile industry manufactures a broad range of products for floor and wall tiling. These products can be broken down into three major types that correspond to different uses:

- unglazed vitrified tiles for outdoor walls and floors;
- glazed vitrified tiles;
- glazed porous tiles for indoor wall coverings.

France is the fourth largest European producer of ceramic tiles, after Italy, Spain and Germany. Annually, 46 million m^2 of ceramic tiles are manufactured by 27 companies in 32 production plants throughout the country, of which 16 million m^2 are exported. Between 1986 and 1994, production increased by 60%. This industry employs a staff of 4,800 and in 1994 had a turnover estimated at ECU 410 million, of which 33% was for export (SESSI, 1995). However, French demand for tiling (floor and wall) has stagnated at approximately 91 million m^2, corresponding to 3.7% of world production, of which 70% is imported (61 million m^2). The market is equally divided between wall coverings and floor coverings (Moretti *et al*, 1995). Renovation is the principle driver of this market (accounting for 60% of the total figures) and has been largely responsible for stimulating the strong recovery in the demand for ceramic tiles, which in 1994 was approximately 7% up on the previous year (Frost & Sullivan, 1995). Figure 39 below shows the French consumption per product for 1994.

Figure 39: French consumption per product for 1994 in percentage

Aston University

Illustration removed for copyright restrictions

Source: Chambre syndical du carreau céramique de France

The majority of French imports, in terms of both value and quantity, come from Italy: 42.4 million m^2 were imported in 1994 as opposed to 36.8 million m^2 in 1993 and 35.6 million m^2 in 1992 (Assopiastrelle, 1995). This is followed, in terms of quantities exported annually, by Spain (whose main producers, while being able to count on highly competitive prices, suffer from a poor capacity to consolidate their commercial footing in France) and Germany, whose particularly strong currency penalises the competitiveness of its companies. Alongside these "traditional" exporters there are a number of new countries, including Portugal, Czechoslovakia, and Turkey, which, with average prices significantly lower than those of other producers, have contributed to a stepping up of competition, even though the quantities they export are still very small and their products do not meet Italian, Spanish or German technical standards.

In spite of the good competitive capacity of foreign ceramic firms, the French producer's sales in term of quantity have gradually increased, above all as a result of the high growth rate shown by their exports, which at 16 million m^2 in 1994 accounted for about 36% of the sector's total turnover as opposed to 24% in 1988. The poor capacity illustrated by local firms to strengthen their position on the domestic market is attributable to numerous factors, including:

- competitive prices of international rivals;

- a progressive decline in the importance of the brand name in consumers purchases;
- concentration of the distribution system;
- a poorly balanced aggregate supply structure.

With regard to this last factor, it is important to emphasise the substantial inability of French industry to meet the demand for wall covering products, while on the other hand more than 50% of the demand for ceramic floor tiles is covered by national production. This asymmetry in supply weakens the French industry with respect to foreign rivals, who not only have the advantage of lower prices, but can also boast a wider and deeper product mix.

3.2.4.3 Strengths and Weaknesses of the UK and French tile industries

The UK and French averages per capita consumption of ceramics remain one of the lowest in Europe (0.92 m^2 and 1.6 m^2 per year respectively) due to a well established tradition in the use of alternative products which satisfy most of the demand for floor and wall materials such as parquet, carpet, etc.. The tile industry in the UK and France is not very well developed and the strategy adopted by these manufacturers is the production of small batches, complex product options and the maintenance of strict quality standards, in other words competition based on quality instead of quantity. However, the major drawback of this strategy is that UK and French firms are relatively small compared to their major competitors and therefore are extremely vulnerable and coveted by larger ceramic groups who seek horizontal external growth.

3.2.5 The brick industry

3.2.5.1 The UK brick industry

The UK brick industry produces three main brick types: clay, calcium silicate and concrete. Table 35 shows the UK output of these brick types, based upon a projected output for 1995 of 3.7 billion bricks.

Table 35: Projected UK brick output for 1995

Brick type	% of total brick output & N° of bricks produced per annum		Approx. Value (ECU)
Clay	92.5%	3.420 million	ECU 500 million
Concrete	6%	222 million	ECU 70 million
Calcium Silicate	1.5%	55 million	ECU 30 million
Total	100%	3.700 million	ECU 600 million

Source: The Brick Development Association (BDA), 1995

As indicated in the above table, the clay bricks segment represents 92.5% of the UK total brick output and incorporate three types of brick; facings, commons and engineering bricks.

- Facing bricks are relatively high quality products, with an appearance and weather-resistance suitable for use in the outer leaf of a wall or in an external brick panel. They are made in a wide variety of textures and colours.
- Commons bricks are lower-quality products with lower frost resistance, and are used for the inner leaf of cavity walls or for internal walls.
- Engineering bricks are shaped from a clay such as Eturia Marl which, when fired at high temperature, will vitrify to produce a brick of high strength and low water absorption. They are used where load-bearing and severe weather resistance is important.

In 1995, the UK brick industry was made up of 90 manufacturers of clay, calcium silicate and concrete bricks, operating from approximately 150 brickworks, of which 130 produce clay bricks. The industry is dominated by four companies: Hanson Brick, Redland, Ibstock and Tarmac (See Table 36). All four operate more than ten sites each and together manufacture 60% to 70% of the total annual UK brick output. The Hanson Brick company was formed in September 1995, and combined the London Brick Company (LBC) acquired in 1984 with Hanson's other UK brick company, Butterley Brick. If independent, LBC would be the largest brick company in the UK (annual turnover approximately ECU 110 million), and Butterley the second largest (annual turnover approximately ECU 60 million). LBC's principal products are known as Fletton bricks, from the original plant of Fletton near Peterborough where the fuel saving properties of Lower Oxford Clay for brick manufacture were discovered in the 1880s. The high organic content of the brick effectively means that the bricks burn themselves, requiring only small amounts of additional fuel. Fletton bricks are a relatively low quality, inexpensive brick traditionally used for house facings. However, they are more porous and less frost resistant than extruded wirecut products and are commonly used for cheaper housing. Butterly Brick produces non-Fletton wire-cut bricks using tunnel kilns rather than the Hoffman kilns used for Fletton brick.

Medium-sized companies such as Baggeridge Brick, Chelwood Brick (formerly Salvessen Brick) and Marshalls Clay Products each operate between two and six sites. The remaining 80 plus companies either operate one or two brickworks or are manufacturers of non-clay bricks. The majority of these smaller producers make bricks for the specialist, higher priced end of the market, the brick being hand-made in some cases.

The high volume and low value of a brick limits the commercial viability of exports. Only 1.5% to 3% of the UK brick market is supplied by imports, mainly from Belgium and Ireland. Exports of bricks from UK producers account for only 2% of UK brick production.

Table 36: The UK's major brick producers

Aston University

Illustration removed for copyright restrictions

Source: The Brick Development Association (BDA), 1995

Employment levels in the UK brick industry over recent years are shown in Figure 40. The 33% decline since 1988 both reflects a reduction in the market demand for bricks and a trend amongst many of the larger manufacturers towards investments in labour saving, capital intensive production equipment, such as extruders for brick forming and automated brick handling equipment with modern tunnel kilns.

Figure 40: Employment in the UK brick industry

Aston University

Illustration removed for copyright restrictions

Source: BDA, 1995
Note: from 1989 to 1993, LBC employment levels were in the range 1001-1500

3.2.5.2 *The French brick industry*

For several decades now the French Brick industry has lost market share to concrete blocks. France has large supplies of low-cost sand and aggregates. Regions like the east and south-west of France have stood up to the competition. Furthermore, construction styles in France make little use of facing bricks which are manufactured largely in the north, in the Paris region and around Toulouse.

In the last two decades the employment in the brick industry has decreased from 12,000 in 1974 to only 2,000 in 1994, concentrated in 23 companies. In 1994, the turnover of these companies reached ECU 250 million (SESSI, 1995) for a production distributed as follow:

- Hollow bricks for walls, partitions and floors, that is, bricks with a 60-65% cavity: approximately 1,984,000 m^3 in 1994;
- wall and partition bricks with vertical perforations: approximately 833,000 m^3;
- facing bricks and accessories, pavers: approximately 320,000 m^3.

The French brick industry is concentrated in the hands of a small number of large groups (Guizol, 1995); 95% of brick production is handled by:

- C.R.T.C. (north)
- Desimplel (Central France)
- Imetal
- Migeon (East and South)
- Pacema (Paris - north)
- Poliet (South)
- Sibo (West)
- Sturm (East)

3.2.5.3 *Strengths and Weaknesses of the UK and French brick industries*

The UK and French markets have contracted since the 1950s and 1960s in line with the level of activity in the housing sector. Traditionally, bricks are used more commonly in the UK housing sector and despite a weak recovery in brick sales in 1993-94 the short term industry's projection remains pessimistic. Over the last decade, the French housing market has substantially declined and in order to stop this slump the French government in 1995 provided incentives such as interest free loans to first-time buyers or to people who undertook renovations/extensions to their dwellings. These measures aimed to strengthen the actual construction market and subsequently the supply side.

As with UK the principal characteristic of the French brick market is that import penetration is very low due to the nature of the product; high volume, low value products, where transport costs can be significant. However, the UK brick market as a whole is demanding higher quality bricks, in terms of physical characteristics such as insulating capability, frost resistance, and, importantly, appearance. Thus traditional Fletton bricks, characterised by relatively low prices (approximately ECU 155 to ECU 185 per 1000) and relatively low physical quality, are now coming under competition from mid-range products, priced ECU 185 to ECU 255 per 1000. Therefore, foreign modern brick factories such as those in France and Belgium may be capable of exporting higher quality products at competitive prices into the UK market. Furthermore, competition is also coming from product substitutes, such as concrete bricks for clay bricks. This particularly affects the clay "commons", where concrete inner wall bricks compete on strength and insulation properties.

In spite of this, the brick industry in both countries is primarily dependent upon the existing level of domestic demand and upon the price elasticity of that demand. For instance, the market for new housing bricks is far more sensitive to price than the renovation/extension market.

3.2.6 The refractory and industrial ceramics industry

3.2.6.1 The UK refractory industry

Refractories manufacture is a large and highly diverse sector, and uses a variety of clay-based and non-clay-based materials: fireclay, silica, magnesite, chrome-magnesite, sillimanite, and special refractory materials including sintered alumina, beryllia, silica carbide, zircon and boron nitride. Its products are not always made from clay and are not always fired. Like advanced ceramics, many aspects of refractories do not sit naturally with the three sectors of tableware, sanitary-ware and tile manufacture.

Refractory materials are able to withstand corrosive and other destructive forces at extremely high temperatures. They are therefore used for four basic functions: as a *heat buffer* between the hot substance and the walls of the containing vessel; as a *chemical barrier* to prevent hot substances eroding the walls of a containing vessel; as *physical protection* for the walls of the containing vessel; and for *heat retention* of hot substances contained in the vessel, thereby reducing energy requirements.

The bulk of the refractory products, which may be shaped or granular in form, are based on naturally occurring and synthetic minerals. The volume made from natural minerals, particularly clay-based materials, is decreasing.

Refractory products are used by a wide range of industries, but the main customer is the steel industry which accounts for 65% of UK sales. This sub-sector also supplies the rest of the ceramics industry, for its kiln firing processes. Refractories are used in the construction of kilns and for "kiln furniture" on which the unfired ware is placed for firing. There are approximately 30 UK refractory producers generating a turnover of ECU 565 million of which 6 generate a turnover of ECU 318 million (Table 37); the largest of these companies is Hepworth Refractories Ltd, a division of Hepworth Plc. Hepworth imports 90% of its raw material, exports 65% of its finished product and supplies over 50% of its output to the iron and steel industry. Other major producers are Baker Refractories Ltd (which is part of Redland Group Plc), and Dyson Industries Ltd (part of J & J Dyson Plc).

Table 37: The UK's refractory manufacturers, 1993

Refractory Company	**Company Turnover 1993 (ECU M)**	**Percentage Mkt. share by value**
Hepworth Industrial Ceramics	140	21%
Baker Refractories	51	7%
Dyson Industries	40	6%
Hoben Davis	7	1%
Vesuvius (in Cookson Group)	45	7%
Morgan Refractories	35	5%
Others	247	36%
Imports	115	17%
TOTAL	**680**	**1%**

Source: Dunn & Bradstreet (1994)

Sales in tonnes across a variety of refractory products are shown in Table 38.

Table 38 : The UK annual refractory sales (tonnes)

	Sales 1989 (tonnes)	Sales 1990 (tonnes)	Sales 1991 (tonnes)
Firebricks & blocks	105,716	66,515	48,807
High alumina bricks	119,205	107,114	92,639
Magnesite &/or chrome	114,640	111,063	99,655
Fireclay holloware & insulating bricks	-	34,306	21,323
Castables	-	1-3,575	90,283
Special refractories (Zircon, silicon carbide)	3590	2,969	-

source: Central Statistical office (1994)

The Advanced Industrial Ceramics sub-sector is highly diverse. The product range includes electrical insulator porcelain, components for diesel engines and gas turbines, rocket nose-cones and orthopaedic replacements. There are approximately 17 companies in the UK's industrial ceramics market of which Morgan Matroc is the largest by a significant margin. Others include A G Hackney, Wade Ceramics, Taylor Tunnicliff, Fairey Industrial Ceramics, Universal Abrasives and GEC-Alsthom. CERAM Research, the part DTI-funded technical and ceramics industry research association, is also active in this sector.

Table 39: The UK's advanced/industrial ceramics manufacturers, 1993

Company Ceramics	Company Turnover 1993 (ECU M)	Percentage Market share by value
Morgan Matroc (Morgan Crucible Grp)	44	38%
Allied Insulators (Fairey)	14	12%
A G Hackney	7	6%
Cookson Ceramics (Cookson Group)	17	15%
Others	8	7%
Imports	26	22%
TOTAL	**116**	**1%**

Source: Dunn & Bradstreet

Although advanced ceramics have their roots in UK research of the 1960s, reductions in funding at a time when Germany, Japan and the US were increasing financial support for research into these materials caused the UK advantage to slip. The global market in 1991 was shared mainly by Japan (59%) and the US (30%), with Western Europe accounting for only 8%. UK companies which are known to have a research/production involvement in advanced ceramics include; GEC-Alsthom, Lucas Industries and Rolls Royce, of which the latter set up a 50:50 joint venture with the Howmet Corporation (US) to develop a spectrum of aero-engine components.

3.2.6.2 The French refractory and advanced ceramics industry

The French refractory product industry is the fourth largest in Europe and employs a staff of about 4,700 (SESSI, 1995). In 1994, the turnover was ECU 585 billion and production 360,000 metric tons, of which 60% was exported. This production comes from 28 companies with 30 plants. Figure 41 shows the market percentage of each refractory product.

Figure 41: Production broken down by properties

Source: Société Française de Céramique

Over the past 10 years, companies have placed emphasis on productivity and quality. This was only possible through the grouping of the industry in order to create groups with European dimensions. In France, 65% of production comes from two major companies:

- Lafarge Réfractaires Monolithiques, which specialises in non-shaped refractories.
- SEPR (Société Européenne de Produits Réfractaires), world leader in the manufacture of electrofused refractories.

The advanced ceramics manufacturers in France belong essentially to industrial groups such as :

- Aérospatiale;
- Péchiney Ugine Kulman;
- Rhône-Poulenc;
- Saint-Gobain;
- SEP;

- Thomson.

At present, the French advanced ceramics market generates a turnover of ECU 70 million and employs a total of 900 people. However, this segment is regarded by multinational companies as one of the few ceramics sector which will grow in the near future and should originate substantial profit.

3.2.6.3 Strengths and Weaknesses of the UK and French refractory and advanced ceramics industries

The demand for refractory goods, especially firebricks, is predicted to decrease, principally due to a decline in steel production. Therefore, global export opportunities for the UK and France are shrinking and competition has intensified. The demand for such products has moved from Europe to Japan and China; these two countries possess a well developed domestic industry which is continuously seeking to improve product research, production efficiencies and cost reduction. The UK and French producers will be able to retain their market share only if they adopt exactly the same strategy.

The advanced ceramics sector is a completely new market and is not really comparable with the traditional ceramics market. The potential growth of this market is very high and countless opportunities exist. At present, advanced ceramics techniques are used in bio-medical, automotive, engineering, electronics and space applications. Current research into clay materials is focusing not only on improved specialist body compositions, but on perfecting ceramics with superior fracture and wear resistance, and qualities to compete with metals. The ceramic blade is already becoming a reality. At the moment, the UK and French manufacturers control about 1.5% and 2% respectively of the global market, compared to 59% for Japan, 30% for the USA and 5% for Germany. This market share is unlikely to rise in the near future unless government and private investment in Research and Development increases.

4. *CRITICAL ANALYSIS OF THE CERAMICS SECTOR*

This concluding section aims to identify the overall barriers affecting the ceramics industry in both the UK and France. As presented in Table 40, barriers fall broadly into two categories: financial and technological.

Table 40: Barriers affecting the ceramics industry

FINANCIAL	The sector as a whole is under-capitalised. Business uncertainty, lack of capital, characteristically low profit margins, the requirement for short pay-back periods, lack of a long-term perspective (companies frequently opt for the short-term, end-of-pipe fix) and concern for high interest/discount rates deters many manufacturers from investing in new technology with high capital costs. Capital constraints are particular acute for the smaller companies in sub-sectors with low profit margins, not only limiting investments in new technology, but also in manpower resources. The industry is characterised by many small companies and it is generally more difficult for smaller organisations to keep up with technical advances. However, this constraint was also identified by larger companies interviewed in this study.
TECHNOLOGICAL	Some of the basic processes and practices in the ceramics industry have remained essentially unchanged for many decades and even centuries. As a result the perception sometimes exists that the sector cannot make significant improvements in its process efficiency. Furthermore, the ceramics industry produces a very wide range of products, and employs a large scope of technologies. Technology improvements therefore need to focus on specific company processes, and a technical solution found by one producer is not necessarily suitable for another producer. One exception to this is the tile industry, which uses virtually the same manufacturing process throughout Europe. Finally, many companies have occupied the same sites for many years. The buildings are often old and multi-floored, which means that they cannot introduce the modern efficient production technologies that work best when on one/ground floor and laid out in a straight line. They have often become land-locked for space as development has occurred around them.

CHAPTER 5

MANUFACTURING PROCESSES AND KEY ENVIRONMENTAL IMPACTS

1. INTRODUCTION

After having examined in depth the industry's current performance across the production of ceramic tableware, sanitary-ware, tiles, bricks, refractories, advanced ceramics and highlighted the strengths and weaknesses of this sector, this chapter considers the production process in terms of process components that are common to the ceramics industry sub-sectors with the dual aims of determining waste arisings (solid, liquid and gaseous) generated from these components and hence the identification of the key environmental impacts of the individuals ceramics industry sub-sectors. The table (Table 41) below presents the common type of wastes produced by the ceramics manufacturing process.

Table 41: Type of wastes generated during the production process

	Solid	Liquid	Gaseous
Waste from the clay/raw material preparation stage	√	√	
Plaster (calcium sulphate) from worn-out plaster moulds used in the body forming stage	√		
Waste generated from the drying process		√	√
Waste from the glazing stage		√	√
Waste from the firing stage	√		√
Waste from the decorating stage			√
Packaging waste	√		

Where appropriate, information has been presented in the chapter in a general, non-attributable way, in order to avoid infringing agreements on confidentiality. However, in the course of the study, it emerged that quantitative data relating to waste totals generated by the whole industry did not already exist in the public domain. Almost all the companies interviewed classified these data as confidential fearing that it could be detrimental to their interests. Only a small number of companies consented to supply figures on waste arising.

1.1 Objectives

The objectives of this chapter are twofold:

- to identify the waste arisings from the common process components and discussed the nature of their associated environmental impacts;

- to analyse the impacts of solid & liquid wastes, gaseous & noise emissions on the environment (defined as air, water, land, waste and noise) and compare the environmental performances of the two countries.

2. *MANUFACTURING PROCESS & WASTE ARISINGS*

Ceramics products are created from the forming and firing of clay and other minerals. The basic steps in this process are common to the different sub-sectors of the industry - tableware, sanitary-ware, tiles (glazed and unglazed), bricks, and "clay" based refractory products. The detailed production processes and the technologies used, however, vary between the different industry sub-sectors, within individuals sub-sectors and even across different production lines on individual factory sites. Some of the general processes used in other sectors of the industry are also relevant to the manufacture of advanced ceramics and non-clay based refractories. However, the highly specialised and varied nature of these products and processes make it inappropriate to consider these parts of the industry areas in such general terms.

This section describes in detail each of the common process components commonly encountered in ceramics manufacturing, as well as the nature, significance and environmental impacts of the waste arisings generated. As illustrated in the flowchart in Figure 42 and in Table 42, ten major components in the production process need to be considered:

1.	Raw Material/Clay Preparation	**6.**	Glazing
2.	Mould Making	**7.**	Firing
3.	Shaping the Clay Body	**8.**	Decorating
4.	Drying	**9.**	Inspection
5.	Finishing	**10.**	Packaging

Typically, waste - in solid, sludge, and gaseous form - is generated by the ceramics manufacturing process. The volumes and content of these arisings, like the manufacturing process itself, vary between the different ceramic sub-sectors and also between competitors within a specific sub-sectors. Indeed, the volume of waste generated is affected to a large extent by the level of production control, quality of product design, quality of production equipment, quality of raw material inputs, quality of management and production-line workforce.

Figure 42: Common process components of ceramics manufacture

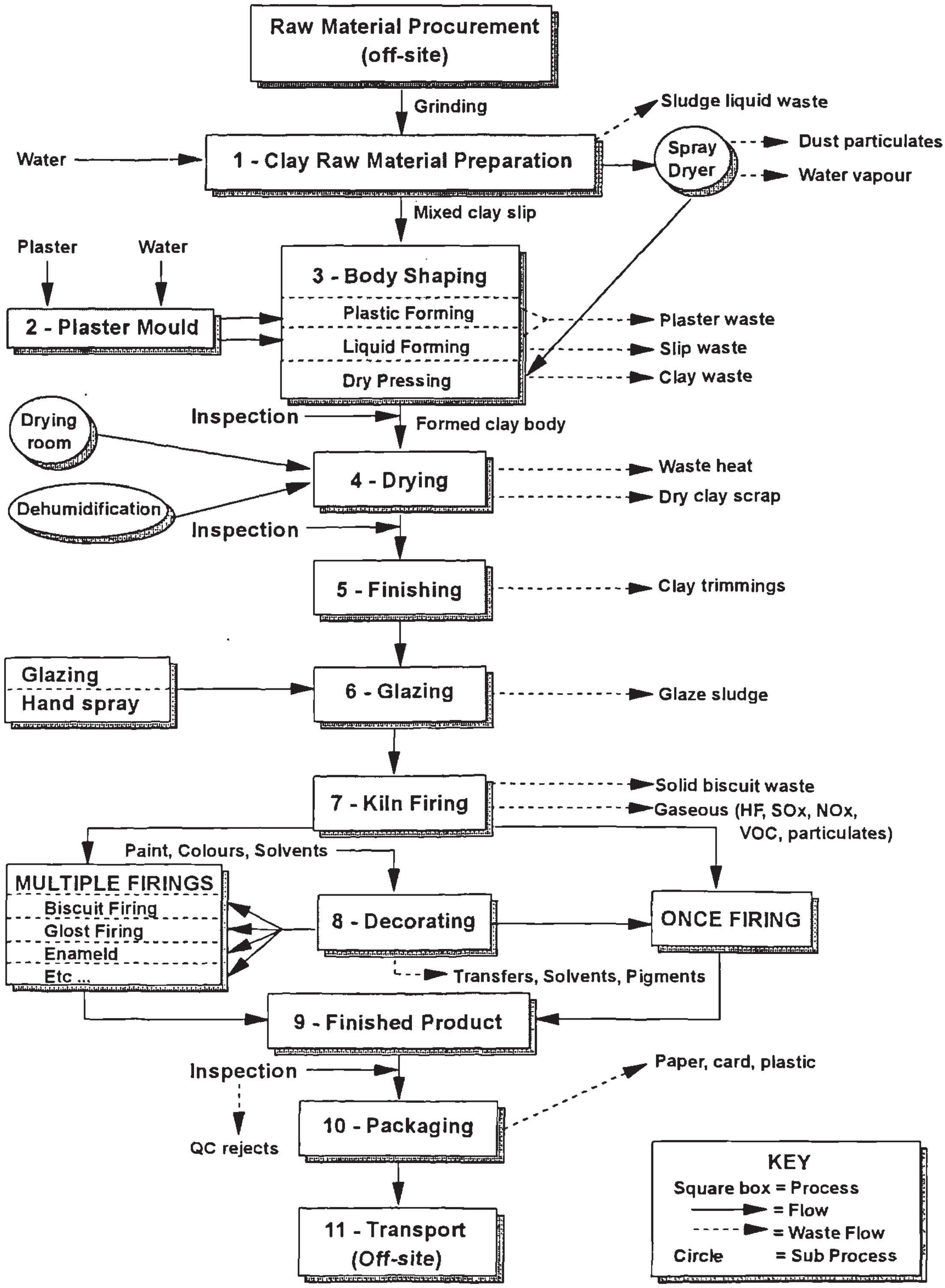


Table 42 : General process components

Process	Method
(Off-Site) RAW MATERIAL PROCUREMENT	Performed by material suppliers rather than ceramics manufacturers • Quarrying • Transport • Raw material processing
1 CLAY PREPARATION	• Slip Manufacture House - grinding, water inputs • Wet Forming: blunging, wet & dry grinding, mixing, filter pressing and de-watering, homogenising, mechanical de-airing. • Dry Forming: spray drying as granules.
2 MOULD MAKING & USE	• Mould Making (usually plaster of Paris; but also modern resins)
3 SHAPING OF THE CLAY BODY	• Casting in Plaster of Paris Moulds • Injection moulding
• Shaping in the Plastic State	• Roller machines • Impact forming
• Shaping in the Liquid State	• Single pressing (combining casting and glazing into a single process) • Electrophoresis casting • Microwave casting • Resin Mould Pressure casting (sanitaryware) • Capillary Vacuum Casting (sanitaryware)
• Shaping in the Dry State	• Dust Pressing (tiles & tableware) • Isostatic Pressing (tableware)
4 DRYING	• Controlled dehumidification • Infrared Drying • Microwave/vacuum drying (of cast ware) • Mangle dryers • Dobbins
5 FINISHING	• Turning • Sticking-up • Sponging, fettling & towing • Cutting and Trimming
6 GLAZING	• Manual spraying application • Electrostatic coating • Auto-spraying
7 FIRING	• Kiln cars and kiln furniture • Fuel type - gas, electricity, oil • Firing schedules - once fire, multiple firings, fast firing, refire • Kiln type: Intermittent or Continuous * Tunnel kiln * Roller hearth kilns * Open flame kiln * Sledge kilns * Muffle kiln * Walking beam kilns * The Trent kiln * Hover kilns * Gottignies multi-passage * Hoffman kiln
8 DECORATION	• Decals decorative refiring • Transfers (lithos)
9 INSPECTIONS	
10 PACKAGING	• Paper, Cardboard, Plastics
11 TRANSPORT & DISTRIBUTION	

2.1 Clay raw material preparation and procurement

The principal property of the raw material sought is its plasticity. In broad terms, this is defined as a material which deforms easily when "worked" but does not deform once it has been made into shape. As early as Neolithic times, man observed that after heavy rains, clay left his footprints. Man subsequently discovered that he could shape it with his hands and make objects out of it when it had dried and became firm in the sun. Unconsciously, he discovered the most important property of clay; its plasticity, realised the potential of this material which was the key to the creation of ceramics products.

The essential clay mineral used in pottery is kaolinite. The name is derived from "Kao-Lin", a hill in North China where a very pure, white-firing clay was discovered. There are deposits of similar clays in other parts of the world, although they were discovered much later. In Britain this type of clay is known as "china clay"; in France and elsewhere as "kaolin". China clays form the main ingredient of porcelains because they are the only clays whose iron contents are sufficiently low to produce the white colour and translucency in the fired product. Kaolinite, commonly known as clay, is often used in conjunction with other raw materials such as sand, flint or other silica minerals (quartz, mica, and various feldspar, e.g. nepheline syenite) as illustrated in Table 43. Fillers, such as bone ash, silica, alumina and wollastonite, are also commonly used due to their unreactive properties which reduce shrinkage and distortion.

However, other type of clays may be used in ceramics productions. Clays with very fine particle size are known as ball clays and exhibit high degrees of plasticity and provide the product with strength. Ball clays are used for the manufacturing of earthenware, sanitaryware and whiteware tiles. Stoneware clays are a type of ball clay sufficiently high in impurities to produce fully dense (vitrified) ware at relatively high temperatures. The so-called "red" clays are the main raw material for making refractory products, tiles and bricks (eg. Lower Oxford Clay).

Table 43: Raw materials used in the making of ceramics product

Sub-sector			Raw materials	%
TABLEWARE		• **Common pottery**	Clay & marl	100%
TABLEWARE		• **Earthenware/Stoneware**	Ball clay	50%
			China clay, Feldspathic minerals	5-20%
			Flint or other silica minerals	30-45%
TABLEWARE	PORCELAIN	• **Hard porcelain**	China clay	50%
			Feldspar	15-25%
			Quartz	15-35%
TABLEWARE	PORCELAIN	• **Vitreous China**	China clay & Ball clay	50%
			Feldspathic minerals	10-20%
			Quartz	35-45%
TABLEWARE	PORCELAIN	• **Soft porcelain**	China clay	30-40%
			Feldspar	30-40%
			Quartz	25-35%
	PORCELAIN	• **Bone china**	China clay	25%
			Cornish stone	25%
			Bone ash	50%
SANITARYWARE			Ball clay	25%
			China clay	25%
			Feldspar	20%
TILES		• **Whiteware**	Ball clay	29%
			Bone china	25%
			China stone	15%
			Quartz	40%
TILES		• **Redware**	Red burning clays	80%
			Sand	20%
BRICKS		Clay bricks (eg. Fletton brick)	Lower Oxford Clay	95%
			limestone/chalk, sawdust	5%
REFRACTORY PRODUCTS		Highly varied between clay and non-clay based materials. Refractory raw materials with: alumina, silica, dolomia, magnesia, zirconia, carbon		
ADVANCED CERAMICS		High purity synthetical raw materials: oxyde, carbide, nitride, boride, silicide, telluride, sulphur, fluoride. A very diverse sub-sector dominated by high tension electrical insulators.	Insulator porcelain:	
			Ball clay	30%
			China clay	17%
			Quartz	25%
			Feldspar	28%

Source: Thermie Report, Energy Technology in the Ceramics Industry, 1992
Rado (1988, 138)

2.1.1 The Process

Conventionally in the UK, the word "clay" encompasses all types of existing clay (i.e. china clay, ball clay, stoneware clay, red clay, Lower Oxford clay) and means the ware in the unfired state. However, to the technologist the prepared mixture of clay with other materials is known as the "body". The composition of a body depends on the raw materials available and the type of pottery one wishes to make.

Most raw materials, plastic (clay) and non-plastic materials (hard materials, feldspar, quartz...) are delivered to companies in a purified, dry, ground state by the raw material suppliers. The raw materials are then mixed with water. In that state the clay mix is known as "**slip**" and is ready to be incorporated into the body.

Alternatively external suppliers can deliver a blended aqueous clay slip suspension of clay, filler and flux with a solids content of around 70-80%. As well as the virgin slip, 'scrap slip' (made from re-blunging dried casts) and 'return slip' (liquid run-off from casting) is added to the casting slip. The slip is homogenised and adjusted to the required water content by a simple mechanical process known as **blunging** (mixing). The slip mixture has a typical water content of approximately 25-40%. This must be reduced to 15-20% before the forming of the body can take place.

The method of clay preparation varies according to the process used for shaping the body. The common methods for shaping the body are described in details in section 2.3 For instance:

- for **drypressing** the slip is dried to form a powder which is then pressed;
- for **plastic pressing** water is squeezed out of the slip to produce a dense plastic body which can be moulded;
- for **wet/liquid forming**, which involves pouring the slip into a plaster mould which then absorbs water from the slip; less water extraction is required in the preparation stage.

The slip can be **wet ground** in a batch or continuous process and then **spray dried** to form granules which are then **dry pressed**. Redware tile manufacturers can obtain granules by **dry grinding** clay using various types of crusher or hammer mills. The powder produced via this route has poorer flow properties than spray dried powder, which means it tends to be used only for coloured clay bodies as these simple mixes do not require homogenisation. Granulation can also be used to improve these properties by reducing the proportion of fines and favourably altering the particle morphology.

A **Filter Press** can be used to squeeze out the excess water from the slip and leave plastic filter cake. This is not sufficiently dense for directly manufacturing products, so is fed through a **"pug" mill**, which, by vacuum extrusion, produces dense, de-aerated clay of approximately 15-20% moisture content.

2.1.2 Waste Arisings

Material suppliers delivering the raw materials (china and ball clay, and silica sand) in a dry, ground state usually use road transport, though may use rail if the facilities exist and costs permit. The dry materials are essentially open to the atmosphere and can give rise to dust emissions at the factory site, for which bag filters are the most frequently usual means of control. For the brick industry dust is controlled by water sprays or by enclosure of equipment within properly designed containment buildings. Local exhaust ventilation can also be controlled through the use of bag filters. The collected dust waste, together with the bags are disposed of to landfill as **shraff** waste (a North Staffordshire colloquialism for pottery waste). Haulage and landfill costs for this purpose are typically costed between ECU 4-11 per tonne. Methods for recycling this dust waste have not yet been developed.

The blunging or mixing of the slip can generate "knottings" of waste slip, these are either returned to the slip, if still clean, or sent to landfill if contaminated when falling onto the floor.

The water extracted by filter pressing contains clay particles in suspension. This effluent goes to on-site settlement tanks, where flocculants and poly-electrolytes are added to remove the solid element. The filtered solids produce a filter cake, but its high water content and inconsistent composition makes it difficult to recycle or reuse - though some companies are currently researching its recyclability.

Spray Drying which forms the clay granules used for dry pressing, releases water vapour and clay particulates to air.

2.2 Plaster mould

Several methods of shaping are used for producing ceramic products. However, practically all industrial pottery is made by moulding. The material traditionally used for moulds is Plaster of Paris. For complicated shaping processes and to increase the wear resistance of the mould, plaster has occasionally been replaced by polyvinyl-chloride and synthetic resins. However, the use of Plaster of Paris as a mould material lies in its very low price compared to synthetic resins.

2.2.1 The process

Plaster of Paris produced by calcining the mineral gypsum at 160°C, is supplied to the pottery in powder form from either Nottinghamshire or Paris. The powder is mixed with water and poured into master moulds. The plaster moulds have to be dried before they are used in order to allow the water, not chemically combined, to evaporate. This has to be done slowly and carefully and ideally in air at room temperature (maximum temperature tolerable is 45°).

2.2.2 Waste arisings

The empty bags which contain the plaster are sent from the plaster store to landfill. Mould production produces a water effluent with high suspended solids, which is collected and pumped to settlement tanks, where deflocculants are added, the liquid is drained off to sewer, and the sludge remaining is pressed into a cake and taken to landfill.

Since the plaster moulds wear out after approximately 80-100 castings, there is a significant output of solid waste material. Until recently, and still the case for many companies, worn out plaster moulds went to landfill, where natural mixing with water can produce sulphides with a high biochemical oxygen demand (BOD). In the UK, however, since May 1994, some companies have passed plaster waste to a waste management company which crushes it down to 2 inch chunks and passes it on to Rugby cement, who add it to their cement process as a retardant to slow the cement's hardening. For a few tableware and sanitaryware companies this can account for 95% of the mould waste which would otherwise go to landfill. This practice is therefore of benefit to both the waste producer and the waste user.

Not all the slip ends up in the moulds. The floor and equipment in the casting room must be regularly washed down, generating further waste-water effluent which goes to settlement tanks before being discharged to sewer. The industry's liquid effluents almost always go to sewers rather than being discharged to "controlled waters". In some cases waste-water is reused elsewhere on site e.g. lavatories and fire extinguishers. Wet slip waste is removed in tankers. Companies have an incentive to remove the solid content from waste-water since discharge fees levied by the water companies are calculated in part according to the solids content.

Attempts have been made to drop waste slip down disused coal-mines, but problems have arisen with the transport of the material into groundwater.

2.3 *Body shaping*

As already mentioned, the shaping of the clay body can be accomplished by a variety of methods. The most traditional and ancient method consists of modelling pottery by hand and dates back to the beginning of Prehistoric civilisation (Rado, 1988). It was discovered that by smearing the outside of a wickerwork basket with clay its strength was increased. Such a basket was probably accidentally burnt and Prehistoric man realised that by firing clay shapes to a temperature sufficiently high it transforms the physical and chemical properties of the original clay into a new substance with many of the characteristics of stone. Fired clay pieces with basketwork inprints dating from 15,000 to 10,000 BC have been found in Gambles Cave, Kenya.

The introduction of the potter's wheel, probably man's oldest machine, revolutionised the making of pottery and marked the beginning of the mechanisation of ceramics products. The earliest known use of a potter's wheel was by Mayan people for making ceramic toys for their children during the Indus Valley civilisation (2,500-1,500 BC).

Since the discovery of hand-made pottery, efforts have been made to industrialise the making of ceramic goods by developing new manufacturing processes as described in the following section.

2.3.1 The Process

Conventionally, industrial methods of shaping are regrouped under three different categories.

Shaping in the plastic state is the traditional pottery manufacturing methods used industrially up to about 1950 and still applied today, on a limited scale, for "difficult" pieces in difficult "bodies", such as large bone china dinner plates and electrical ceramics.

Shaping in the liquid state is an ancient origin method but used in Europe only since about 1730, it is known as **slip casting** and is applied to figurines and shapes such as tea pots, coffee pots, jugs, and other hollow ware such as sanitaryware. The slip is poured into plaster moulds which absorb the moisture and leave clay deposited on the inside surface. When a sufficient thickness has built up, the excess slip is poured off. At this stage the clay has a moisture content of around 20%. The plaster mould cannot be removed until the clay is sufficiently dry.

The shaping in the dry state and isostatic pressing method is becoming more widely used, although by only a minority of the larger companies due to the high capital costs of installing the spray driers. Dry pressing or semi-dry pressing (signifying a moisture content of up to 3% and 8% respectively) is the most advanced of all pottery-forming methods. It is used in the shaping of wall and floor tiles (when it is often referred to as dust pressing), most high-grade refractories, abrasive wheels, and many articles in the electro-ceramic industry. The powder to be pressed is put in a rubber or plastic bag (often called the tooling) which is then placed in a container and subjected to hydrostatic pressure. However, the actual operation of IDP ("isostatic" dry pressing) is somewhat complicated, and involves a number of time-consuming operations such as filling the dies, closing dies, fixing pressure head, actual pressing, stress relieving and various steps in the removal of the pressed article. A new process has been developed, combining IDP with a normal rigid die, which has the advantage of being able to apply equal pressure across the work piece.

2.3.2 Waste Arisings

The shaping process generates quantities of excess solid clay body, rejected solid bodies and amounts of sludge/liquid consistency clay slip. If effectively collected to avoid contamination this excess is usually returned to the clay preparation stage for reblunging.

2.4 The Drying Process

The last section suggested that dry pressing was the shaping method of the future. As no water is involved, dry pressing does not require drying; this means greatly reduced manufacturing costs through savings in energy (and floor space), through fewer rejects and through the removal of a bottleneck in a fully automated production line. However, at the present time, many products are still shaped with water as an essential ingredient. Therefore, once the piece is shaped this water has to be removed. The laws of Athens stipulated a drying period in the sun of five years for bricks to ensure dimensional stability. It is the safest way, but of course, too slow for industrially made ceramics. Nowadays, drying is accelerated by heat which has to be kept to below a certain maximum temperature depending on air humidity.

2.4.1 The Process

The final **drying** of granulate pressed products can be very short, and in some cases is incorporated into the firing cycle. "Green" products formed by other methods contain too much water, and a separate, gentle drying operation is required. Pockets of moisture can result in damage during firing, as steam can be generated within the product.

The drying regime must be controlled to slowly reduce the ambient humidity if cracking is to be avoided. The temperature cannot exceed 60°C if the product is still supported by its plaster mould, as is usually the case, since the plaster dehydrates and can be ruined at temperatures above 60°C. Obviously, the sequence of drying is not the same for each method of shaping. Items with a higher initial moisture content or a greater thickness take longer to dry. Sanitaryware represents the most extreme example, with drying times of up to 48 hours compared with only 40 minutes for some tiles. This is also due to the higher drying temperatures often used for tiles, which can be in excess of 200°C. The sanitaryware moulds are in two pieces which are separated to release the moulded body.

Once the product is sufficiently dry to allow it to be removed from the mould, the mould itself needs to be dried before being reused.

The common methods of drying ceramics products in practice are convection, radiation, high-frequency and microwave drying.

- **Drying by convection** is the most widely used method in the pottery industry. A current of warm air is passed over the surface of the moist article. This airstream supplies some of the heat required to evaporate the water and removes the vapour from the surface, transporting it away from the drying system.
- **Drying by radiation**, for instance infra-red drying, allows uniform heat transfer to be produced and thus provides more rapid heating than is otherwise permissible in pottery drying.
- **High-frequency drying** is often used for drying electronic components (e.g. electrical insulators). Under the influence of very high frequency, the moistured item consumes a certain amount of electrical energy and transforms it into heat. Contrary to other forms of drying, the heating starts in the centre of the piece and, therefore, prevents cracking, especially in large and thick items.
- **Microwave drying**, is used to cause rapid mould release. Generally, this method is not often used because of high capital costs.

For tableware, tiles, refractories and advanced ceramics, the dryers tend to be continuous using turntables or conveyors to move the ware through a heated chamber. In vertical dryers the product rises through a temperature/humidity gradient, weaving the ware back and forth on a continuous belt. The dried product is removed after it has reached the top, and the moulds are returned on the belt to receive a new green product at the making up point.

For larger products such as sanitaryware intermittent dryers are often used. Chamber dryers are ideal, but sometimes the whole factory is heated just to dry the product which is left on racks. Curtains may be pulled down on either side of the racks to contain the drying environment.

Fans, insulation and lowered ceilings in the sanitaryware drying rooms improve drying efficiencies, as can careful production control to ensure that the dryers are always full. The use of microwaves in the drying process is currently being researched.

2.4.2 Waste Arisings

During drying, shrinkage of the ware exerts stresses which can damage and mis-shape the item (wet to dry cast shrinkage = 2.5%). Design is, therefore, a very significant factor influencing the levels of waste generated by the drying process. Damaged items can generally be crushed and added back into the slip mix for blunging.

2.5 Finishing

Before the ware is placed for firing imperfections have to be removed from the clay body. Since castware is very often made in multiple Plaster of Paris moulds seams are unavoidable where the separate parts of the mould meet. On ware made with new moulds the seams are very fine, but they become more noticeable as the mould wears.

2.5.1 The Process

Cutting and trimming imperfections in the moulded, semi-dry and unfired ware are the main finishing stage. This operation consists of eliminating in the dry state with a knife-type tool, the spare formed by the riser in hollow ware or by the casting hole in the case of handles, spouts, or the individual parts making up figurines. With cups, as well as casteware, blemishes are often removed in the semi-dry state with water, using a sponge or brush pencil.

2.5.2 Waste Arisings

Relatively small quantities of solid clay waste is produced during finishing. Again, if uncontaminated, this can be returned to the slip mix.

2.6 Glazing

Glazing is the process of covering the body with a thin layer of glass. The purpose of glazing is to make pottery more pleasing to the touch and eye and to provide an impervious coating (in case of porous body) which makes the ware more hygienic, more resistant to chemicals, and in many cases mechanically stronger.

The earliest glaze known is that in stone beads of the Badarian age in Egypt, about 12,000 BC. Accordingly, glaze is 5,000 years older than pure glass, although the glaze referred to was probably very different from the glaze used today.

2.6.1 The Process

Prior to applying the glaze the fired ware is in what is termed the "biscuit" state. Glaze can be applied to the ware pre- or post-firing. For instance, relatively robust sanitaryware is glazed before firing, whilst tableware, being more delicate, is glazed after biscuit firing since the absorption of water in the glaze can cause the body to collapse. Glaze composition varies according to the firing temperatures required. Common materials used are listed in Table 44.

Alternatives to the use of heavy metals, notably Lead (Pb) and Cadmium (Cd), are being developed, and in some areas are already widely used (e.g. sanitaryware and lower quality tableware). The lustre and durability requirements of high quality bone china and electrical insulators make Pb glazes harder to replace for these products.

Table 44: Glaze raw material

Oxide desired	Raw material	
Silica (SiO_2)	• Crystal quartz, quartz sand, flint • China clay • All feldspathic and micaceous minerals	• Talc • Zircon • Wollastonite
Alumina (Al_2O_3)	• Aluminium hydrate • All feldspathic and micaceous minerals	• Corundum • China clay
Potash (K_2O)	• Nepheline syenite, Cornish stone • Potassium carbonate	• Potash feldspar • Potassium nitrate
Soda (Na_2O)	• Sodium carbonate • Nepheline syenite, Cornish stone	• Borax • Soda feldspar
Lithia (Li_2O)	• Spodumene, petalite • Lithium carbonate	• Amblygonite • Lepidolite
Lime (CaO)	• Wollastonite (rarely) • Lime feldspar (very rarely)	• Dolomite • Calcium borate
	• Calcium carbonate, viz. chalk, limestone, marble	
Magnesia (MgO)	• Talc	• Dolomite
	• Magnesium carbonate, viz. magnesite	
Baria (BaO)	• Barium feldspar (Celsian, very rarely) • Barium carbonate	• Barium sulphate (barytes)
Strontia (SrO)	• Strontium carbonate	
zinc oxide (ZnO)	• Zinc oxide	• Zinc carbonate
Lead oxide (PbO)	• Lead oxide, red lead, lead dioxide, lead carbonate etc.	
Boric oxide (B_2O_3)	• Boric oxide • Borax	• Calcium borate
Tin oxide (SnO_2)	• Tin oxide	
Zirconia (ZrO_2)	• Zirconia	• Zircon

Source: (Rado,1988, 138)

Glazes for high temperatures (above 1,200°C) as used in hard porcelain, are prepared simply like mill mixtures of bodies. Lower temperature glazes require "fritting" which means pre-melting followed by cooling. Furthermore, fritting makes poisonous lead compounds non-toxic and therefore performs and important function in protecting the health of the glaze workers. According to British factory regulations the amount of soluble lead in glaze must not exceed 5%. Such glazes are called "low sol" glazes.

Glaze is applied by either hand dipping or spraying. Spraying glaze slip onto the product has superseded dipping operations in most areas of ceramic manufacture. Spraying tends to give better coverage and thickness control, and is almost exclusively used for sanitaryware and electrical insulators. Tiles, which only need to be glazed on one side, can be coated by passing through a glaze slip waterfall. Most ornate and some less ornate tableware is hand dipped. Refractories are rarely glazed.

2.6.2 Waste Arisings

Spraying efficiencies of 25% to 50% mean that over-sprayed glaze has to be collected and recirculated. The collected glaze sludge is passed through magnets, sifted, settled and then added to virgin glaze, at a maximum of 60% recycled to 40% virgin. This re-circulation process is performed by the majority of manufacturers. Nevertheless, amounts of glaze do become contaminated or are unfeasible to recycle, therefore ending up in glaze sludge waste which is de-watered before being landfilled as inert or special waste depending on its composition.

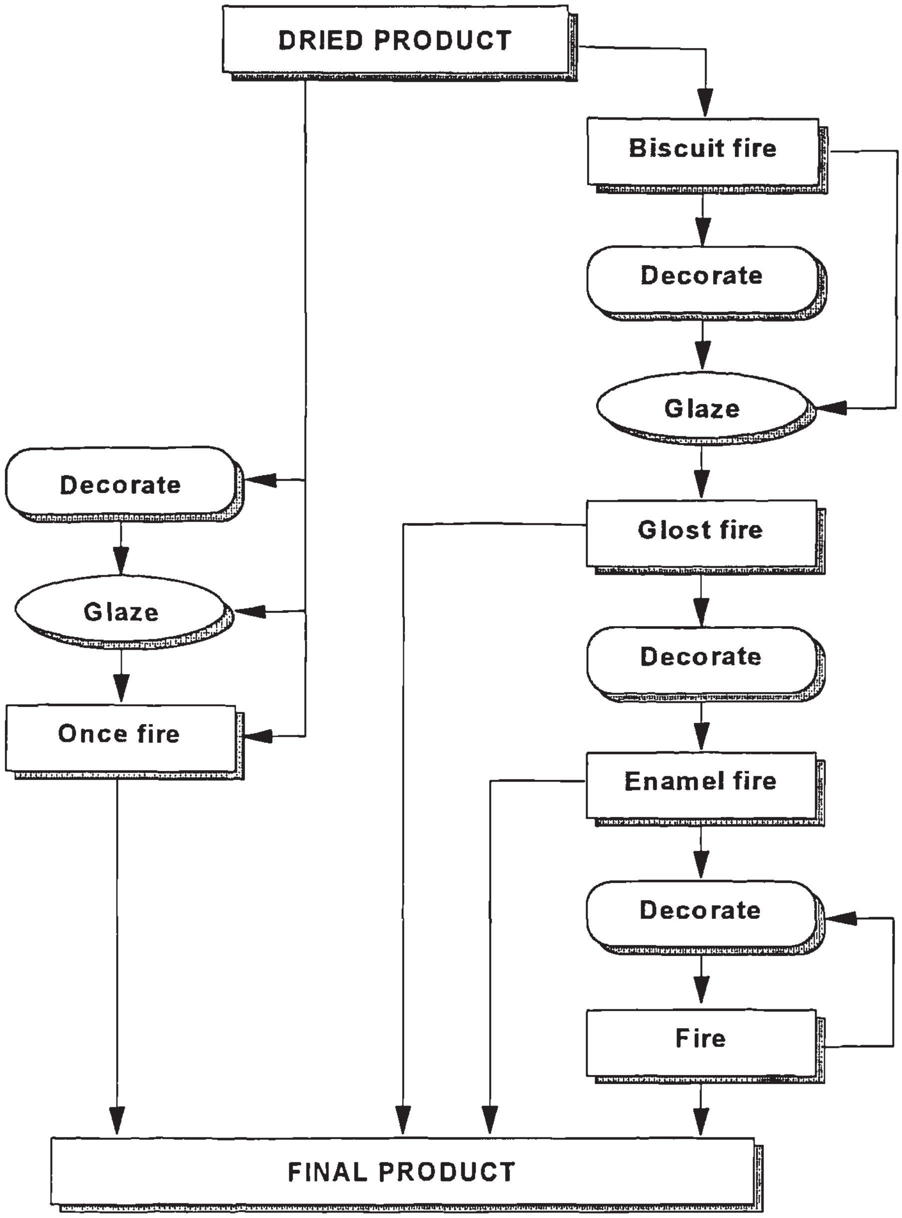
2.7 Kiln Firing

Firing, like decoration and glazing, can take place in a variety of ways depending on the product type, the quality of the ware and the effects required. Much of the ancient pottery was fired. However it was the most difficult and skilful ceramics operations which were kept a trade secret. The wastage resulting from failures, i.e. cracked or miss-haped ware was so common that one of the gates of Jerulasem was called the "Gate of Potsherds" (i.e. broken pots). The Ancient Greeks sought the aid of the gods and medieval potters offered prayers before firing.

2.7.1 The Process

The firing process could require once firing or more, depending on the ceramics production. The conventional production of pottery involves three firings: biscuit, glost (glazing) and decorating firing compared to only one firing for tiles, all sanitaryware and the cheapest tableware as described in Figure 43.

Figure 43: The ceramics firing process



In comparison with the pottery, firing of the "green" bricks required a special process notably for Fletton brick production. The Fletton brick production process is distinctive in relation to other brick production processes in that :

- it is traditionally carried out in a Hoffman kiln rather than tunnel kilns, which typically consists of 34 transverse brick-arched chambers;
- it uses a distinctive firing regime, with a long soak time for the reduction phase;
- it utilises high natural organic content of the raw material (Lower Oxford Clay), though it is artificially augmented in some cases;

The "green" brick firing process in the kiln comprises four disctinct phases:

1. **Drying**, where hot air from the cooling chambers is drawn (via the hot air flue) through the green brick stack in five chambers, connected in parallel, until they are completely dry (100 hours at temperatures of 100-200°C), the trace holes being sealed with paper at this stage;

2. **Reducing**, where the temperature of one chamber increases to over 1000°C and the bricks are held under reducing conditions for 20 hours until the inherent organic materials is reduced to carbon, the trace holes being open from this stage onwards (sealing paper burnt off);

3. **Oxidisings**, where the bricks are vitrified to the required degree, initially with the fuel provided by the carbon within the clay in one chamber (over 1000°C for 20 hours), followed by the use of supplementary fuel firing in two chambers to maintain the required temperature profile for the soaking time of the bricks (900°C for 40 hours), air being admitted via the potholes to control the temperature;

4. **Cooling**, where ambient air is drawn over the fired bricks in two chambers, the heated air being used to dry the green bricks as above.

Table 45 summarises the principal firing temperatures required for each individual ceramic product.

Table 45: Firing temperatures of the ceramics types

Sub-sector		Comments	Firing Temperature (°C) First fire (biscuit)	Firing Temperature (°C) Glazing fire	Colour and special characteristics
	Common pottery	• Often called earthenware by the non-expert, comprises a very wide range of ware. Common pottery is porous.	900	1000-1100	Brown-red Sometimes unglazed
TABLEWARE	**Earthenware**	• Earthenware (always glazed) remains porous after firing. It is almost exclusively fabricated on a mass-production scale.	1050-1150	950-1050	Off-white
TABLEWARE	**Stoneware**	• Stoneware is similar to common pottery, the big difference is that it is non-porous and vitrified. Josiah Wedgwood lasting achievements, Jasper and Black basalt, have indubitably established stoneware.	1100-1300	1000-1100	Grey, buff, etc. Sometimes no glazing fire, glaze effect obtained by introducing common salt at end of first fire
	Porcelain	• Porcelain signifies hard porcelain. This is essentially the high quality tableware which has a vitreous, fully dense body.	900-1000	1400	Bluish white Translucent
	China	• Bone china is a specific English product and contains calcined animal bone.	1250	1100	Pure white Translucent
SANITARYWARE		Ceramic fitments for bathrooms, lavatories and kitchens.	1260		
TILES	**Whiteware**	• Wall and floor tiles. They are nearly always glazed and non-porous, though can be vitrified.	1200		Vitrified tiles
TILES	**Redware**	• Predominance of red firing clay and redware tiles can be porous or non-porous, glazed or unglazed.	1100		Porous tiles
BRICKS		Longer soaking time for Fletton bricks, require a twicer longer tunnel kilns	1000	1000	
REFRACTORY PRODUCTS		Highly varied between clay and non-clay based materials.	1250-2000		
INDUSTRIAL AND TECHNICAL CERAMICS		A very diverse sub-sector dominated by high tension electrical insulators.	1200		

Adapted from Thermie Report, 1992

As already mentioned, the conventional production of tableware and that of some wall tiles, involves three firings. The first firing called **biscuit firing**, increases the strength of the product. There is then an opportunity to apply decoration before applying the glaze prior to the **glost firing**. However, it is possible to apply decoration and glaze to the dried product before firing, body and glaze being matured at the same time, which considerably reduces production costs. The main advantage of once-firing is its cost reduction through fuel savings by eliminating the two lower temperature firings, but results in a limitation of decoration to high-temperature colours. In the tableware sector once-firing is particularly suitable for stoneware and in the tile industry, porous single firing is used mainly for redware floor tiles, although its use for whiteware wall tiles is now increasing.

The biscuit firing temperatures vary greatly from product to product, but tend to lie around 1000°C. The glost firing can be at either a higher or lower temperature depending on the particular company's preference.

Firing represents the largest single use of energy in the production process. For table and sanitaryware it accounts for 50-80% of all energy used, and for tiles 50-60% Typical total specific energy consumptions (SEC) for the different sub-sectors are shown in Table 46.

Table 46: Typical specific energy consumptions (SEC) for tableware, tiles, sanitaryware

PRODUCT	PROCESS	SEC (GJ/Tonne)
Earthenware	Filter pressing	0.3
	Plastic forming	0.05
	Drying	3
	Once firing	5
	Misc electrical	1.5
	Total	**9.85 GJ/t**
Porcelain	Filter pressing	0.3
	Plastic forming	0.05
	Drying	20
	Biscuit & Glost	40
	Enamel firing	8
	Misc electrical	1.5
	Total	**69.85 GJ/t**
Glazed Tiles	Wet grinding and spray drying	1.7
	Forming (press)	0.4
	Drying (vertical)	0.5
	Biscuit firing (tunnel kiln)	3.0
	Glost firing (roller kiln)	1.8
	Glazing	0.1
	Misc electrical	1.5
	Total	**9.0 GJ/t**
Unglazed Tiles	Dry grinding	0.4
	Forming (press)	0.4
	Drying (vertical)	0.5
	Firing (roller kiln)	3
	Misc electrical	1.5
	Total	**5.8 GJ/t**
Sanitaryware	Manual casting	0.01
	Drying (vertical)	6
	Once firing (intermittent)	20
	Misc electrical	1.5
	Total	**27.51 GJ/t**

Source: Thermie Report, 1992

Kilns are either continuous or intermittent. In a continuous kiln the full firing temperature is maintained continuously in one or other zone of the kiln, (i.e. tunnel kilns). An intermittent (or periodic) kiln is a batch - type kiln, which goods are set when cold, fired, cooled and then withdrawn when the kiln is turned off and cooled, (eg. bottle kilns and muffle kilns).

2.7.2 Waste Arisings from the Kiln Firing Process

Firing is the main source of gaseous emissions to the air from the production process. These can include hydrogen fluoride (HF), oxides of nitrogen and sulphur (NOx and SOx), volatile organic compounds (VOCs) and particulate matter.

The firing process generates considerable amounts of heat, most of which is, at present, lost. Attempts to reuse this heat are constrained by the fact that kiln exhaust contains the gases given off from the fired ware. This requires cleaning (eg.using wet scrubbing) before heat can be recovered.

As with drying, the original design of the product can significantly affect the number of damaged items rejected as waste, since further shrinkage of approximately 3-5% occurs from dry to fired.

Earthenware biscuit which is unglazed or glazed but not strongly coloured, can now be passed to the tile manufacturer, who crushes and grinds it to add to raw materials for tile production. This recycling route can not yet deal with fired bone china, while this waste input provides approximately 14% of H & R Johnson's raw material. Other companies could do the same if they had suitable crushing/grinding facilities. At present, the majority of the major ceramics producers in the Stoke-on-Trent region are passing this pitcher waste to H & R Johnson.

2.8 Decorating

The glost firing is the end of the manufacturing line for many products. However, there is then another opportunity to apply decoration, if required, which can then be fixed by enamel firing. White pottery without patterns of colours is usually regarded as "undecorated". If colour is present either as design on the piece or in the body or glaze, then the piece is called "decorated". Colour in pottery is the most striking decoration and is almost invariably provided by certain metallic oxides.

2.8.1 The Process

The basic principle of producing colour in ceramics is mainly influenced by the temperature and the atmosphere of firing applied to the colouring metal oxides. The palette of colours available is far greater for the low temperature ranges. Colouring agents and temperature ranges for specific colours are listed in Table 47.

Some colouring agents have the quality to produce different colours under different conditions. For instance, copper is normally used for green shades at low temperature. In highly alkaline low-temperature glazes it turns into a beautiful turquoise (marine blue). The magnificent reds, originally made in ancient China and reproduced in Europe since the nineteenth century, known as rouge flambé, sang-de-boeuf, etc., originate from copper and are only obtained under reducing atmosphere introduced at the right stage.

Table 47: Common ceramics colour compounds

Colour	Colouring agent	Temperature range, stability
White	• Tin oxide, suitable fluxed, eg. lead silicate • Zirconia	• Decorating and glazes • Replacing tin oxide as much cheaper
Black	• Mixtures of oxides of iron, cobalt, chrome, manganese, and occasionally nickel • Uranium oxide depleted • Iridium oxide	• All temperatures • High temperature in reducing conditions only (hard porcelain) • Very expensive
Yellow	• Tin oxide plus vanadium compounds • Zirconium vanadates • Oxides of antimony, cadmium, praseodynium, titanium, usually with iron, lead chromate • Uranium oxide depleted	• Not stable beyond 1100°C • Not stable beyond 1100°C • Not stable beyond 1100°C • In oxiding atmospheres only
Blue	• Compounds of cobalt • Vanadium-zirconium silicates	• All ranges of blue including deep shades. All temperatures. • Turquoise shades only; up to 1280°C. More stable than cobalt compounds.
Green	• Chromium sesquioxide and other chromium compounds • Copper compounds	• Stable up to high temperatures; colour tone largely dependent on filler, glaze, or body. • Up to 900°C only.
Red	• Ferric oxide plus zinc oxide • Chromium-tin compositions, lead chromate • Chromium-alumina compositions • Cadmium-selenium compositions • Uranium oxide depleted	• Stable at low temperatures only • Stable at low temperatures only • For high temperatures • For low temperatures only • Difficult, usually only orange tints, in oxidizing conditions only
Pink	• Diluted reds, particularly chromium-tin bleached by alkalis • Manganese-alumina compositions • Gold chloride solution	• Suitable for staining bodies, eg. hard porcelain and bone china • For low temperatures.
Purple	• Cobalt componds • Gold chloride with tin chloride	• For bone china body only • For low temperatures only
Gold	• Metallic gold	• For low temperatures only
Silver	• Metallic platinum, also palladium	• For low temperatures only

Source: Rado, (1988, 154-155)

The most common form of colour decoration in whiteware (earthenware, bone china, hard porcelain) is by patterns. However, other methods such as printing are traditionally used. First introduced in the mid-eighteenth century, printing produces the most beautiful and accurate on-glaze and especially under-glaze decoration.

2.8.2 Waste Arisings

The use of cleaning solvents, thinners and heavy metal colours can generate low to medium levels of toxic waste in the form of cloth and tissues, empty containers etc. This is stored on site before going for disposal and is classified as "special" waste. Attempts are made to minimise this volume by increasing the efficiency of colour use and avoiding applying excess amounts to the ware that need wiping off, as well as by segregating this waste from inert wastes, thus avoiding contaminating the latter and imposing more stringent disposal obligations.

2.9 Inspection

Quality control inspections of the ware occur throughout the production process as indicated in the flowchart in Figure 42.

2.9.1 The Process

Rejected fired and glazed ware (if not too strongly coloured) can be smashed, ground and returned into the slip. The higher a company's quality of manufacture (eg. careful cast design, machinery maintenance, production control and staff training), the lower the waste reject rate. Equally, the higher the product quality and inspection standards, the greater the potential for rejects : this is especially true for high quality tableware items.

The inspection process accounts for a significant proportion of rejects. Typical reject rates are shown in Table 48.

Table 48: Rejection Rates for Different Product Types

Sub-sector	Process	Reject Rate
TABLEWARE	• forming: plastic	10%
	pressed	5%
	slip cast	5%
	• biscuit firing	5%
	• glost firing	5%
	• final inspection	10%
TILES	• glazed whiteware wall tiles	1% scrap
		10% seconds
	• unglazed redware floor tiles	2% scrap
		5% seconds
SANITARYWARE		10-15% rectified
		10% scrap

Source: Thermie Report (1992)

2.10 Packaging

The amount of packaging used for ceramic products depends significantly on the nature of the product and the market in which it is sold. High quality tableware, for example, can be very delicate and require protective packaging. In addition, with decorative products, the packaging can be equally decorative, and use relatively high volumes of paper, card and plastics. Ceramic tiles sold in the retail market cannot be packaged in batches greater than 20 kg, thereby increasing packaging per volume of these goods.

2.10.1 Waste Arisings

Waste paper, cardboard and plastic wastes are generated at the production factory, at the retailer outlet and for the customer. As such it represents a significant production cost. Some companies have been successful in reducing this financial and environmental impact through improved packaging design and increased use of recycled and recyclable packaging materials.

2.11 Specific Waste Arisings in the refractory sector

Zirconia sand used in the production of specialist refractories is a weak radioactive substance. Whilst levels are very low, concern has been voiced about the possible health effects for workers in the zirconia grinding mills who prepare the zircon sand for the forming and firing stages.

Hexavalent Chrome (Cr VI) can be formed when a chrome oxide (Cr II) refractory is heated to very high temperatures. Hexavalent chrome is a carcinogenic and non-stable compound that usually returns to Cr II on cooling. However, some amounts of hexavalent chrome can remain and accumulate in a kiln lining. No evidence exists of causative links between the incidence of Cr VI and human health effects, though the refractories industry is concerned about the possible effects. Those at possible risk include refractory manufacture workers and kiln "wreckers" who dismantle worn-out kiln refractory linings. In the US concern about Cr VI has also been raised in relation to Cr VI contamination of landfill leachate.

Volumes of hexavalent chrome generated by the refractory production process are very low.

2.12 Section Summary

Waste arisings from the common manufacturing process stages are summarised in Table 49 overleaf.

Table 49: Summary of wastes arisings from common stages of the manufacturing process

Process component			Waste arising	Quantity
			* bag filter dust and paper to landfill; knottings;	low
			* floor contaminated raw material.	low
1	CLAY RAW MATERIAL PREPARATION	• Solid	* zircon sand = refractories only.	low
			* chrome = refractories only	medium/low
			* scrap clay pieces and sweepings	medium
			* lignite sievings	very low
		• Liquid	* filter press de-water & sludge	high
			* flocculants	
			* used plaster moulds	high
2	PLASTER MOULD MAKING & USE	• Solid	* used synthetic moulds	low
			* paper bags	low
		• Liquid	* excess plaster liquids & washings	medium
3	BODY SHAPING	• Solid	* clay scrap	high
		• Liquid	* mould slop and floor washings	medium
4	DRYING	• Solid	* deformed biscuit bodies	medium/high
		• Liquid	* n/a	n/a
5	FINISHING	• Solid	* clay scrap	medium
		• Liquid	* n/a	n/a
6	GLAZING	• Solid	* glaze containers	medium
		• Liquid	* some dirtied glaze not recycled	low
		• Solid	* biscuit damaged during firing	high
			* glost waste	high
7	KILN FIRING		* scrubbed solid residue if scrubbers used	low
		• Liquid	* n/a	n/a
			* waste heat, HF, Nox, Sox, VOCs	high
8	DECORATING	• Solid	* brushes, tissues, containers, litho transfers;	low
		• Liquid	* solvents, some paints, dyes, colours	low/medium
9	INSPECTIONS	• Solid	* QC rejections & test samples	medium
		• Liquid	* n/a	n/a
10	PACKAGING	• Solid	* paper, card, plastics	high
		• Liquid	* n/a	n/a
11	TRANSPORT	• Solid	* n/a	n/a
		• Liquid	* oil washings	low
12	OVERALL PROCESS CONTROL	• Solid	* fired waste due to sub-optimum kiln operation	potentially high
		• Liquid	* process waters & lubricants	potentially high
			* sub-optimum kiln energy efficiencies	potentially high
OTHER	suppliers' pallets; office & sanitary; building maintenance; site housekeeping, floor cleanings, lavatories			low/medium

Key: n/a = not applicable

3. PRINCIPAL IMPACTS ON THE ENVIRONMENT

Having described the components of the manufacturing process common to the industry sub-sectors and identified the waste arisings generated from these components, this section analyses the influence of the individual ceramics industry on the environment. This influence is derived from the overall process parameters such as clay material preparation, energy consumption, raw material employed, production organisation, packaging and product transportation. For the purpose of this research the environment is defined as air, water, land, waste and noise. It is therefore undeniable that a number of the aforementioned parameters affect more than one environmental category.

3.1 Impact on air

The main environmental concerns relate on emission into the air generated by the:

- firing phases
- toxic colouring agents and hazardous raw material used
- energy use
- Transport of the raw materials and the final products

These emissions can either be directly detrimental to the workforce health due to toxic inhalation or can contribute to global warming, transboundary pollution such as acid deposition and localised pollution problems such as ground level ozone depletion.

The evidence from personal exposure monitoring programmes is that established control measures are effective in protecting the workforce from indoor airborne dust. Gases are also generally adequately controlled, though there is some concern over volatile organic compounds (VOCs), particularly where solvent bonding agents are used in some refractories. (Only one UK refractory manufacturer now uses naturally occuring tar/bitumin as a bonding agent; synthetic solvents are now more commonly used). Concern has recently grown over air-bourne fibres released from the production of ceramic fibre in the refractory and advanced ceramics sub-sectors. These could have possible carcinogenic effects, and there are current moves to reclassify ceramic fibres as "class 2" or "3" carcinogin under the IARC Cancer Causing Substances Classification System. The high costs of indoor air control systems is of commercial significance to the industry, and collaborative research may be needed into exhaust gas and extraction systems, both to reduce costs and to further improve environmental performance.

3.1.1 Releases to air from Firing

Releases from firing originate mainly from the constituents of the clay. As exhibited in (CO). Table 50 the most significant pollutants released are odours and organic compounds from the reduction of organic materials, oxides and sulphur of nitrogen (NOx and SOx), fluorides (HF), chlorides (Cl), particulates and carbon monoxide (CO).

Table 50: Principal releases to air

Oxides of Sulphur (SOx)	Sulphur oxides releases consist mainly of sulphur dioxide (SO_2) mostly from sulphide in the clay. SO_2 is formed during the reduction and oxidation stages, mainly from the iron pyrites content of the clay.
Oxides of Nitrogen (NOx)	NOx emissions, eg. Nitrogen dioxide (NO_2) by the nitrites oxidation formed during the glazing process.
Oxides of Carbon (COx)	Carbon monoxide (CO) and carbon dioxide (CO_2) are formed during the reduction stage of the firirng process.
Hydrogen fluoride (HF)	HF emissions derive from the fluoride compounds contained in the clay minerals.
Chlorides (Cl)	Gaseous chlorides are produced from the chlorides within the clay and from supplementary fuel if coal is used.
Particulates	The main source of particulates from the firing process is the entrainment of loose particles from the surface of the body products. If the fuel used is coal then soot and ash are also produced.
Toxic heavy metals	In general in very low levels, eg. lead, cadmium, zinc, selenium, etc.

3.1.2 Releases to air from toxic colouring agents and hazardous raw materials

Colour in pottery is almost invariably provided by certain metallic oxides. Some of these are recognised by scientists as toxic heavy metals. **Lead** is one of the toxic heavy metals which has traditionally been used in bone-china manufacture to bring encapsulation of decorative colours into the glaze. Encapsulation of colour is less effective with lead-free glazes, which also offer a more limited range of available colours than do lead-based glazes. Parts of the tableware sector in the past experienced problems of handling heavy metal colours for instance **cadmium, zinc or selenium** and glazes which could result in ingestion by workers during the decorative stage. However, these problems have now been effectively addressed through the introduction of tighter controls over handling and the decorating process.

Elsewhere in the industry (eg. sanitaryware), where consumer demands for colour and decoration are less exacting, less toxic elements, such as zinc and barium, have been uniformerly introduced.

Furthermore, metals in ceramic glazes on tableware products have been shown to leach out of the glazed surface under acidic & alkali conditions. There is concern that leaching into food and drink could have human health effects associated with lead and cadmium intake. However, strict regulations on the leaching rate of Pb and Cd have been imposed in the UK, France, many other parts of the EU and the vast majority of export markets for UK and French ceramics producer. Consequently, many producers are now switching to non-Pb & non-Cd and low - Pb & low-Cd glazes, which have developed rapidly over the past decade. As such, the environmental impact of metal release from modern glazed products is being effectively minimised.

Hexavalent chromium (Cr.61) is another toxic solution which, under certain conditions, may remain and accumulate in a refractory lining. For this reason those most at risk from Cr.61 are kiln wreckers dismantling used chrome containing refractories from worn out linings. The refractories industry has researched the hexavelant chrome issue and looked specifically at the condition of chrome containing refractories both after they have been used and during disposal. No clear causative links have been identified between the incidence of Cr61 and human health effects, though there remains concern about possible carcinogenic effects. Other possible effects include irritation to eyes, nose and throat and as a cause of dermatitis. Moreover, prolonged exposure to hexavalent chrome can lead to liver and kidney damage.

Zirconia is used as a refractory raw material to manufacture products which have a high resistance to corrosion and erosion. Zirconia is very mildly radioactive due to the fact that in its natural surroundings radioactive isotopes such as thorium and tritium are absorbed. The type of isotope depends on the geographic source of the zirconia, mainly Australia, South Africa and Russia. Levels of radioactivity in warehouses by CERAM Research, are well within the "ionising radiation" limits. Thus the control of nuisance dust in the atmosphere of the manufacturing plant is more of an issue than the level of radioactivity. Strict radiation monitoring and atmospheric dust control standards have effectively limited the physical and radioactive impacts associated with grinding zircon sand for the manufacture of zirconia refractories. As such the manufacture of zirconia refractories does not generate significant environmental impacts. It is notable that zirconia is the oxide of the metal zirconium, and zircon sand is an equivalent molecular compound of zirconia and silica (ZrO_2 SiO_2) which is found naturally in major deposits in Australia. It does not have the same tendency as Baddeylite to absorb radio-active isotopes (the natural occurring zirconia source).

Finally, a recent development of relevance to the ceramics industry is the work being undertaken as part of EU Health and Safety regulations on the possible re-classification of **silica** as a potential carcinogen. The UK H&SE have issued a consultative document on this proposed EU reclassification of silica. Since this is a relatively new area of research further investigation is necessary before EU regulations are established.

3.1.3 Releases to air from energy used

Energy use involves the consumption of hydrocarbon resources and results in the release of CO_2, SOx, NOx and particulates to the atmosphere. Energy use represents between 10-30% of the total production cost depending on the industry sub-sector (labour and materials being the other most expensive variable costs). Energy is used in all stages of the production process but particularly in the preparation of the clay body, drying of the cast body, and firing. For example, a typical large sanitaryware manufacturing site (with output of around 1.5 million pieces per year) uses the same amount of gas as 7,500 houses, while the gas consumed by the kilns during firing is equivalent to 2,500 houses.

Natural gas is the "standard" fuel, accounting for 85% of energy consumed by the UK tableware sector in 1992 (electricity accounts for 10%; and oil 5%) and by 80% of the French industry for the same period. Gas is used for the continuous kilns, once-fired and biscuit intermittent kilns. Electric kilns become significant for the glost and decorative firings when cleanliness is important, but here volumes are smaller.

3.1.4 Releases to air from transport of the raw materials and the final products

The impact of transport on air - clay-based raw materials and finished product transports - remains to be addressed. The majority of the UK and France ceramics manufacturers rely on road transport of the material inputs and finished product rather than rail, because of the large cost differential and lack of available rail infrastructure. The clay-based raw materials used in the ceramics industry are almost always indigenous to the manufacturer with the intention of limiting the transport costs. The use of lorries for the raw material and the finished product transportation contribute undoubtedly to global warming.

3.2 Impact on water

Water is one of the raw materials used in the ceramics industry which does not form part of the finished product but is, nevertheless, vital. Water is essential in the refining process, in the general preparation and mixing of the constituent minerals and in the traditional methods of shaping the actual articles. Releases to water consist of surface water run-off and surplus spray water. Waste-water contains suspended solids consisting mainly of clay particles, but there is the potential for contamination by other process raw materials, for example by toxic colouring agents as indicated in the section below. Both the volume of water input into the production process and the nature and quantity of the wastewater output are financially and environmentally significant.

3.2.1 Releases to water from raw materials procurement

The clay-based raw materials used in the ceramics industry are obtained by quarrying methods or are dug from pits and generate substantial amounts of liquid waste. Run-off from quarries is of concern even though the material is susceptible to leaching by rain and ground water before operations began. The act of quarrying breaks material down into smaller units giving a larger surface area, and increasing the risk. Stock-piles also tend to be exposed to the elements, leading to more run off so monitoring needs to be faster and more accurate. There may be scope for treatment and abatement processes although it is difficult to see how these would operate. Mine waters are another area of concern which would be difficult to deal with, a certain amount may be extracted by means of pumping treatment, but a high proportion would escape through natural routes. In some extraction processes flotation tanks are used to separate usable material, often using organic treatments which generate effluent high in COD, BOD, suspended solids etc.

3.2.2 Releases to water from production process

Generally, the more water input into a ceramic manufacturing process, the more water has to be extracted and dried from the body before and after casting. This not only requires greater inputs of energy but also produces greater volumes of wastewater subject to generate pollution. For example, an effluent with a high biochemical oxygen demand (BOD) starves watercourses of the oxygen needed to sustain biological water life. Similarly, effluents with a high metal content can bio-accumulate in the food chain and cause adverse health effects.

Thus manufacturers seek to minimise input volumes by altering the production process and to reduce wastewater outputs and the need for costly treatment, by filtering, flocculating and chemically "cleansing" the wastewater. The extracted sludges and solids are usually disposed of to landfill, which incurs financial costs and may result in harm to the environment by leachates.

3.3 *Impact on land*

Releases to land consist mainly of sludges from wastewater, waste from unfired clay materials and rejected or broken fired products (bricks, plates...). The incidence of land contamination can rarely be attributed to a particular component of the ceramics manufacturing process, but relates more to matters of process control, site housekeeping and general environmental management and employee awareness.

The main areas likely to cause (or to have already caused) contamination of land are site demolition, changes in site use and redevelopment. For example, the removal of asbestos and fuel storage tanks may cause contamination, even where none existed before. Other potential problem areas include on-site landfill operations used by some of the larger producers; leakage of fuel, solvents and dyes; and some airborne contaminants produced while operations are in progress.

3.4 *Impact on waste generated*

As with liquid wastes, manufacturers seek to minimise the volume and alter the content of solid wastes by changing the production process and implementing waste minimisation reuse and recycling schemes. Segregation of wastes is also important, since contaminated clay solids cannot be reused. Furthermore, when "special" wastes are mixed with inert solid wastes, the total mixture must all be classified as "special", increasing costs of disposal. Segregation is especially important where potentially toxic materials are used, for example, some solvents, glazes containing lead, and colours containing heavy metals - principally cadmium, zinc or selenium.

3.4.1 Solid wastes generated by the ceramics manufacture

Solid process wastes from ceramics manufacture can be divided into two categories as illustrated in the following Table 51:

- waste raw material and products from the production process or products rejected by quality control;
- material used in processing which has a finite life, such as plaster moulds and kiln refractory linings.

Many of these substances, especially the "green" unfired raw materials are recycled back into the manufacturing process.

Table 51: Solid process wastes

Raw Materials	• unprocessed clay/zirconia dust • scrap raw material from the preparation stage (usually recycled) • formed, but unfired (usually recycled) • biscuit fired (can be recycled as "grog", typically at rates of approx.30%) • glazed/decorated, but not glost fired • glazed/decorated and glost fired • reject finished product
Process waste	• used gypsum plaster moulds (table & sanitaryware) • refractory kiln furniture and refractory linings • heavy metal sludges, refractory hexavelant chrome • spent limestone from fluoride emission scrubbers

3.4.2 Packaging wastes

The fragility of many ceramic products makes high levels of packaging essential. This generates large volumes of non-hazardous waste including paper, cardboard, plastics, wooden pallets and plastic stripping. Companies identify significant financial costs and some potential environmental costs in this area, and have sought to address the issue by designing packaging structures which use lower volumes of material and contain a higher recycled and recyclable element. An increasing number of ceramics manufacturers also ensure that packaging waste and other paper, card and plastics is segregated, shredded, bailed and compacted, thereby reducing waste volumes and landfill disposal costs.

3.5 Impact on noise emissions

Noise is another issue which is becoming increasingly important. The degree to which noise emissions represent significant environmental impact of a manufacturing site varies according to the proximity of other land uses (particularly residential populations), the nature of activities performed on a site and the effectiveness of noise-screening measures. Whilst most sites have only negligible impacts in this respect, elsewhere noise problems can arise from operations such as transport and the disposal of fired waste (e.g. onto on-site waste disposal facilities).

Furthermore, the use of lorries can have a significant environment impact in the vicinity of a manufacturing site, particularly when situated near to residential properties. Residential complaints typically focus on noise levels, especially where night-time departures are necessary to satisfy customer requests for early morning deliveries. The size and weight of the lorries generate problems of congestion and road surface damage. These are acute on the highly congested M6, which serves the Staffordshire-based producers or the hilly and tortuous roads of the centre of France where Limoges is located.

4. *CRITICAL ANALYSIS*

Typically, waste - in solid, sludge, and gaseous form - is generated during the ceramics manufacturing production. The volumes and content of these arisings, like the production process itself, vary between sub-sectors and companies. To a large extent, the volume of waste produced is closely related to the level of production control, type of equipment, quality of product design, quality of raw materials inputs, quality of management and production-line workforce.

The environmental impact of the production of ceramics goods relates on:

- **gaseous emission released into the air**

  Gaseous emission is the main environmental impact, most significantly pollutants released are odours and organic compounds, oxides and sulphur of nitrogen (Nox and Sox), fluorides (HF), chlorides (Cl), particulates and carbon monoxide (CO). The gaseous emissions can either be directly detrimental to the workforce health due to toxic inhalation or can contribute to global warming.
- **liquid effluent discharged to sewer**

  Water is a key raw material used in the ceramics industry. However, the more water is inputted into the process, the more water has to be extracted and dried form the body. This not only requires greater inputs of energy but also produces greater volumes of wastewater containing suspended solids and occasionally toxic colouring agents subject to generate pollution.
- **disposal of wastes**

  Solid waste consists mainly of waste raw material used in processing which has a finite life, such as plaster moulds and kiln refractory linings and products from the production process or products rejected by quality control. Moreover, the fragility of many ceramics products makes high levels of packaging essential. This generates large volumes of non-hazardous waste including paper, cardboard, plastics, wooden pallets and plastic stripping.
- **noise emission**

  Noise is another environmental issue which is becoming increasingly important.

Table 52 summarises the environmental impacts stemming from waste arisings from the individual process components, and presents a rating of their environmental significance.

Table 52: The environmental significance of key process component waste arisings

Process Components		Waste Arising	Quantity	Environmental Impact	Significance of Environmental Impact
1 Clay Raw Material Preparation	SOLID	• bag filter dust and paper to landfill; knottings;	• low	• landfill waste	low
		• floor contaminated raw material.	• low	• landfill waste	low
		• zircon sand = refractories only.	• low	• radioactivity (low)	medium
		• chrome = refractories only	• medium/low	• toxic to humans	medium
		• scrap clay pieces and sweepings	• medium	• landfill waste	medium
		• lignite sievings	• very low	• landfill waste	very low
	LIQUID	• filter press de-water & sludge • flocculants	• high	• suspended solid in water, BOD, COD, pH	**HIGH**
2 Plaster Mould Making & Use	SOLID	• used plaster moulds	• high	• landfill waste	**HIGH**
		• used synthetic moulds	• low	• landfill waste	low
		• paper bags	• low	• landfill waste	low
	LIQUID	• excess plaster liquids & washing	• medium	• water pollution: solids, BOD	medium
3 Body Shaping	SOLID	• clay scrap	• high	• landfill waste	**HIGH**
	LIQUID	• mould slop and floor washing	• medium	• water pollution: solids, BOD	medium
4 Drying	SOLID	• deformed biscuit bodies	• medium/high	• landfill waste	medium
	LIQUID	• n/a	• n/a	• n/a	n/a
5 Finishing	SOLID	• clay scrap	• medium	• landfill waste	medium
	LIQUID	• n/a	• n/a	• n/a	n/a
6 Glazing	SOLID	• glaze containers	• medium	• may contain toxic metals	low
	LIQUID	• some dirtied glaze not recycled	• low	• may contain toxic metals	**HIGH**
	SOLID	• biscuit damaged during firing	• high	• landfill waste	
		• glost waste	• high	• landfill waste	**HIGH**

Process Components		Waste Arising	Quantity	Environmental Impact	Significance of Environmental Impact
7 Kiln Firing		• scrubbed solid residue if scrubbers used	• low	• landfill waste	
	LIQUID	• n/a	• n/a	• n/a	n/a
		• Waste heat	• high	• Energy efficiency	**HIGH**
8 Decorating	SOLID	• brushes, tissues, containers, litho transfers;	• low	• special waste to landfill & toxicity	low/medium
	LIQUID	• solvents, some paints, dyes, colours	• low/medium	• heavy metal toxicity	medium
9 Inspections	SOLID	• QC rejections & test samples	• medium	• landfill waste	low
	LIQUID	• n/a	• n/a	• n/a	n/a
10 Packaging	SOLID	• paper, card, plastics	• high	• landfill waste	high
	LIQUID	• n/a	• n/a	• n/a	n/a
Transport (off-site)	SOLID	• n/a	• n/a	• n/a	n/a
	LIQUID	• oil washing	• low	• *impact on water biota*	low
Overall Process Control	SOLID	• fired waste due to sub-optimum kiln operations	• potentially high	• generates landfill waste from sub-standard ware	**HIGH**
	LIQUID	• process waters & lubricants	• potentially high	• waste water pollutant	**HIGH**
		• sub-optimum kiln energy efficiencies	• potentially high	• energy efficiency	**HIGH**
Other		• suppliers' pallets; office & sanitary; building maintenance; site housekeeping, floor cleanings, lavatories	• low/medium	• landfill waste	low

Key: n/a = not applicable

Table 53: Significance of environmental impacts within the different industry sub-sectors

Production Process Stage	Table/ ornamentalware	Tiles	Sanitary-ware	Refractory	Technical/ industrial ceramics
Raw Material Procurement	4	3	4	4	2
Mould Making	3	2	3	3	3
Fabrication/shaping of the Body	4	2	4	2	3
Drying	4	3	4	3	3
Glazing	3	2	2	1	3
Finishing	3	2	3	1	2
Firing	5	5	5	5	5
Decorating	3	2	2	1	1
Inspection	3	2	2	2	3
Packaging	2	1	1	1	1
Overall Precess Control	5	5	5	5	4
TOTAL	***39***	***29***	***35***	***28***	***30***

Scoring:5 = high significance environmental impact
1 = low significance environmental impact

CHAPTER 6

MANAGERIAL PERCEPTIONS AND INTENTIONS TOWARDS ENVIRONMENTAL ISSUES

1. INTRODUCTION

This chapter considers the managerial perceptions and intentions of the UK and French ceramics industry in relation to the improvement of environmental performance in order to assess whether environmental issues are viewed by this sector as a constraint or an opportunity.

This chapter analyses the findings of the survey combining written comments and graphical presentation when relevant. However, For more information and detailed analysis reference should be made to appendices D to G. The analyses of responses have been undertaken overall both in relation to the different industrial sectors analysed in chapter 3 and company sizes (Table 54) so as to determine relevant correlation. Cross-correlation and other more detailed analyses have also been assigned to identify specific issues relevant to the study.

Table 54: level of analyses

SECTOR	SIZE
• Brick;	• micro (1-50);
• Industrial & Refractory;	• small (51-99);
• sanitary ware & Tiles,	• medium (100-250);
Tableware	• large (251+)

In view of the small sample size from the Sanitaryware & Tiles sector (11 for the UK and 8 for France), the conclusions relating to this sector should be treated with some caution.

In order to not swamp the reader with an abundant mass of information the following information has been annexed:

- **Appendix B:** the list of British and French ceramics manufacturers;
- **Appendix D:** the survey questionnaire (English and French);
- **Appendix E:** the sub-tables of data summarising the responses to each question.

1.1 Objectives

Its more specific objectives are :

- to highlight the perceived drivers and barriers for improving environmental performance such as production efficiency, costs benefits, better image;
- to assess the general environmental awareness of the UK and French managers, for instance, their knowledge on environmental options and technology available or the type of information sources used;
- to assess company action to improve environmental performance;
- to assess the management position adopted by ceramics industries to tackle environmental issues and their attitudes to environmental initiatives.

2. OVERALL ATTITUDES AND BENEFITS TOWARDS ENVIRONMENTAL ISSUES

This section identifies the attitudes of respondents from improving environmental performance raised in questions 5, 6, 12, 14, 28 and 29. The following table (Table 55) summarises the overall attitudes and benefits identified by the British and French ceramics manufacturers towards environmental initiatives.

Table 55: Overall attitudes and benefits towards environmental initiatives

Q5	**Level of Environmental impact of the company's respondent** The vast majority of respondents in both countries agreed that the ceramics activity impacts on the environment (65% in the UK and 56% in France).
Q6	**Level of benefit of having an environmental policy** On average, more than a half of the British and French respondents felt that an environmental policy would benefit their companies. However, the breakdown by size revealed that in both countries the vast majority (approximately 60%) of micro and small-sized companies did not support this idea.
Q12	**Correlation between business environmental initiatives and benefit** Surprisingly, in all size bands more British respondents (35% against 24%) felt that business environmental initiatives were of little benefit to their company.
Q14	**Main benefit from improving environmental performance** Unsurprisingly, the major benefit from improving environmental performance, perceived by respondents of both countries, was cost reduction closely followed by none.
Q28	**Benefits of adopting new procedures** Among companies who recently introduced changes to improve their corporate environmental performance, the most important benefits gained were better image among employees, saved money, and increased efficiency. A total of 23 respondents cited "other" benefits, which included greater environmental awareness, competitive advantage, energy savings, noise reductions, improved total quality management, product differentiation and quality and increased rate of production.
Q29	**Disadvantages in adopting new procedures** The vast majority of companies who had taken action could identify no disadvantages in adopting this new procedure or equipment. The only other factors mentioned by a significant number of companies were capital costs, too expensive/costly and too much work.

2.1 Level of Environmental impact of the company's respondent (Question 5)

As a whole, the vast majority of respondents in both countries agreed that the ceramics activity impacts on the environment (67% in the UK and 56% in France).

2.1.1 Breakdown by sector

For the UK, the highest level of agreement was in the Brick sector (78%) while the strongest disagreement was in the Industrial & Refractory sectors (33%). Whereas, for France, agreement was strongest in the tableware sector (61%), and this sector also accounted the highest level of disagreement (37%) closely followed by Industrial & Refractory sectors (35%).

The principal reason to account in the UK more respondents than in France who assumed that their activities impact on the environment is due to a greater awareness of the environmental issues induced by a higher degree of concentration and internationalisation of the British industry.

2.1.2 Breakdown by size

The breakdown by size shows that a significant number of British respondents from the large segment (36%) agreed on the view that the ceramics industry does not have an environmental impact while for France this segment represents the lowest level of agreement (14%). However, on average 40% of the other segments of the industry in France subscribe to this idea against 20% for the UK.

2.2 Level of benefit of having an environmental policy (Question 6)

Overall opinions on the statement "Having an environmental policy does not currently benefit my company" were pretty similar for each sector in both countries.

2.2.1 Breakdown by sector

On average, approximately 56% of respondents in the UK and 54% for France believed that an environmental policy benefits their companies. It is also of interest to note, the very high rate of British respondents from the Sanitaryware & Tiles sectors who strongly disagreed on this statement (50%). Finally, approximately 45% in the UK and 42% in France of the Industrial & Refractory respondents and 36% in the UK and 39% in France of the tableware respondents agreed that an environmental policy does not benefit their company.

2.2.2 Breakdown by size

More importantly, the breakdown by size revealed that for both countries micro and small-sized companies did not believe that an environmental policy could currently benefit their business. Approximately, half of the micro-sized companies (44% for the UK and 42% for France) and 60% of the small-sized companies (57% for the UK and 54% for France) support this idea with nearly 10% of the British respondents from the small-sized segment strongly agreeing.

2.3 Correlation between business environmental initiatives and benefit (Question 12)

The overall result to the statement "Business environmental initiatives are of little benefit to my company" revealed that the UK respondents were on average more in favour of this statement (35%) compared with only 24% for France.

2.3.1 Breakdown by sector

The highest level of agreement for the UK was in the Industrial & Refractory sectors (44%) followed by the Tableware sector (36%) and the Brick sector (35%) while for France it did not exceed 30% with the tableware sector.

2.3.2 Breakdown by size

For the UK, the percentage of respondents who agreed versus disagreed was higher in the micro (39%) and small sizes (50%) segments. For France only 8% of the large segment (1 company) agreed with this statement. As a whole, it emerged on reading these graphs that British manufacturers did not consider business environmental initiatives as beneficial as their French counterparts.

2.4 Main benefit from improving environmental performance (Question 14)

The major benefits, if any, perceived by the respondent from improving environmental performance are examined in this question (14). For the UK the four most frequent responses (31 responses) were cost reductions to company, followed by better image in local community (27 responses), none (26 responses), and cleaner working environment. For France cost reductions to company (20 responses) had the highest response, then none (19), better image in local community (17), and finally cleaner working environment.

The principal result of this question was a vast majority of respondents identified no major benefits for their company from improving environmental performance. In spite of this response was significantly pointed out in the UK (26 respondents). It was also tremendously mentioned in France (19 respondents). Furthermore, with 31 responses for the UK and 20 for France, the cost reduction responses confirmed the result of question 13 where 29 respondents for the UK and 27 for France agreed that reducing the environmental impact of their company can have significant cost benefit.

2.4.1 Breakdown by sector

The breakdown by sector of the four common responses revealed that the cost reductions to the company was the greatest perceived benefit from the UK Brick sector (35%), the French Sanitaryware & Tiles sector (40%), the French Industrial & Refractory sectors (36%) and finally the UK (42%) and French (40%) tableware sector. Better image in the local community was the major benefit for the UK Industrial & Refractory sectors (33%) and for the French Brick sector (37%). Only the UK Sanitaryware & Tiles sector mentioned a cleaner working environment (55%) as primary benefit.

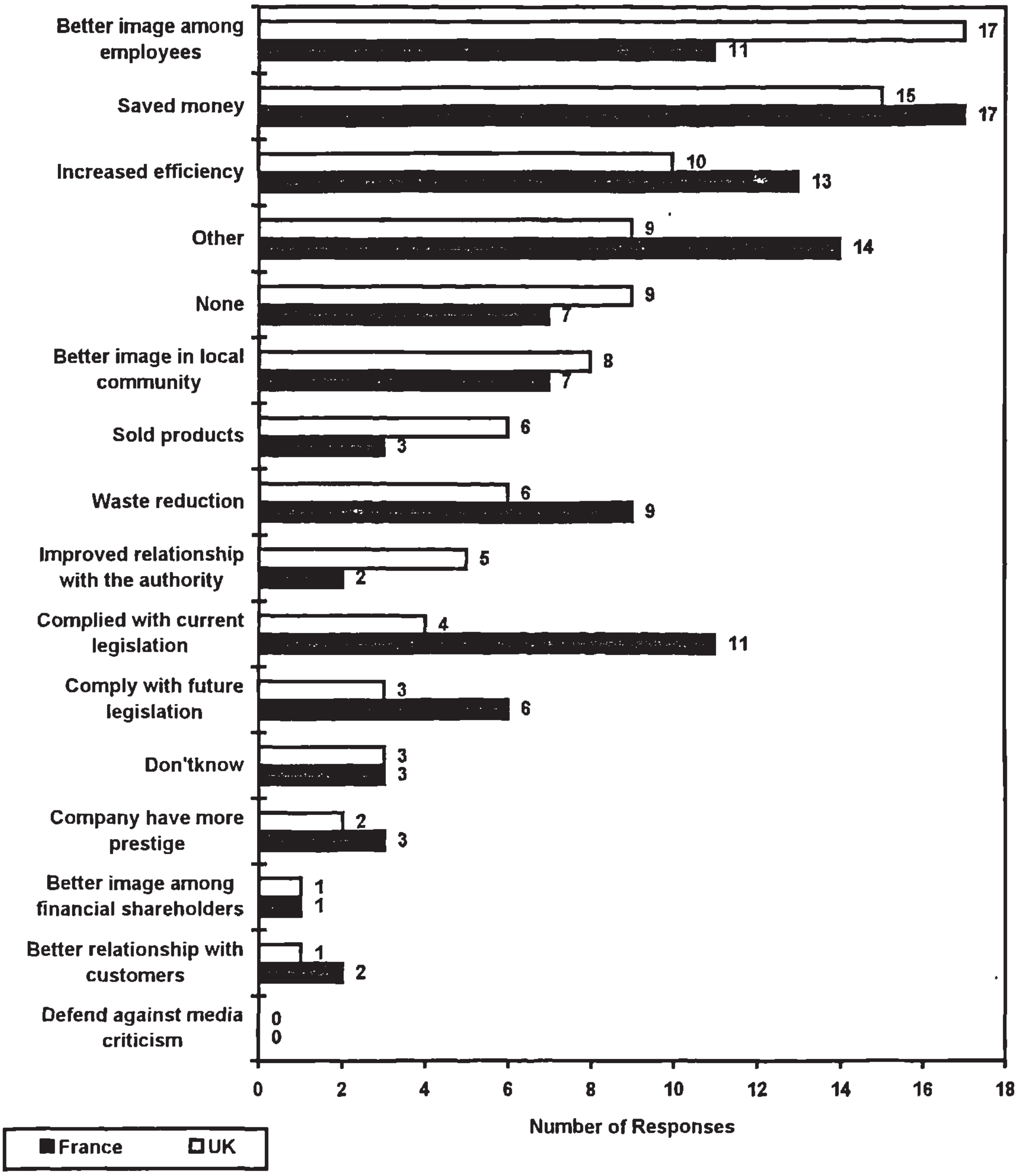
2.4.2 Breakdown by size

In terms of company size cost reductions to company was the major perceived advantage for the British medium-sized (52%) and large-sized (41%) segment. For France, cost reductions was also mentioned first by small-sized company (55%), medium-sized (44%), and large-sized band (38%). Better image in the local community was perceived as essential by small British companies (50%).

2.5 Benefits of adopting new procedures (Question 28)

Among the companies who recently took actions to improve their corporate environmental performance, the most frequently cited benefits obtained as a result of the changes that had been implemented are summarised in Figure 44. The most important benefits were better image among employees (17 respondents for the UK and 11 for France), money savings (15 respondents for the UK and 17 for France), and increased efficiency (10 respondents for the UK and 13 for France). A total of 23 respondents cited "other" benefits (9 UK and 14 French), which included greater environmental awareness, competitive advantage, energy savings, noise reductions, improved total quality management, product differentiation and quality and increased rate of production. Note also, that 9 respondents in the UK and 7 in France admitted that they did not get any benefit in adopting these new procedures.

Figure 44 (Q28) : Benefits of adopting new procedures



2.5.1 Breakdown by sector

The four most important benefits were similar in both countries. Indeed, better image among employees was, on average, (32%) the response the most often cited by British respondents, especially in the Brick sector (39%) and in the Industrial & Refractory sectors (41%). For France it was to save money (32%). The second most mentioned benefit was for the UK to save money (30%) while for France it was to increase efficiency (25%). To comply with legislation was the third most mentioned benefit by French respondents but was cited first (32%) by the French Brick sector such as better image among employees (28%) which was also cited first by Industrial & Refractory sectors.

2.5.2 Breakdown by size

In terms of company size, British micro (50%) and small-sized (42%) cited better image amongst employees as the main benefit while medium-sized mentioned money savings (30%) equally with increased efficiency (30%) such as large-sized companies (41%). For France, saving money was cited first by small-sized (43%), medium-sized (41%) and large-sized companies (29%) while for micro-sized companies it was better image among employees (35%). Complying with legislation was also frequently mentioned in the small-sized segment (32%)

2.6 Disadvantages in adopting new procedures (Question 29)

The vast majority of companies (Figure 45) who had taken action could identify no disadvantages (38 in the UK and 32 in France) in adopting this new procedure or equipment. The only other factors mentioned by a significant number of companies were capital costs (15 UK respondents, 14 French), too expensive/costly (9 UK respondents, 7 French) and too much work (3 UK respondents and 4 French).

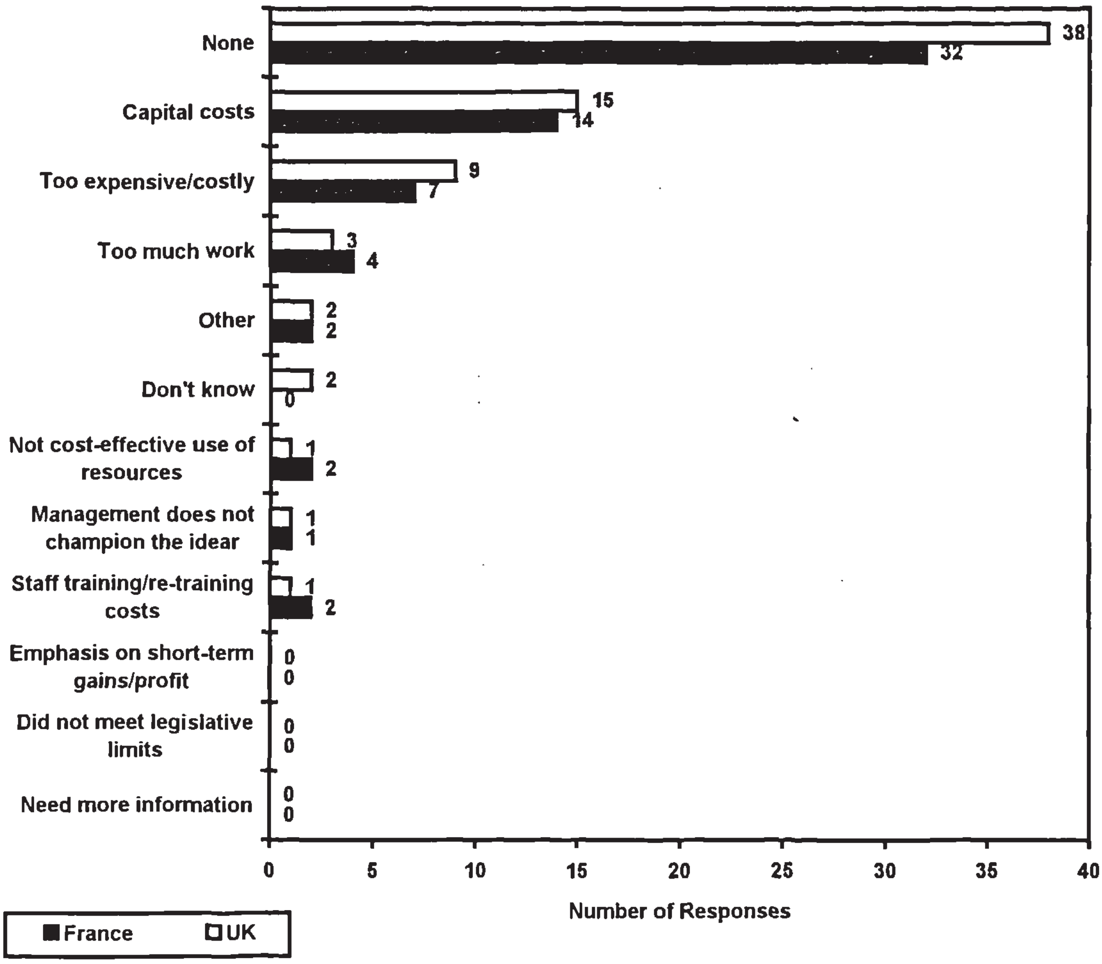
2.6.1 Breakdown by sector

The first mentioned disadvantage in all sectors in the UK and in France was none except for the French Sanitaryware & Tiles sector who predominantly cited initial capital costs. Concerns about capital costs were also significant in the UK and French Industrial & Refractory sectors (30% each of them) and in the UK Sanitaryware & Tiles sector (29%).

2.6.2 Breakdown by size

The responses were fairly similar for all four sizes of company in each country. Although, British Micro-sized companies appeared to have encountered fewer disadvantages (81%) in adopting this new procedure compared to their French counterparts (61%). This result was absolutely inverse in the small-sized companies, indeed 40% of the British respondents perceived disadvantages while a staggering 87% did not in France.

Figure 45 (Q29) : Disadvantages in adopting new procedures



3. INTERNAL DRIVERS AND BARRIERS FOR IMPROVING ENVIRONMENTAL PERFORMANCE

The internal drivers and barriers for improving environmental performances in the ceramics sector are examined in this section. They can be categorised as follows (Table 56):

Table 56: Internal drivers and barriers for improving environmental performances

- **FINANCIAL & ECONOMIC**

Q7	**Correlation between environmental performance and efficiency** A small majority of respondents supported the idea that improving environmental performance usually improves production efficiency. However, the breakdown by size revealed that 30% of the micro-sized companies interviewed in the UK and 41% in France did not believe that improving environmental performance usually improves production efficiency of whom 42% for the UK and 31% for France did not have an opinion.
Q13	**Correlation between environmental impact and cost benefits** Marginally more British than French respondents agreed that reducing environmental impact can have significant cost benefit. However, a third of the respondents neither agreed nor disagreed. Large-sized UK companies were much more in favour of this statement compared with their French counterparts.
Q10	**Correlation between financial constraints and improvement** Two third of respondents in both countries felt that financial constraints restrained them from doing more to improve their environmental performance. Surprisingly, in France the largest percentage of disagreement was in the large-sized segment (39%) which proved the fragile financial structure of the French ceramics industry and therefore the inability to adapt quickly to new requirements (technical, managerial, environmental, etc.).
Q30	**Long term financial benefits** Long term financial benefits in encouraging improved environmental performance were regarded as very important or fairly important by 63% of respondents in both countries while the vast majority of British small-sized (76%) and medium sized companies from each country (83% for the UK and 71% for France) felt that it was important.

Q31 | **Short term financial benefits**

On average, short term financial benefits were also considered, by a vast majority of respondents (relatively more UK respondents (65%) than French (59%)), as being a stimulus to encourage improved environmental performance of their company.

- **SHAREHOLDER'S & EMPLOYEE'S VIEWS**

Q34 | **Shareholder's/supporter's views**

Shareholder's/supporter's views as a mean to encourage improved environmental performance were only regarded important in the UK by 15%, and in France by 20%, of respondents, although the number of "don't knows" was particularly high (73% either the UK or France). This reflects the high degree of specialisation of people interviewed.

Q39 | **Employee's views**

The employee's views were considered by the vast majority of respondents (60% for the UK and 55% for France) as an important factor to improve environmental performance of their company.

3.1 Financial & Economic drivers and barriers for improving environmental performances

This section identifies the main internal Financial & Economic drivers and barriers for improving environmental performances.

3.1.1 Correlation between environmental performance and efficiency (Question 7)

In both countries, a majority of respondents agreed with the statement that improving environmental performance usually improves production efficiency, approximately 40% in each country against 25% for the UK and 33% for France disagreeing.

3.1.1.1 Breakdown by sector

More detailed analysis revealed that 70% (7 companies out of 10) of the British Sanitaryware & Tiles sector agreed or strongly agreed with this statement, with no disagreement from any companies interviewed. The French Sanitaryware & Tiles sector also accounted for the highest rate of agreement (57%) compared to a disagreement of 14% (1 company out of 7).

3.1.1.2 Breakdown by size

Overall, opinions were evenly divided for the UK and France. However, in line with the result of Question 5, 30% of the micro companies interviewed in the UK and 41% in France did not believe that improving environmental performance usually improves production efficiency while 42% for the UK and 31% for France did not have an opinion. Comparatively, 48% of the UK large-sized companies strongly agreed on this statement.

3.1.2 Correlation between environmental impact and cost benefits (Question 13)

For the UK and France, marginally more respondents (38% for the UK as for France) agreed with the statement that reducing environmental impact can have significant cost benefits than disagreed (34% for the UK and 33% for France). Note also the high percentage of respondents who were neither agree nor disagree (28% for the UK and 29% for France).

3.1.2.1 Breakdown by sector

For both countries, the two sectors who most disagreed with this statement were the Industrial & Refractory (40% for the UK and 34% for France) and the tableware (35% for the UK and 25% for France).

3.1.2.2 Breakdown by size

The size analysis brought out the fact that for the UK large-sized companies were more in favour of this statement (55%) compared with an average of 30% for micro and small sized companies. While for France, the agreement was evenly distributed across the four segments (approximately 39%) with the lowest percentage for the micro-sized segments (35%).

3.1.3 Correlation between financial constraints and improvement (Question 10)

Most respondents, approximately 65% in each country, agreed that financial constraints restrained them from doing more to improve their environmental performance.

3.1.3.1 Breakdown by sector

Approximately 78% of the respondents in the UK Sanitaryware & Tiles sector and in the French brick sector agreed on this statement. Finally, 70% of the respondents in the tableware sector (72% for the UK and 67% for France) viewed financial constraints as one of the key reasons for not doing more to improve their environmental performance.

3.1.3.2 Breakdown by size

Among British and French respondents it appeared that the largest percentage of disagreement was the micro-sized band (37%) for the UK while for France it was the large-sized segment (39%). This high percentage of disagreement in France confirms the fragile financial structure of the French ceramics industry and therefore the inability to quickly adapt to new requirements (technical, managerial, environmental, etc.).

3.1.4 Long term financial benefits (Question 30)

This question aimed to assess how companies considered long term financial benefits in encouraging improved environmental performance. There were regarded as very important or fairly important by 63% of respondents in each countries.

3.1.4.1 Breakdown by sector

For the UK and for France the long term financial importance was greater in the Sanitaryware & Tiles sector (55% UK, 63% France). However respondents in the British Tableware sector (27%) as well as the French Industrial & Refractory sectors (24%) did not consider long term financial benefits as important.

3.1.4.2 Breakdown by size

The analysis by size revealed that the vast majority of British small-sized (76%) and medium sized companies from each country (83% for the UK and 71% for France) felt that it was important. Approximately 32% of the British and French large-sized companies and 26% of the French small-sized companies did not feel long term financial benefits were important.

3.1.5 Short term financial benefits (Question 31)

On average, short term financial benefits were considered to be relatively more important, in the UK (65%) than in France (59%), as a stimulus to encourage improved environmental performance of their company.

3.1.5.1 Breakdown by sector

Overall, opinions on this question were evenly distributed between the four sectors. However, 26% of the respondents for the UK and 21% for France in the Tableware sector, did not regard short term financial benefits as important, compared to 24% of the French interviewees in the Industrial & Refractory sectors and 19% in the Brick sector.

3.1.5.2 Breakdown by size

The short term financial benefits were considered relatively less important by large-sized companies (32% for the UK and 40% for France) in contrast with the 80% of respondents in the medium-sized companies who considered this issue important.

3.2 Shareholder's & Employee's views for improving environmental performances

This section specifically looks at the Shareholder's and Employee's views.

3.2.1 Shareholder's/supporter's views (Question 34)

Shareholder's/supporter's views as a mean to encourage improved environmental performance were only regarded important in the UK by 15% and in France by 20% of respondents, although the number of "don't know" answers was particularly high (73% either the UK or France).

3.2.1.1 Breakdown by sector

Although samples were small, the Brick sector in both countries did not regard this issue as being of any importance at all, while 23% of the UK Industrial & Refractory sectors and 50% of the French Industrial & Refractory sectors acknowledge the importance of Shareholder's/supporter's views.

3.2.1.2 Breakdown by size

The highest rate of responses other than "don't know" was provided by large companies but surprisingly 14% in the UK and 20% in France responded that this issue was not very important while 32% in the UK and 33% in France regarded it as important.

3.2.2 Employee's views (Question 39)

The vast majority of respondents (60% for the UK and 55% for France) considered that employee's views were an important factor to improve environmental performance of their company.

3.2.2.1 Breakdown by sector

The UK Sanitaryware & Tiles sector was the only sector to predominantly feel that this issue was not important (45% - but small sample) comparatively, 63% of the French respondents regarded employee's views as important.

3.2.2.2 Breakdown by size

Surprisingly, 32% of the UK Large-sized companies and 40% of the French respondents felt that employee's views to improve environmental performance were not very important.

4. EXTERNAL DRIVERS AND BARRIERS FOR IMPROVING ENVIRONMENTAL PERFORMANCE

The external (Table 56) drivers and barriers for improving environmental performances in the ceramics sector are examined in this section. They can be categorised as follows:

Table 57: External drivers and barriers for improving environmental performances

- **ENVIRONMENTAL**

Q37	**Environmental impact alone** Approximately, half of the respondents (48% in the UK and 51% in France) considered environmental impact alone as an important issue. Although, 20% in the UK and 23% in France of respondents did not know if this issue encouraged environmental performance of their company while a third of micro-sized companies did not consider this issue important.

- **MARKET & CUSTOMER**

Q38	**Market position and market share** Market position and market share were not perceived by respondents (52% in the UK and 42% in France) to be important factors influencing environmental improvements. Furthermore, a third of the respondents answered "don't know" to this question.
Q33	**Customer pressure** In general, customer pressure was not regarded as an important incentive to encourage improved environmental performance (only 28% of UK respondents and 18% of French).

- **INSTITUTIONAL & PUBLIC OPINION**

Q36	**The views of the local community** A majority of respondents (58% for the UK and 57% for France) felt that the views of the local community were quite important in encouraging improved environmental performance of their company.
Q35	**Public opinion** Respondents predominantly emphasised the importance of public opinion; on average for the UK 37% and 44% for France of interviewees regarded this issue as important in encouraging improved environmental performance of their company.

- **LEGAL & REGULATORY**

Q8	**Correlation between legislation and environmental action** On average, for both countries half of the respondents agreed that their company only took environmental action to meet legislation.

Q9	**Level of awareness in regard to environmental legislation** The vast majority of respondents in both countries agreed that it was not always clear how environmental legislation affected companies.
Q15	**Awareness of the options to meet environmental legislation** The vast majority of respondents felt that they were well informed about the options and technologies available to meet environmental legislation.
Q32	**Compliance with relevant legislation** Over 80% of respondents regarded as at least important to comply with relevant legislation.

4.1 Environmental impact for improving environmental performances

This section considers the environmental impact alone.

4.1.1 Environmental impact alone (Question 37)

Approximately, half of the respondents (48% in the UK and 51% in France) considered environmental impact alone as an important issue. Although, 20% in the UK and 23% in France of respondents did not know if this issue encouraged environmental performance of their company.

4.1.1.1 Breakdown by sector

The largest proportion of "don't know" was for the UK and for France in the Tableware sector (47% in each country), followed by the Brick sector (42% UK, 31% France). Furthermore, the highest sector regarding environmental impact alone as important was for the UK the Industrial & Refractory sectors (53%), while for France it was the Sanitaryware & Tiles sector (63%).

4.1.1.2 Breakdown by size

Overall, a third of micro-sized companies did not consider this issue important while large-sized companies predominantly supported the idea (55% in the UK and 73% for France).

4.2 Market position and customer pressure for improving environmental performances

This section addresses the issues of market position and customer pressure.

4.2.1 Market position and market share (Question 38)

Market position and market share was not perceived (52% in the UK and 42% in France) to be important factors influencing environmental improvements. Furthermore, a large number (approximately 27% for the UK and 32% for France) fell into the "don't know" category.

4.2.1.1 Breakdown by sector

Two sectors in the UK and in France regarded these issues as more important than by others, the Brick sector (16% in the UK and 38% in France) and the Sanitaryware & Tiles sector (27% in the UK and 50% in France).

4.2.1.2 Breakdown by size

Market position and market share were also seen as being marginally more important by large-sized companies (23% UK, 27% France).

4.2.2 Customer pressure (Question 33)

Customer pressure, in general was regarded as important by only 28% of British respondents and comparatively by 18% of French respondents as an incentive to encourage improved environmental performance of their company.

4.2.2.1 Breakdown by sector

This situation was reflected across all sectors but with its importance was greatest in the Sanitaryware & Tiles sector (27% for the UK and 38% for France) and lowest in the Tableware sector (23% for the UK and 16% for France). Furthermore, the highest proportion of respondents in France did not know (25% in France against 12% in the UK) and it was marginally more important in the Brick sector (25%) and Tableware sector (26%).

4.2.2.2 Breakdown by size

While for the UK there were only minor differences across the company size range, for France, it can turn out to be three time as high. Indeed, only 10% of the respondents in the Brick sector regarded customer pressure as important compared to 27% in the small-sized segment and 29% in the medium-sized range.

4.3 Institutional and public opinion for improving environmental performances

This section specifically looks at the impact of public opinion on corporate environmental decision.

4.3.1 The views of the local community (Question 36)

A majority of respondents (58% for the UK and 57% for France) felt that the views of the local community were quite important in encouraging improved environmental performance of their company.

4.3.1.1 Breakdown by sector

This view was reflected across the sectors in both countries, but with a relatively greater proportion of respondents in the Brick sector (63% UK, 62% France) and Tableware sector (62% UK, 63% France). Although, 36% of the French Sanitaryware & Tiles sector considered that it was not important.

4.3.1.2 Breakdown by size

For the UK, the largest number of respondents who did not consider this issue important was located in the micro-sized range (32%), while for France it was the medium-sized segment with only 24% of respondents. In France, three-quarters of respondents in the large-sized segment felt that this issue was important compared to 55% in the UK.

4.3.2 Public opinion (Question 35)

Predominantly, respondents emphasised the importance of public opinion, on average 37% for the UK and 44% for France, of interviewees regarded this issue as important in encouraging improved environmental performance of their company.

4.3.2.1 Breakdown by sector

The importance of public opinion in general was greatest in the Tableware sector (47% for both the UK and France) and lowest in the Sanitaryware & Tiles sector (18% for the UK and 25% for France). The French Brick sector (50%) appeared to take this issue more seriously compared to their British counterparts (26%).

4.3.2.2 Breakdown by size

The vast majority of British medium-sized companies (61%) regarded this issue as important compared to 52% for France. Although, 49% of the UK micro-sized companies, 46% of the UK large-sized segment, and 33% of the French small-sized range considered this issue as not important.

4.4 Legal and regulatory pressure for improving environmental performances

This section examines the managerial position in the UK and France towards environmental legislation and the relative importance in encouraging improved environmental performance of the ceramics industry

4.4.1 Correlation between legislation and environmental action (Question 8)

On average, for both countries half of the respondents agreed that their company only took environmental action to meet legislation.

4.4.1.1 Breakdown by sector

However, opinions were diametrically opposed within the Sanitaryware & Tiles sector, 60% of the British respondents tend to disagreed or strongly disagreed while 62% of French respondents tend to agreed or strongly agreed (but small sample).

4.4.1.2 Breakdown by size

No significant differences between companies' sizes have been identified. Nevertheless, in general it appears that British manufacturers had a more fixed reaction on this statement as approximately 55% either agreed or disagreed strongly compare to only 39% for France.

4.4.2 Level of awareness in regard to environmental legislation (Question 9)

The vast majority of respondents (approximately 80%) in both countries agreed that it was not always clear how environmental legislation affected companies.

4.4.2.1 Breakdown by sector

This opinion appeared to be shared by most of the respondents excepted the UK Sanitaryware & Tiles sector where respondents disagreed at approximately 30%.

4.4.2.2 Breakdown by size

Unsurprisingly for the UK and for France, across the four company-sizes band the opinion that it was not always clear how the environmental regulation affected the business was also very consistent (around 80%).

4.4.3 Awareness of the options to meet environmental legislation (Question 15)

Over 70% of respondents (79% for the UK and 72% for France) felt that they were at least fairly well informed about the options and technologies available to meet environmental legislation while approximately only 10% felt that they were not very well or not at all informed.

4.4.3.1 Breakdown by sector

For the UK 100% of the respondents from the sanitaryware & tiles sector were well or very well informed.

4.4.3.2 Breakdown by size

With no surprise, for the UK and for France the majority of respondents who were not very well or not at all informed were predominantly located in the micro-sized segment.

4.4.4 Compliance with relevant legislation (Question 32)

The vast majority of respondents regarded as at least important to comply with relevant legislation (84% for the UK and 80% for France) as a mean to encourage improved environmental performance of their company.

4.4.4.1 Breakdown by sector

Importance was very high in all sectors with a bias towards the "very important" response. However for the UK and for France the tableware sector differed a little from this trend with comparatively a more significant "fairly important" (21% for the UK and 32% for France).

4.4.4.2 Breakdown by size

Overall, there was no significant variance across the four sizes and among UK respondents or French. It did not much matter from which segment respondents were originated they responded in the same way.

5. COMPANY ACTION TO IMPROVE ENVIRONMENTAL PERFORMANCE

This section reviews actions taken by companies to improve their corporate environmental performance, and assesses benefits and disadvantages obtained due to the implementation of these changes. Finally, it identifies factors in encouraging improved environmental performance of companies. The table below (Table 58) summarises the actions taken by British and French ceramics manufacturers to improve environmental performance.

Table 58: Company action to improve environmental performance

Q11	**Correlation between better advice and decision process** The vast majority of respondents shared the idea that it would make it easier for them if better advice was available. Indeed, up to 80% of British respondents from the small-sized band agreed or strongly agreed with this statement as well as the French small and medium-sized companies. Despite all the programmes (generally specially designed for SMEs) set up by local, national and European authorities to help companies, it appears that in both countries companies, in particular SMEs, are feeling that they are lacking information on environmental issues.
Q17	**Corporate environmental policy** Over half the respondents in the UK (54%) and 47% in France considered that they do not need a formal corporate environmental policy, although this view was less common in large companies and in both countries, on average of 20% of the interviewees responded that they were considering one.
Q18	**Monitoring of waste or emissions produced** While only a quarter actually had an environmental policy, over 64% in the UK and 48% in France monitored levels of waste or emissions.
Q19	**Reduction targets for emissions and waste set** Very few companies in the UK (30%) and France (22%) have set up reduction targets for emission and waste, with the lowest percentage for micro and small-sized segment in both country.
Q20	**Accreditation under an environmental management system** Only 2 companies in the UK (2% of the sample) and 3 in France (3% of the sample) were already accredited under an environmental management system, while a further 14 for the UK (15% of the sample) and 9 for France (10% of the sample) were seeking to be accredited. Furthermore, 35% of the respondents for the UK and a staggering 42% for France did not know.
Q21/22/23	**Type of accreditation / EMAS & BS7750** Of only 16 British companies accredited or seeking to be accredited under an environmental management system, 9 supported EMAS and 5 supported BS7750 while

for France out of 12 companies accredited or seeking to be accredited, 7 supported EMAS and 5 Afnor X30-200, the French equivalent to BS7750.

Q25 **Action taken recently to improve environmental performance**

Approximately a third of the companies had not introduced any change to improve environmental performance over the last 2 years. The majority of respondents (70%) in the UK and France had not improved environmental performance by adopting a different managerial approach or process procedure, but by purchasing (50%) a new piece of equipment. Among companies who did not take any action to improve their environmental performance, a majority were in the micro-sized segment, while a minority were in the large-sized range (1 company for the UK and 2 for France).

Q26 **Factors leading to improve environmental performance**

The main reason for this change was a requirement to meet legislation (33 responses in the UK and 36 in France). Other frequent responses included reduced costs (11 in the UK and 19 in France), need to renew equipment (10 in the UK and 9 in France), improving image either among employees or in the local community and new management.

Q40 **Member of a local Waste Minimisation Club**

Only 7% of the total population surveyed (7 respondents in the UK and 6 in France), were already members of a Local Waste Minimisation Club, 45% of the respondents expressed an interest in joining one while 48% responded that they did not want to be members.

Q41 **Aware of a Local Waste Minimisation Club**

The proportion of respondents interested in membership were, for both countries, very significant in the Large-sized segment (60%) and medium-sized segment. Only 10 respondents in the UK and 11 in France were aware of a Local Waste Minimisation Club.

Q42 **Sources of information**

Usually, when advice on environmental issues is needed respondents contact their trade/industry associations first, then the industrial research organisations, followed by the local authorities and finally the environmental journals or magazines.

5.1 Correlation between better advice and decision process (Question 11)

For each country, nearly three quarters of the respondents agreed that if better advice was available, it would be easier for them.

5.1.1 Breakdown by sector

Agreement on this statement was extremely high for the British tableware sector (80%) and also for the French Sanitaryware & Tiles sector who reached absolute consensus (100%).

5.1.2 Breakdown by size

For the UK and France, the agreement on this statement was uniformly distributed across the fours sized segments. Up to 80% of the British respondents from the small-sized band agreed or strongly agreed on this statement as did the French small and medium-sized companies.

5.2 Corporate environmental policy (Question 17)

The vast majority of respondents in the UK (54%) and in France (47%) answered "No, no need" to the question does your company have a formal corporate environmental policy.

5.2.1 Breakdown by sector

The proportion with no environmental policy in the UK was greater in the Tableware sector (68%), compared to 58% in the Brick sector, 46% in the Industrial & Refractory sectors and only 27% in the Sanitaryware & Tiles sector. In France approximately half of the companies among each ceramics sector did not have an environmental policy.

5.2.2 Breakdown by size

With no surprise, the breakdown by size revealed that the vast majority of micro and small-sized companies in each country did not have a formal corporate environmental policy (more than 70%), while medium and large companies have one (around 60%). Furthermore, for each country on average, 20% of the interviewees responded that they were considering one.

5.3 Monitoring of waste or emissions produced (Question 18)

The majority of respondents from each country (64% in the UK and 48% in France) replied positively to the question "are the levels of waste or emissions produced at your site monitored in any way?".

5.3.1 Breakdown by sector

For the UK, the largest sector who did not monitor levels of waste or emissions was the Industrial & Refractory sector (47%), and the Tableware sector (32%). While for France 60% of the Tableware industries did not monitor levels of waste or emissions, followed by the Sanitaryware & Tiles sector (50%) and the Industrial & Refractory sectors (45%).

5.3.2 Breakdown by size

For the UK, approximately 60% of the micro-sized companies did not monitor levels of waste or emissions while 80% of the large companies monitored them. For France, 100% of the large-sized respondents declared that monitoring is conducted in their company against 25% for the micro-sized range.

5.4 Reduction targets for emissions and waste set (Question 19)

The number of companies setting reduction targets for emission and waste followed the same pattern as previously observed for question 18. Indeed, the number setting targets was 30% for the British companies and only 22 % for French companies.

5.4.1 Breakdown by sector

The lowest sector for the UK to set reduction targets was the Tableware sector (15%), compared to approximately half of the companies interviewed in the Sanitaryware & Tiles sector. French sectors followed a similar trend; approximately 13% for the Tableware sector and the Sanitaryware & Tiles sector compared to around 31% in the Brick sector and the Industrial & Refractory sector.

5.4.2 Breakdown by size

The breakdown by size for the UK and for France confirm that larger companies were more inclined to set reduction targets for emissions and waste. Indeed, most of the respondents (50% UK and 40% France) in the medium-sized or large-sized companies replied in the affirmative, while interviewees in the micro-sized and small-sized segment predominantly responded in the negative (for the UK approximately 20% and for France 10%).

5.5 Accreditation under an environmental management system (Question 20)

Only 2 companies for the UK (2% of the sample) and 3 in France (3% of the sample) were already accredited under an environmental management system, while a further 14 for the UK (15% of the sample) and 9 for France (10% of the sample) were seeking to be accredited. Furthermore, 35% of the respondents for the UK, and a staggering 42% for France, did not know.

5.5.1 Breakdown by sector

For the UK the highest proportion of companies accredited or seeking to became accredited was in the Sanitaryware & Tiles sector (45%), although in this case the sample was relatively small. The smallest proportion was in the Tableware sector (3%). For France 17% of the respondents in the Industrial & Refractory sector were accredited compared to only 6% in the Brick sector, 12% in the Sanitaryware & Tiles sector and 5% in the Tableware sector.

5.5.2 Breakdown by size

The proportion of companies accredited in the UK and in France increased with the size of the company. For the UK large/medium-sized companies accounted for approximately 20% of the companies accredited or seeking to be, while for France it was around 30%. However, accreditation in the UK micro/small-sized segments was approximately 11% while for France only 1 company was seeking to be accredited (7%).

5.6 Type of accreditation (Question 21)

Of only 16 British companies accredited or seeking to be accredited under an environmental management system, 9 supported EMAS[1] and 5 supported BS7750[2] (Figure 46) while for France out of 12 companies accredited or seeking to be accredited, 7 supported EMAS and 5 supported Afnor X30-200, French equivalent to BS7750.

---

[1] EMAS is the European Eco-Management & Audit Scheme is part of a trend in European legislation towards encouraging voluntary industrial initiatives (e.g., the Eco-labelling regulation). The objective of the scheme is to promote continuous improvements in the environmental performance of industrial activities by:

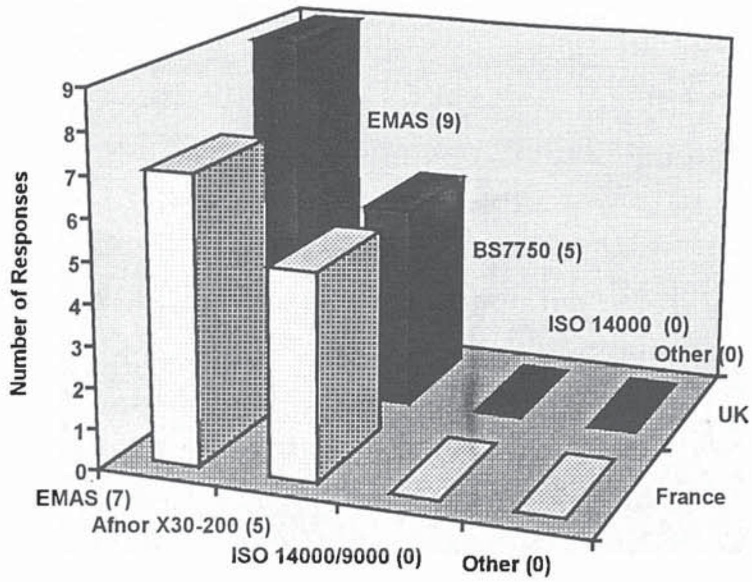
- the establishment and implementation of environmental policies, programmes and management systems by companies, in relation to their sites;
- the systematic, objective and periodic evaluation of the performance of such elements;
- the provision of information on environmental performance to the public.

The regulation entered into force on 13 July 1993 and the system as a whole becomes operational on 10 April 1995. The regulation will be reviewed in 1998.

[2] BS7750 is a voluntary system which aims to protect the environment through a quality management approach. The 1992 version, revised in January 28th 1994, ensured compatibility with the EMAS Regulation - in particular with reference to Economically Viable Application of Best Available Technology (EVABAT). The standard requires participating companies to:

- carry out an initial environmental review;
- identify the significant environmental effects;
- establish site level environmental policies, programmes & management systems;
- integrate environmental management into overall management systems;
- systematically and periodically evaluate the performance of the policy, programme and system.

Figure 46 (Q21) : Accreditation under an environmental management system



5.7 EMAS (Question 22)

5.7.1 Breakdown by sector

Of the 9 British companies or the 7 French companies accredited or seeking to be accredited under EMAS, all of them felt it was at least fairly effective in encouraging business to improve their environmental performance.

5.7.2 Breakdown by size

The breakdown by size revealed that, for the UK, 78% of the companies accredited or seeking to be accredited EMAS (7 out of 10) were either Medium-sized or large-sized, while for France 86% of the companies interviewed (6 out of 7) were in the same two segments.

5.8 BS7750 (Question 23)

5.8.1 Breakdown by sector

Among the small number of companies who were registered or seeking to be BS7750 (5 for the UK) 3 of them were in the Sanitaryware & Tiles sector and the other 2 in the Industrial & Refractory sector. For France, 5 companies were also accredited or seeking to be accredited, evenly distributed across the four sectors.

5.8.2 Breakdown by size

The breakdown by size revealed, for the UK, that one company at least in each size range was registered or seeking to be BS7750 registered, while for France only Large and Medium companies were accredited or seeking to be accredited to Afnor X30-200.

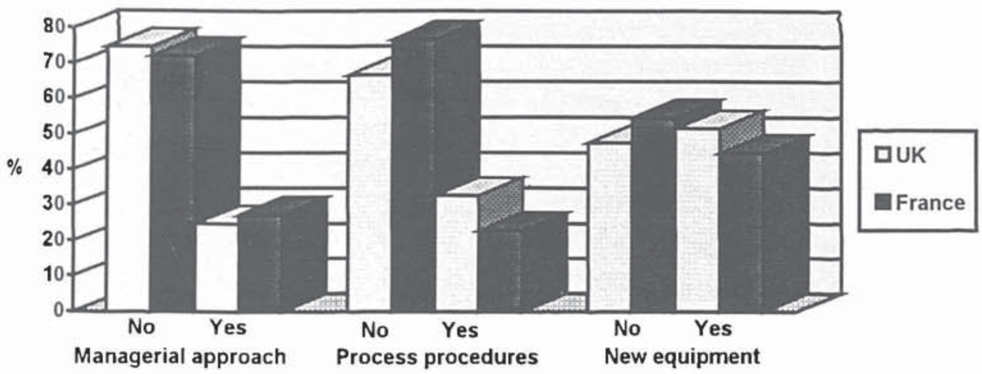
5.9 Action taken recently to improve environmental performance (Question 25)

To the question "has your company introduced any change to improve environmental performance over the last 2 years", 28 UK respondents answered in the negative to all three options (managerial approach, process procedure, and installed new piece of equipment) as well as 32 French interviewees.

The majority of respondents (70%) in the UK and France did not improve environmental performance by adopting a different managerial approach or process procedure. Those who did improve, did so by purchasing (50%) a new piece of equipment (Figure 47).

To interpret this question, 2 levels of analysis were conducted, firstly based on respondents who answered "no" to the three suggestions and secondly, each of the three initiatives were individually analysed in relation to companies who recently introduced a change. These initiatives were not mutually-exclusive. A further breakdown by sector and by size was also carried out.

Figure 47 (Q25) : Improved environmental performance over the last 2 years

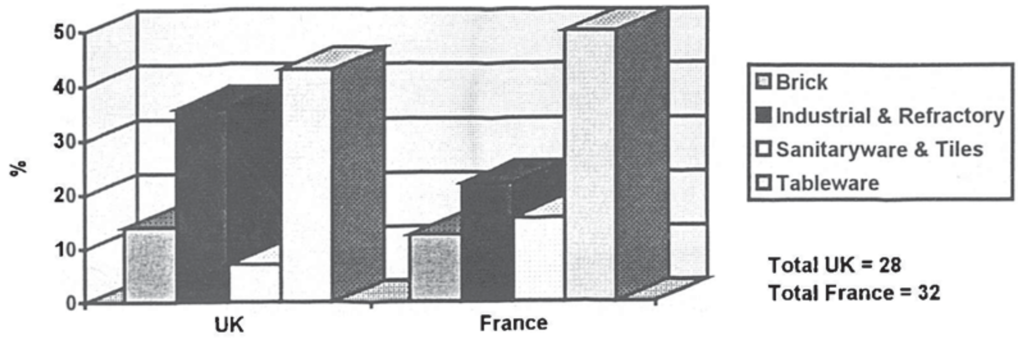


5.9.1 Breakdown by sector

The vast majority of companies who had not taken any action to improve environmental performance (Figure 48) most commonly originated, for the UK, from the Tableware sector (42%) and the Industrial & Refractory sectors (35%) while for France they were mainly from the Tableware sector (50%).

For the UK the first improvement cited by respondents, who recently took an action to improve their environmental performance, among the four sectors, was the installation of new equipment, the highest rate was in the Industrial & Refractory sectors (54%) and the lowest in the Tableware sector (41%). Moreover, changes in process procedures were also most common in the Tableware sector and Sanitaryware & Tiles sector (31%). French ceramics manufacturers followed approximately the same pattern. However, on average (29%) managerial approach was cited more often, and was even the first choice in the Brick sector (42%). Changes in process procedures were also significant in the Tableware sector (30%) but less common in the Brick sector (15%).

Figure 48 (Q25) : No action over the last 2 years vs sector

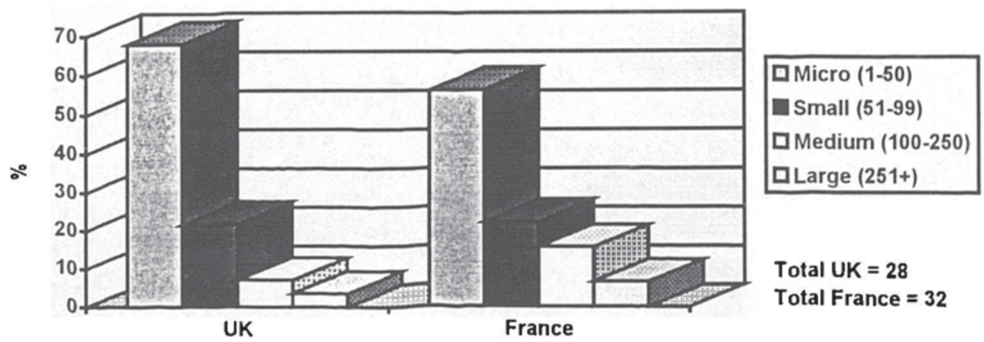


5.9.2 Breakdown by size

Among companies who did not take any action to improve their environmental performance, a majority (70% in the UK and 54% in France) were in the micro-sized segment (Figure 49) while a minority were in the large-sized range (1 company for the UK and 2 for France).

Among British and French companies who took actions over the last 2 years, large-sized companies equally took actions in all three areas mentioned e.g. managerial approach (28% for the UK and for France 30%), process procedures (37% for the UK and also for France) and finally new equipment (35% for the UK and 33% for France). While micro-sized companies mainly installed new equipment (61% for the UK and 59% for France).

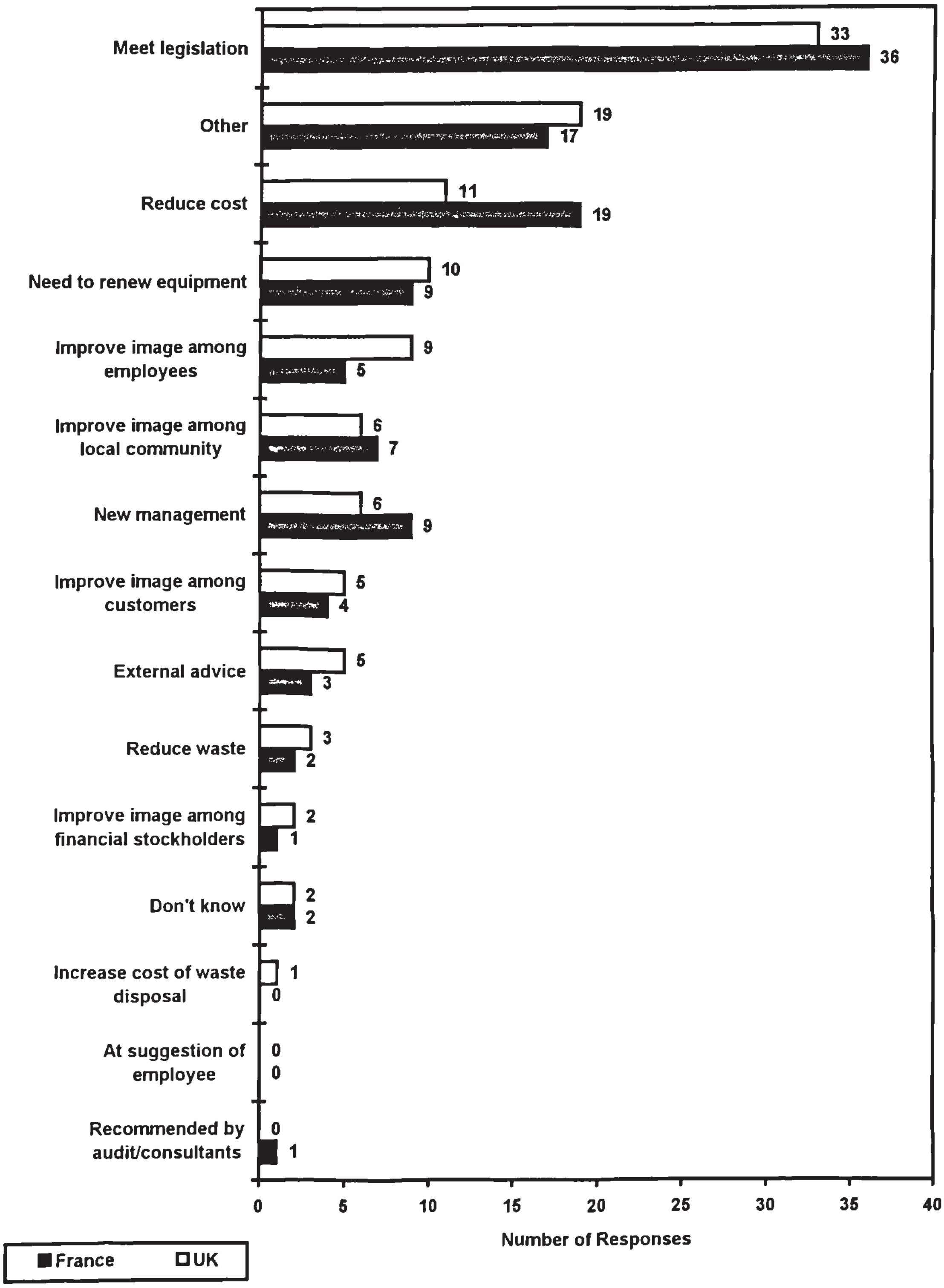
Figure 49 (Q25) : No action over the last 2 years vs size



5.10 Factors leading to improve environmental performance (Question 26)

Respondents were then invited to point out the impetus of this change(Figure 50). The factor prompted most frequently was the requirement to meet legislation (33 responses in the UK and 36 in France). Other frequent responses included reducing costs (11 in the UK and 19 in France), needs to renew equipment (10 in the UK and 9 in France), improving image either amongst employees or in local community and new management. However, 19 respondents in the UK and 17 in France cited "other" motivations which included issues such as a decision from the parent company, operating flexibility, new technology in use, new clients' specification, desire to penetrate new market, and a few also cited environmental awareness.

Figure 50 (Q26) : Factors influencing companies to change procedure



5.10.1 Breakdown by sector

For the UK legislation was always the most important factor across the four sectors. To reduce costs was the next most important driver in the Sanitaryware & Tiles sector (41%), Brick and Tableware sector (20%) while the need to renew equipment accounted also for

25% in the Brick sector. For France, legislation was also the major driver except in the Sanitaryware & Tiles sector where half of the respondents cited reducing costs and the other half new management (but this was a small sample).

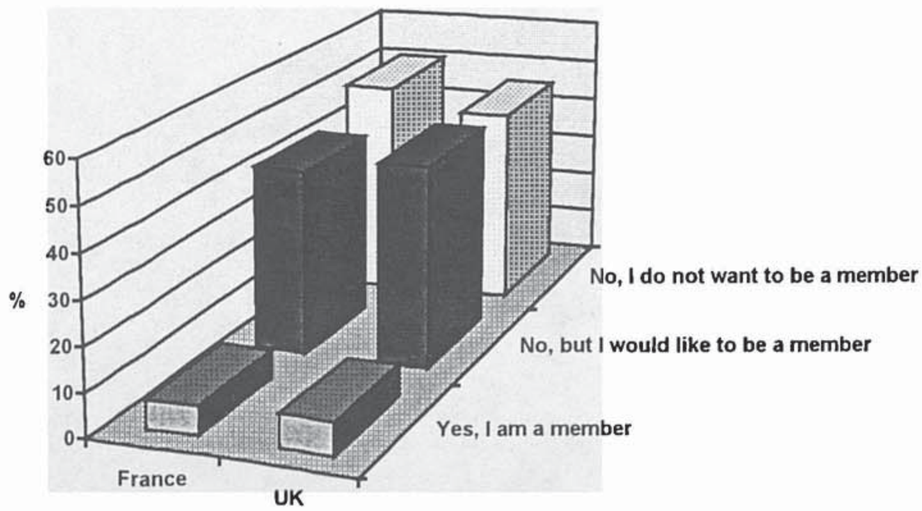
5.10.2 Breakdown by size

For the UK legislation was also the most important factor influencing companies to adopt a new procedure. The next most important driver mentioned by the micro-sized companies was the need to renew equipment (25%). This was also cited by large-sized companies (19%), while in the small companies it was to improve image among employees (25%) and for medium sized companies cost reduction was the most important (42%). For France legislation was always cited first across all sizes, with half of the respondents in the micro, small and medium-sized companies and 43% in the large-sized range. The second most significant driver was cost reduction, cited by a third of the small and large sized companies.

5.11 Member of a local Waste Minimisation Club (Question 40)

Approximately 7% (Figure 51) of the total population surveyed (7 respondents in the UK and 6 in France), were already members of a Local Waste Minimisation Club. 45% of the respondents expressed an interest in joining one while 48% responded that they did not want to be a member.

Figure 51 (Q40) : Member of a local waste minimisation club



5.11.1 Breakdown by sector

Respondents who were already members of a Local Waste Minimisation Club were spread across all four sectors, with a more substantial representation in the Sanitaryware & Tiles sector. Respondents interested in joining one were, indisputably, higher in the Tableware sector (67% in the UK and 43% in France) while respondents who were not interested in membership were markedly high in the Brick sector (58% in the UK and 61% in France).

5.11.2 Breakdown by size

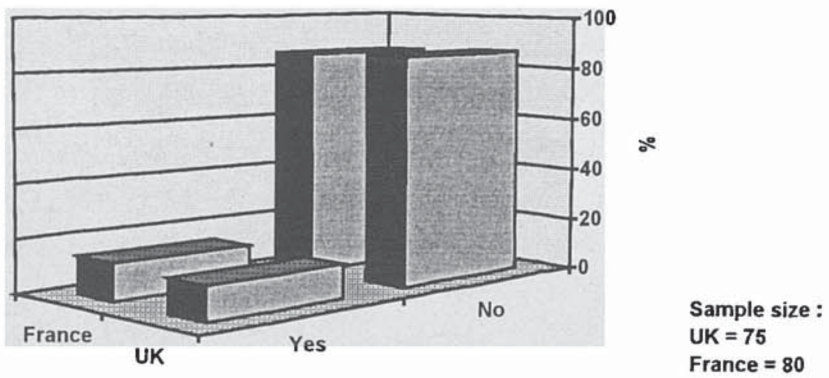
For the UK respondents who are members all originate from large-sized companies while for France they were more spread across small, medium and large-sized companies.

The proportion of respondents interested in membership were for each country very significant in the large-sized segment (60%) and medium-sized segment (42% in the UK and 61% in France). Small-sized companies in the UK seemed to be more inclined to join a Local Waste Minimisation Club (63%) compared to French (31%).

5.12 Aware of a Local Waste Minimisation Club (Question 41)

Only 10 respondents in the UK and 11 in France were aware of a Local Waste Minimisation Club (Figure 50).

Figure 52 (Q41) : Aware of a local waste minimisation club



5.12.1 Breakdown by sector

Predominantly respondents who were aware of a Local Waste Minimisation Club were in the Sanitaryware & Tiles sector (27% UK and 25% France).

5.12.2 Breakdown by size

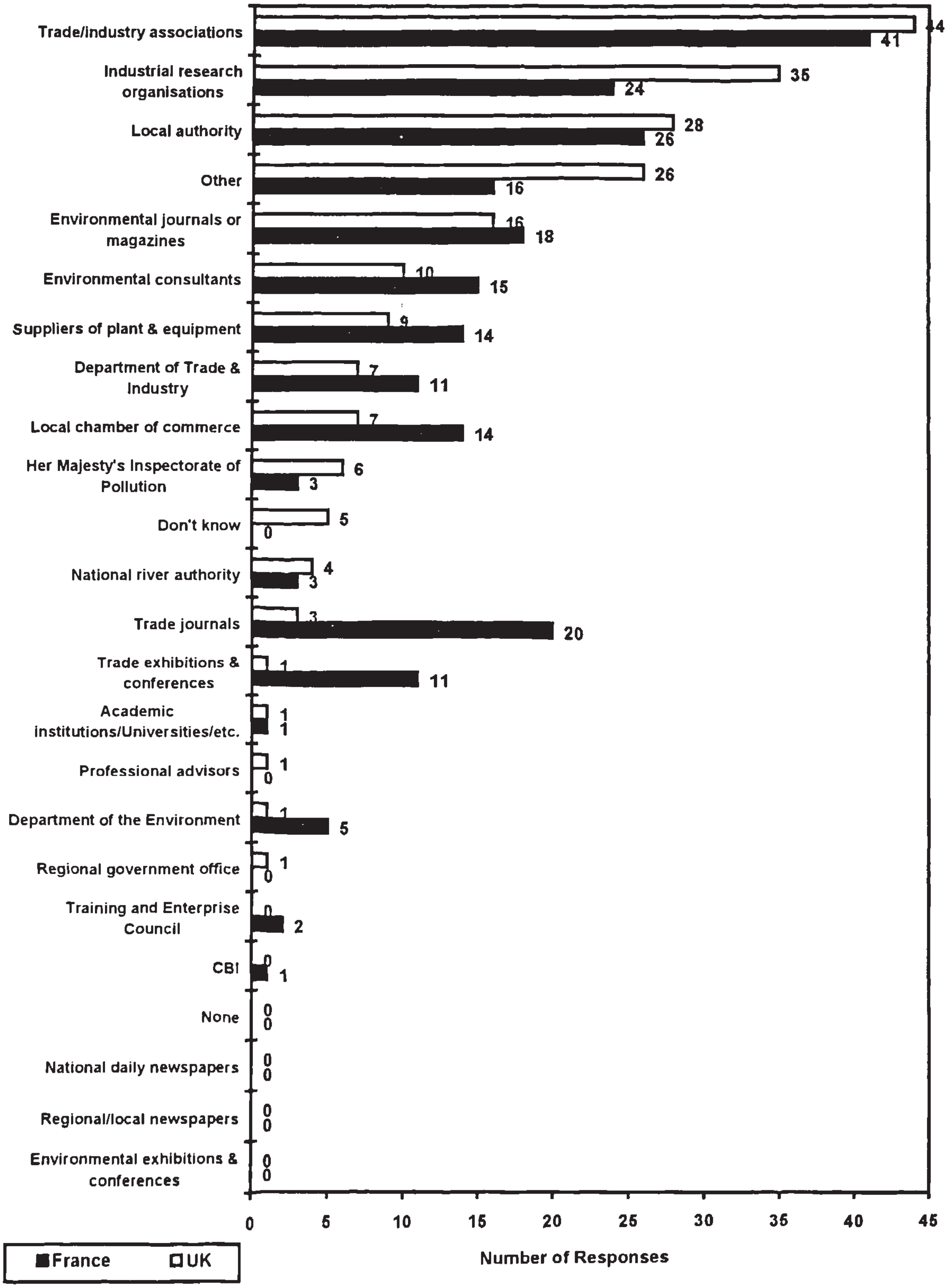
Not surprisingly, awareness for the UK and for France was greater in the large-sized and medium-sized segment.

5.13 Sources of information (Question 42)

The respondents were questioned on where they usually turned for advice on environmental issues (Figure 53). The most frequently-cited source of information (44 responses in the UK and 41 in France) was trade/industry associations. This was followed by industrial research organisations, which appeared to be a source of information preferred proportionally by more UK industrialists (35 responses) than French ones (24). Local authorities (28 responses for the UK and 26 for France) and environmental journals or magazines (16 responses for the UK and 18 for France) seemed also to be popular among ceramics manufacturers.

However, even though many sources of information were commonly cited they were also major differences between respondents of each country Indeed, a significant number of respondents in France mentioned trade journals (20 responses against 3 in the UK), environmental consultants (15 responses against 10 in the UK), local chamber of commerce (14 responses against 7 in the UK), suppliers of plant & equipment (14 responses against 9 in the UK) and trade exhibitions & conferences (11 responses against 1 in the UK).

Figure 53 (Q42) : Where to turn for advice on environmental issues



5.13.1 Breakdown by sector

Predominantly, for the UK, across all four sectors, respondents turned to trade/industry associations for advice while for France this was cited first for only the Brick sector and the Tableware sector. Also, in France, Industrial & Refractory sectors (40%) and Sanitaryware & Tiles sector (38%) primarily mentioned local authorities.

5.13.2 Breakdown by size

The breakdown by size revealed that generally companies primarily contact their trade/industry associations when they are looking for advice, with a greater emphasis within the micro-sized segment (48% in the UK and 44% in France) compared to a third of respondents in the other range. Although, respondents from the UK medium-sized band mentioned primarily regional government office and for France industrial research organisations.

6. CROSS-CORRELATION BETWEEN OVERALL ATTITUDES VERSUS ACTION

This section analyses in more detail the between respondents' overall attitudes towards environmental issues and their specific action. Moreover, legislation and financial issues have also been further examined as it emerges to be the main perceived constraints. The table below (Table 59) outlines respondents' opinion on environmental issues towards existent action.

Table 59: Opinion towards action

Q17/5	**Formal corporate environmental policy versus impacts on the environment**
Q17/6	**Formal corporate environmental policy vs. in favour of environmental policy**
	As a whole, in each country nearly a third of the people who agreed that their company has impact on the environment have established a formal corporate environmental policy. However more surprisingly, only half of the large-sized companies in favour of environmental policy in the UK and France have in place a formal corporate environmental policy.
Q25/5	**Change over the last 2 years versus impacts on the environment**
Q25/6	**Change over the last 2 years versus in favour of environmental policy**
	Predominantly, respondents in both countries who agreed that their activities have impacts on the environment or felt that an environmental policy would benefit their companies also took recently action to improve their environmental performance.
Q18/5	**Levels of waste or emissions monitored versus impacts on the environment**
Q18/6	**levels of waste or emissions monitored vs. in favour of environmental policy**
	Of UK producers who agreed that the production of ceramics goods have an impact on the environment, a vast majority (70%) also monitor their levels of waste or emissions while for France they were only 53%. Furthermore, the results confirm that larger companies in general are more advanced as far as the environment is concerned.
Q19/5	**Reduction targets set versus impacts on the environment**
Q19/6	**Reduction targets set versus in favour of environmental policy**
	The breakdown by size indicates that Medium-Large companies, who share the view that the ceramics industry have an environmental impact, have also largely implemented reduction targets for emission and waste. While very few respondents in SMEs who felt that an environmental policy would benefit their company have also taken action to set up reduction targets for emission and waste.

Q10/13	**Financial constraints versus significant cost benefits**
Q30&31/13	**Short & Long terms financial benefits versus significant cost benefits** Amongst the respondents, who agree that reducing their environmental impact can have a significant cost benefits, a majority shared the opinion that financial constraints restrict them to do more. Interestingly, only 27% of UK and 40% of French respondents from large company established a correlation between significant cost benefit that could be gained by reducing environmental impact and Short and Long terms financial benefits to improve environmental performance.
Q30&31/10	**Short & Long terms financial benefits versus financial constraints** A large majority of respondents from large-sized companies who felt that financial constraints restrained them from doing more to improve environmental performance did not simultaneously agree on the principle that Short and Long terms financial benefits allowed companies to improve environmental performance.
Q8/32	**Action only to conform with legislation versus compliance with legislation** The breakdown by size confirms that environmental action are marginally more driven by regulation in France than in the UK.

6.1 Formal corporate environmental policy versus impacts on the environment

Amongst the 67% of British respondents who agreed that their company impact on the environment only 31% declare having a formal corporate environmental policy. For France they were 33% but among 56%.

6.1.1 Breakdown by sector

The breakdown by sector reveals that among UK respondents convinced that their company have an environmental impact 43% of the Sanitaryware & Tiles (67% for France) and 44% of the Industrial & Refractory (50% for France) have a formal corporate environmental policy compare to approximately 30% for the UK and French Brick industry and only 18% for the tableware sector in both countries.

6.1.2 Breakdown by size

Unsurprisingly, the Breakdown by size shows that among respondents who agreed that their company have an environmental impact only 14% of the Micro and Small British segment (17% for France) have a formal corporate environmental policy compare to 36% for medium-size in the UK (64% in France) and 75% for large-size (50% in France).

6.2 *Formal corporate environmental policy versus in favour of environmental policy*

Amongst approximately half of the respondents in both countries who agreed that an environmental policy benefits their companies, a third responded that their company have a formal corporate environmental policy.

6.2.1.1 Breakdown by sector

Among the British and French tableware respondents who were in favour of that an environmental policy benefits their companies approximately 12% have a formal corporate environmental policy compare to an average of 50% in the other sector.

6.2.1.2 Breakdown by size

Surprisingly, only half of the large companies in both countries who were in favour of environmental policy have a formal corporate environmental policy in place.

6.3 *Change over the last 2 years versus impacts on the environment*

Amongst the 67% of British respondents who agreed that their company impact on the environment three quarters declare having over the last two years conducted some changes to improve their environmental performance. For France they were 65% among the 56% who agreed that their company have an environmental impact.

6.3.1 Breakdown by sector

With 64% in the UK and 56% in France the tableware sector is the lowest segment who agreed that their company impact on the environment concurrently with introducing some changes over the last two years to improve their environmental performance.

6.3.2 Breakdown by size

Half of the British and French Micro and Small-sized company and over 90% of the UK Medium and Large-sized company (75% for France) who agreed that their company impact on the environment have over the last two years introduced some changes to improve their environmental performance.

6.4 *Change over the last 2 years versus in favour of environmental policy*

As for previously, a vast majority of respondents (approximately 80% in both countries) who felt that an environmental policy would benefit their companies have also recently took action to improve their environmental performance.

6.4.1 Breakdown by sector

The breakdown by sector reveals that each ceramics sub-sectors in both country are evenly distributed.

6.4.2 Breakdown by size

The result reveals that only half of the micro companies in the UK (75% in France) who consider that an environmental policy would benefit their companies have also introduced recently some changes to improve their environmental performance.

6.5 Levels of waste or emissions monitored versus impacts on the environment

Over 70% in the UK compare to only half of the French respondents who agreed that the production of ceramics goods have an impact on the environment also monitor their levels of waste or emissions.

6.5.1 Breakdown by sector

The breakdown by sector reveals that while for the UK no major differences can be observed (all sectors are no less than 60%), for France the tableware and Sanitaryware & Tiles sectors (but very small sample) accounts for respectively 39% and 33% of people considering that the ceramics industry engender an impact on the environment and monitor as well the levels of waste or emissions.

6.5.2 Breakdown by size

The overwhelming number of respondents (100%) in the large size band for both the UK and France who consider that the ceramics industry impact on the environment and also monitor the levels of waste or emissions confir that this segment is ahead as far as the environment is concerned.

6.6 levels of waste or emissions monitored versus in favour of environmental policy

Amongst the interviewees who felt that an environmental policy would benefit them 69% in the UK and 56% in France also monitor their wastes or emissions.

6.6.1 Breakdown by sector

Surprisingly in France none of the respondents interviewed in the Sanitaryware & Tiles sector (but very small sample) and only 44% in the tableware sector agreed that an environmental policy would benefit them and concurrently monitor wastes or emissions.

6.6.2 Breakdown by size

As previously, large-size companies largely adhere on the view that monitoring wastes or emissions and having an environmental policy would benefit their companies.

6.7 Reduction targets set versus impacts on the environment

Amongst the respondents who agreed that the ceramics industry impact on the environment only 33% in the UK and 27% in France declare having set up reduction targets for emission and waste.

6.7.1 Breakdown by sector

The breakdown by sector reveals that the Brick and Tableware sectors are the lowest segments (with respectively 36% and 14% for the UK and 14% and 13% for France) who are in favour that the ceramics industry have an environmental impact and have set up reduction targets for emission and waste.

6.7.2 Breakdown by size

The breakdown by size indicates that half of the Medium-Large companies for both countries who share the view that the ceramics industry have an environmental impact have also set up reduction targets for emission and waste while for the SMEs they were only 23% in the UK and 13% in France.

6.8 Reduction targets set versus in favour of environmental policy

Amongst the respondents who felt that an environmental policy would benefit their company not more than a third in the UK and France have also set up reduction targets for emission and waste.

6.8.1 Breakdown by sector

Only 5% of the respondents in the British tableware sector and 19% in France felt that an environmental policy would benefit their company and have also implemented reduction targets for emission and waste.

6.8.2 Breakdown by size

The breakdown by size confirms previous findings, that there are very few SMEs who share the view that an environmental policy would benefit their company have also taken action to set up reduction targets for emission and waste.

6.9 Financial constraints versus significant cost benefits

Amongst the respondents who agreed that reducing their environmental impact can have a significant cost benefits, 69% in the UK and 59% in France felt that financial constraints restrict them to do more to improve their environmental performance.

6.9.1 Breakdown by sector

The breakdown by sector reveals that a minority of respondents (54% in the UK and 30% in France) within the tableware sector share the view that reducing their environmental impact can have a significant cost benefits and also agree that financial constraints restrict them to do more.

6.9.2 Breakdown by size

Only 20% of Large-sized respondents in France compare to 64% in the UK who share the opinion that reducing the impact on the environment can have a significant cost benefits also felt that financial constraints restrict them to do more.

6.10 Short & Long terms financial benefits versus significant cost benefits

Approximately 65% in both country who felt that reducing environmental impact can have significant cost benefits also agreed that Short and Long terms financial benefits allowed them to improve environmental performance.

6.10.1 Breakdown by sector

Tableware industry is the lowest sector in the UK (55%) and France (40%) who felt that significant cost benefit could be gained by reducing environmental impact and concurrently Short and Long terms financial benefits would led to improve environmental performance.

6.10.2 Breakdown by size

Interestingly, only 27% of UK and 40% of French respondents from large-sized company agreed on those 2 statements which confirm the significant financial cut and cost reduction undertook by large companies in the last couple of years.

6.11 Short & Long terms financial benefits versus financial constraints

The vast majority of respondents (63% in the UK and 75% in France) who felt that financial constraints restrained them from doing more to improve their environmental performance also agreed that Short and Long terms financial benefits allowed them to improve environmental performance.

6.11.1 Breakdown by sector

The correlation between the view that financial constraints restrained them from doing more to improve their environmental performance and that Short and Long terms financial benefits allowed companies to improve environmental performance is evenly shared by all sectors.

6.11.2 Breakdown by size

The breakdown by size confirms previous finding, i.e. the majority of respondents from large-sized companies who largely agreed that financial constraints restrained them from doing more to improve their environmental performance do not felt that Short and Long terms financial benefits allowed companies to improve environmental performance.

6.12 Action only to conform with legislation versus compliance with legislation

Amongst the respondents who regarded as important to comply with relevant legislation 44% in the UK and 52% in France agreed that they only take environmental action to conform with legislation.

6.12.1 Breakdown by sector

The Breakdown by sector reveals that in the UK only 22% of the Sanitaryware & Tiles sector (63% in France) and 38% of Industrial & Refractory sector(48% in France) who regarded as important to comply with relevant legislation also agreed that they only take environmental action to comply with legislation.

6.12.2 Breakdown by size

The breakdown by size shows that in France Micro companies (61%) compare to Medium-Large companies (50%) who have regarded as important to comply with relevant legislation have concurrently agreed that they only take environmental action to comply with legislation. While for the UK it is evenly distributed (approximately 40%) and confirms that environmental action are marginally less driven by regulation.

7. CRITICAL ANALYSIS

Many of the conclusions from the survey are common in both countries and to all sectors, although in some cases they varied according to the origins of the respondents or with the size of the company involved. One important feature of this industry as a whole is the dominance of Small and Medium-sized Enterprises. In both countries there is interest and a considerable unrealised potential as far as environmental improvements are concerned.

As a whole, the vast majority of respondents in both countries agreed that ceramics activity impacts on the environment. However, over half of the respondents in the UK (54%) and 47% in France considered that they do not need a formal corporate environmental policy. Moreover, only a third of the people who agreed that their company impact on the environment have established a formal corporate environmental policy and just half of the large-sized companies in favour of environmental policy in the UK and France have in place a formal corporate environmental policy. Clearly, large companies in all sectors have done relatively more in terms of environmental improvements and realised the benefits moving to a situation where legislation is less of a driver than commercial issues. The breakdown by size indicates that Medium-Large companies who share the view that their industry have an environmental impact have also largely implemented reduction targets for emission and waste. Indeed, larger companies have more time and money available, have strategic management in place allowing for proactive environmental management to take place more easily, and consider adverse publicity more seriously as it affects them more deeply.

As regards micro and small-sized companies, they mostly felt that environmental policy is an extra burden on the running of their businesses which is not surprising as they often work on an *ad hoc* basis with little or no long term corporate objectives which is therefore not conducive to effective strategic environmental management. Unsurprisingly therefore, a majority of UK and French respondents did not perceived any benefit in improving environmental performance. In general however, marginally more UK companies, principally in the large-sized band, concurred that reducing environmental impact could lead to significant cost benefit. But, two third of respondents, particularly SMEs companies in both countries, were not in the position to do any major improvement due to financial constraints. Interestingly, nearly half of the French large-sized segment compared to less than a third in the UK shared this position. It confirms the financial constraints of the large French ceramics industry and their difficulties to introduce any major change (technical, managerial, environmental, etc.) and concurrently, the better financial structure of the British industry due to an higher degree of concentration and internationalisation.

In general for both countries, the results of this study suggest that only coercive environmental regulation and financial benefits spurred the ceramics industry to improve environmental performance. Hence at the moment, it appears that environmental action are marginally more driven by regulation in France than in the UK despite for both countries, they are not always clear on how environmental legislation affects them. So, unsurprisingly the vast majority of respondents agreed that they are lacking of information on environmental issues. This could be due to faults in the diffusive information pathways from support organisations and/or lack of time and financial resources devoted to this issue. Finally, the ceramics industry seems to be willing to take more care of the environment. But at the moment, the vast majority of SMEs in this sector still have a very low level of awareness of environmental issues which leads them to a reactive approach towards corporate environmental practices.

Tableware Sector

A significant number of respondents from this sector considered that an environmental policy does not benefit their company (Question 6) and 80% of the UK respondents felt that it would make it easier for them if better advice was available (Question 11). In line with these views, 68% of UK respondents felt that they do not need a formal corporate environmental policy, compared with 50% in France. However, 60% of respondents in France (32% in the UK) reported that they did not monitor levels of waste or emissions (Question 18). The sector to set fewest reduction targets was the tableware sector with 15% in the UK and 13% in France (Question 19). For the UK the highest proportion, was in the Sanitaryware & Tiles sector (45%). The Tableware sector (Question 20) was also the lowest sector to be accredited or seeking to be (3% in the UK and 5% in France), although the sample was relatively small. The vast majority of tableware companies in both countries (42% in the UK and 50% in France) had not taken any action to improve their environmental performance over the last two years (Question 25). Finally, when looking back at the benefits and disadvantages of the actions taken, the vast majority of companies could identify no disadvantages at all (38 in the UK and 32 in France) in adopting a new procedure or equipment. The only other factors mentioned by a significant number of companies were capital costs (15 UK respondents, 14 French), too expensive/costly (9 UK respondents, 7 French) and too much work (3 UK respondents and 4 French) (Question 29). A quarter of the tableware respondents in the UK and France did not regard short term financial benefits as an important stimulus to encourage improved environmental performance of their company (Question 31).

The tableware sector is therefore characterised by a defensive approach based on taking corrective steps only when pushed by the law.

Sanitaryware & Tiles Sector

The vast majority of UK and French respondents in this sector felt that having an environmental policy is an undeniable advantage (Question 6), and not surprisingly, they agreed that improving environmental performance usually improves production efficiency (Question 7). The UK Sanitaryware & Tiles managers also felt that financial constraints restrained them from doing more to improve their environmental performance (Question 10). All of the French Sanitaryware & Tiles managers interviewed agreed that it would make it easier for them if better advice was available (Question 11). The UK Sanitaryware & Tiles manufacturers reckoned that a cleaner working environment (55%) is the major benefit from improving environmental performance (Question 14) and in the UK the sector there was the highest level of monitoring (Question 18) and setting up targets (Question 19). This sector is on a very competitive market and it is with no surprise that the second most important factors cited to improve environmental performance was to reduce costs in both the UK and France (Question 26). Customer pressure to encourage improved environmental performance was regarded as relatively important by the sanytaryware & tiles sector (27% for the UK and 38% for France) (Question 33).

The sanitaryware & tiles sectors has clearly adopted a reactive attitude towards environmental issues and realised the benefits of acting in advance.

Industrial & Refractory Sector

In both countries, respondents from this sector felt most strongly that reducing environmental impact cannot lead to significant cost benefit (Question 13) and considered that business environmental initiatives were of little benefit to their companies (Question 12). Over half of respondents in both countries stated that to improve their environmental performance over the last two years, they installed a new piece of equipment (Question 25). Over 40% of UK respondents in this sector felt that they got no benefit from adopting the new procedure (Question 28).

By virtue of its diversity (in process/product terms), it is harder to classify this sector. However, by the nature of the processes (clean technology), the hi-tech industries have adopted a proactive attitude while the low-tech segment attitudes are more co-operative, by making a sincere effort to comply with standards of their own accord.

Brick Sector

More respondents in the UK brick sector (35% compared with 21% for France) considered that business environmental initiatives were of little benefit to their company (Question 12) while 79% of French respondents felt that financial constraints restrained them from doing more to improve their environmental performance (Question 10). Unsurprisingly, they also felt that cost reduction to the company was the major perceived benefit (Question 14). The British and French brick sector was one of the largest sectors to set reduction targets (37% for the UK and 31% in France) for emissions and waste (Question 19). Two thirds of respondents in both countries felt that the views of the local community were quite important in encouraging improved environmental performance in their companies (Question 36).

The brick sector is particularly sensitive to air pollution and dust issues, due partially to the fact that for several years now, the European Commission has to strengthened the legislation on air. On this particular issue the brick sector attitude is increasingly protective. As a whole the brick sector has adopted a laggard attitude.

CHAPTER 7

ENVIRONMENTAL BEHAVIOUR OF TRADITIONAL FIRMS

1. INTRODUCTION

The environment has emerged as one of the most significant political issues of the 1990s. Public pressures and new environmental control legislation have the potential to impose higher costs on business and consumers. To ensure that environmental pressures produce benefits that outweigh costs, businesses must be armed with the best available understanding. They should comprehend many aspects including:

- the environmental agendas that governments are developing;
- interactions with legislators on environmental issues;
- environmental technology options;
- the needs of customers' concerns about the environment;
- the way that competitors may respond to environmental pressures.

This final chapter focuses upon the main empirical findings discussed in the preceding chapters and bears upon the firm's environmental behaviour model discussed in Chapter 2 Section 6.

1.1 Objectives

Further objectives are to discuss:

- The overall role of regulatory pressures, cost-savings and other commercial concerns in shaping the environmental responses of the companies surveyed.

- The main findings from the comparative analysis conducted in Chapter 6 regarding industry sub-sector/industrial structure especially where these differed as well as national differences between the UK and France in terms of regulatory traditions, economics and broader cultural issues.

- The firms which have not introduced environmental improvements in the last two years and believe that such initiatives would not yield financial benefits.

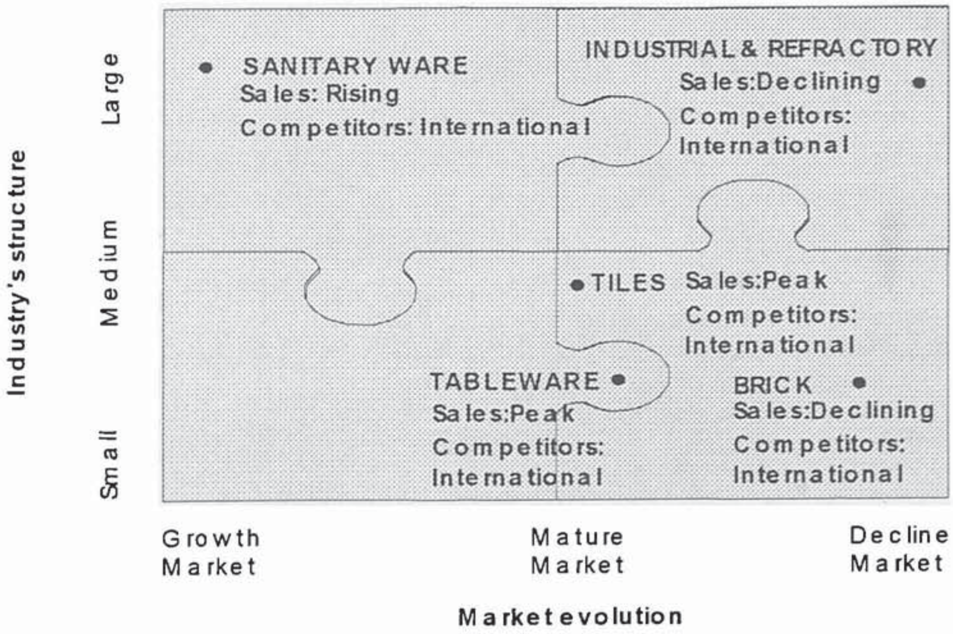
To illustrate the above trends responses from interviews conducted with trade bodies and research organisations have proved important in amplifying the current analysis.

SECTORAL AND NATIONAL DIFFERENCES

This section discusses the main sectoral and national differences that have been observed from the comparative analysis carried out in Chapter 6 in terms of regulatory traditions, economics and broader culture.

The ceramics sector as illustrated in the following table (Table 60) and described in more details in Chapter 4 is, as a whole, positioned in a mature/declining market which forces industries operating in this market to be highly competitive in order to survive. This industry is still predominantly composed of SMEs companies mainly positioned in a mature or declining market. Traditionally, the UK and French ceramics sector tends to be under-capitalised and oligopolistic - dominated by few large companies, principally in the tableware/domestic goods sub-sector. According to various indicators, the ceramics market in the UK and France have reached saturation point. This is principally because sales are sluggish and becoming largely a function of repeat purchasing. Moreover, customer's tastes are becoming more discerning, looking for additional features and becoming increasingly price-sensitive. Furthermore, competition for customers has now become increasingly intense as new competitors have been attracted during the growth phase of the 1960s and 1970s.

Table 60: Ceramics industry market positioning



As a whole, the demand for the majority of European ceramic goods is very elastic. One reason for this is that close substitutes are readily available (from countries in the Far East) and that a small price increase will cause many consumers to transfer to these substitutes, resulting in a large fall in European demand. This phenomenon was observed during the economic recession of the 1980s, when competitors decided to penetrate the European market and initiated a price cutting strategy in a drive to dominate the market through lower costs.

In 1993, the ceramics industry employed 43,027 people in the UK as against 33,198 in France. Only 50% of them in France were employed in a company of more than 200 staff compared to 70% in the UK. Since the 1991 figure the number of units operating in the industry has fallen by approximately 10.5% in the UK and by 8% in France.

2.1 UK and French administrative structures for the environment

Environmental protection in the UK is the responsibility of several classes of institution which are national, regional or local, accountable to elected members (the Department of Environment to Parliament, local authorities to their Councils, for example) or not, and which often separate regulation and operation, pollution and nature protection. The DoE has general responsibility for environmental issues. It is responsible for drawing up regulations and publishing guidance notes and circulars on the operation of environmental controls. The political team to which the administration answers is larger than in any Community country and reflects the very broad areas of responsibilities of the Department. Whilst the team's size varies from time to time, it is always headed by a secretary of state who is a cabinet minister and by a number of ministers of state with particular portfolios. The environment protection deputy secretary is responsible for five directorates, including:

- Her Majesty's Inspectorate of Pollution (HMIP)
- air, climate and toxic substances
- pollution control and wastes
- environmental policy and analysis, including environmental statistics and reporting
- the Energy Efficiency Office

Reorganised in the 1970s, local authorities in the UK have continued to evolve in number and in attribution. They remain the principle level of executive authority despite the fact there has been a considerable increase in the degree of control exercised by central government in many areas of their work. They have development, management and control powers which make them important instruments of environmental protection.

France is a parliamentary democracy in which the administration is largely independent of day to day parliamentary control. It has traditionally had a more interventionist and centralised administration than the UK. However, some policy making and executive powers have been decentralised to regional and departmental councils, which now manage important financial resources, whilst much of the execution of national policy will be undertaken by the deconcentrated (regionalised) services of the central ministries.

Metropolitan France has five levels of administration below the national government. It is divided into 22 *régions* and 96 *départements* (counties). Below that are 325 *arrondissements* and 3,710 *cantons*, neither of which play a significant role in environmental management. The final level are the 36,433 *communes* (district).

The *régions* and *départements* have parallel and complementary structures. Each is responsible for different aspects of policy making and execution. The *régions* were created as public bodies in 1972 without autonomy or regional assemblies. They became full local authorities in 1982 and have since been managed by an elected assembly responsible for the budget based on their own resources from indirect taxation and loans. Many *régions* have set up environmental administrative structures, which take different forms from *région* to *région*. The administrative structure at regional level are headed by the regional *préfet* who act as the point of contact between the State and the *régions* for activities which cover more than one *département*, particularly for co-ordinating the implementation of national planning initiatives. The *département* is the main level at which central government policies are implemented. The *préfet*, who is the state representative in the *département*, takes all necessary measures in the field of public order, and the protection of public health. The *préfet* is also the authority which grants the permit to open and operate a "classified facility". The *maire*, who is the elected head of the *commune* manages town planning and grants construction and demolition permits. The *maire* also has powers to prevent pollution in his district but with powers limited by those exercised by the *préfet*. The *maire* is also in charge of the disposal of domestic waste and the reduction of noise pollution.

2.2 Sectoral and National differences in the brick sector

As outlined in chapter 4, the principal characteristic of the brick market is that import penetration is very low, not exceeding 2% of the total production, due to the nature of the product; high volume, low value products, where transport costs can be significant.

in 1995, the UK brick industry produced three main brick types (clay, calcium silicate and concrete) and was made up of 90 manufacturers operating from approximately 150 brickworks, of which 130 produced clay bricks (representing 92.5% of the UK total brick output). The industry is dominated by four companies (Hanson Brick, Redland, Ibstock and Tarmac) and together manufacture approximately 70% of the total annual UK brick output. Employment levels in the UK brick industry over recent years have decreased by approximately 33% since 1988. This reflects both a reduction in the market demand for bricks and a trend amongst many of the larger manufacturers towards investments in labour saving, capital intensive production equipment, such as extruders for brick forming and automated brick handling equipment with modern tunnel kilns.

For several decades now the French Brick industry has lost market share to concrete blocks due to large supplies of low-cost and aggregates. Furthermore, construction styles in France make little use of facing bricks which are manufactured largely in the north, in the Paris *région* and around Toulouse. Since 1974, the employment in the brick industry has decreased by approximately 80% and in 1994 employed approximately 2000 people while 95% of the brick production was handled by one company the C.R.T.C. (north).

The UK and French markets have, since the 1950s and 1960s, shrunk in line with the level of activity in the housing sector. Traditionally, bricks are used more commonly in the UK housing sector and despite a weak recovery in brick sales in 1993-94 the short term industry's projection remains pessimistic. Over the last decade, the French housing market has substantially declined and in order to stop this slump the French government in 1995 provided incentives such as interest free loans to first-time buyers or to people who undertook renovations/extensions to their dwellings. These measures aimed to strengthen the actual construction market and subsequently the supply side.

The UK brick market as a whole is demanding higher quality bricks, in terms of physical characteristics such as insulating capability, frost resistance, and, importantly, appearance. Therefore, foreign modern brick factories such as those in France and Belgium may be capable of exporting higher quality products at competitive prices into the UK market. Furthermore, competition is also coming from product substitutes, such as concrete bricks for clay bricks. This particularly affects the clay "commons", where concrete inner wall bricks compete on strength and insulation properties. In spite of this, the brick industry in both countries is primarily dependent upon the existing level of domestic demand and upon the price elasticity of that demand. For instance, the market for new housing bricks is far more sensitive to price than the renovation/extension market.

2.3 Sectoral and National differences in the industrial & refractory sector

The production techniques in this sector is large and very diverse, reflecting the many different applications of advanced ceramic materials. To take this diversity into consideration this sector is usually divided between refractories and technical/advanced products. The advanced ceramics sector is a completely new market and is not really comparable with the traditional ceramics market. At the moment, the UK and French manufacturers control about 1.5% and 2% respectively of the global market. The demand for technical ceramics, is becoming of increasing importance largely because they are providing technologies for high-growth fields such as health care, telecommunications, electronics, transportation. However, demand still remains marginal compared to refractories products. The product range includes electrical insulator porcelain, components for diesel engines and gas turbines, rocket nose-cones and orthopaedic replacements. The principal demand for refractories products is for the production of goods requiring high temperature processes as metals, glass, steel, cement, ceramics, etc.

Refractory products are used by a wide range of industries, but the main customer is the steel industry which accounts for 65% of UK sales. This sub-sector also supplies the rest of the ceramics industry, for its kiln firing processes. There are approximately 30 UK refractory producers generating a turnover of ECU 565 million of which 6 generate a turnover of ECU 318 million.

The French refractory product industry is the fourth largest in Europe and employs a staff of about 4,700. In 1994, the turnover was ECU 585 billion of which 60% was exported. Over the past 10 years, companies have placed emphasis on productivity and quality. This was only possible through the grouping of the industry in order to create groups with European dimensions. In France, 65% of production comes from two major companies : Lafarge Réfractaires Monolithiques and SEPR (Société Européenne de Produits Réfractaires).

The demand for refractory goods, especially firebricks, is decreasing, principally due to a decline in steel production. Therefore, global export opportunities for the UK and France are shrinking and competition has intensified. The demand for such products has moved from Europe to Japan and China; these two countries possess a well developed domestic industry which is continuously seeking to improve product research, production efficiencies and cost reduction.

2.4 Sectoral and National differences in the sanitaryware & tiles sector

This sector encompasses all ceramic bathrooms, lavatories, kitchen fittings as well as glazed, unglazed and decorative wall and floor tiles. This sector has been deeply affected by the recession and the decrease in new building programmes (private dwellings, public buildings and industrial structures). Over the past few years, the maintenance and renovation market for tiles and sanitary-ware has become the principle driving force of this market. Fashion trends also constitute a very important element in product replacement.

In the UK and French sanitary-ware sector, companies tend to be "large" (turnover of over ECU 11 million), and there are few small operators (turnover of less than ECU 0.35 million). Also, the production processes adopted by different companies in this sector are broadly similar. There are only 7 UK sanitary-ware producers, of which the largest four manufacturers account for a total of over 80% of the UK sanitary-ware production volume. The UK sanitary-ware industry employed approximately 3,000 people in 1993. There are approximately 20 companies manufacturing tiles in the UK, of which 5 dominate in terms of size for an approximate total turnover of ECU 150 million. In 1994, the UK imported 69% (35 million m^2) of its domestic tile's consumption and exported 20% of its production (4 million m^2). France is the second largest European manufacturer of ceramics for sanitary-ware with 18% of total production employing approximately 5,000 people in 1994. Over the past few years, this sector has faced profound changes and concentration. In 1994, 83% of the employment was concentrated within five companies. Industrial restructuring activity has integrated most French ceramics companies within international groups consequently, within a 15 year period, the number of plants has dropped by 25%. France is the fourth largest European producer of ceramic tiles, after Italy, Spain and Germany. This industry employs a staff of 4,800 across 27 companies and in 1994 had a turnover estimated at ECU 410 million, of which 33% (16 million m^2) was for export. Between 1986 and 1994, production increased by 60%. However, France imported 70% of its domestic consumption (61 million m^2). Renovation is the principle driver of this market accounting for 60% of the total figures.

The recent and ongoing recessionary pressures have deeply affected the UK and French sanitary-ware industry. The effect of the recession on the sanitary-ware sector and the evolution of demand has forced manufacturers to initiate a drastic change of the production process. Indeed, demand has evolved considerably and bathrooms of the past are barely recognisable with the fitted bathrooms customers aspire to today. Over the last decade, the sanitary-ware market shrank considerably and synthetic products have penetrated the market to directly compete with ceramic goods. However, the main strength of the UK and French industries is that they are integrated into international groups that are more able to face global competition owing to financial structures which allow them to support Research and Development and advertising campaigns through mass media.

Average per capita consumption of ceramics in the UK and French remains one of the lowest in Europe due to a well established tradition in the use of alternative products which satisfy most of the demand for floor and wall materials such as parquet, carpet, etc.. The tile industry in the UK and France is not very well developed and the strategy adopted by these manufacturers is the production of small batches, complex product options and the maintenance of strict quality standards. In other words, competition based on quality instead of quantity. However, the major drawback of this strategy is that UK and French firms are relatively small compared to their major competitors and therefore are extremely vulnerable and coveted by larger ceramic groups who seek horizontal external growth. The poor capacity illustrated by French local firms to strengthen their position on the domestic market is attributable to numerous factors, including:

- competitive prices of international rivals;
- a progressive decline in the importance of the brand name in consumers purchases;
- concentration of the distribution system;
- a poorly balanced aggregate supply structure.

With regard to this last factor, it is important to emphasise the substantial inability of French industry to meet the demand for wall covering products, while on the other hand more than 50% of the demand for ceramic floor tiles is covered by national production. This asymmetry in supply weakens the French industry with respect to foreign rivals, who not only have the advantage of lower prices, but can also boast a wider and deeper product mix.

2.5 Sectoral and National differences in the tableware sector

The UK and France have a long tradition of manufacturing and exporting tableware products. The UK is the fourth largest world-wide supplier of tableware goods with a market share of 8%, while 7% for France. The demand for tableware and ornamental ware has been substantially modified over the last 20 years and is nowadays more fragmented. Two sub-sectors are identifiable:

Private individual buyers

The one-off purchase by private buyers of a complete dinner service traditionally used only for special occasions is declining due principally to a change in the consumer society and a decline in weddings. The tendency at present is to change tableware more frequently and to purchase goods for everyday use with added features such as dishwasher resistancy or microwave suitability.

Professional buyers, i.e. hotels, restaurants, hospitals, canteens, etc.

The demand by professional buyers has increased over the last decade due to a change in life style; people are eating out more often thus making canteens and restaurants increasingly more popular. Indeed the special requirements of the hotel and catering trade has given rise to the "hotel ware" sub-sector with specially designed hard-wearing ceramics.

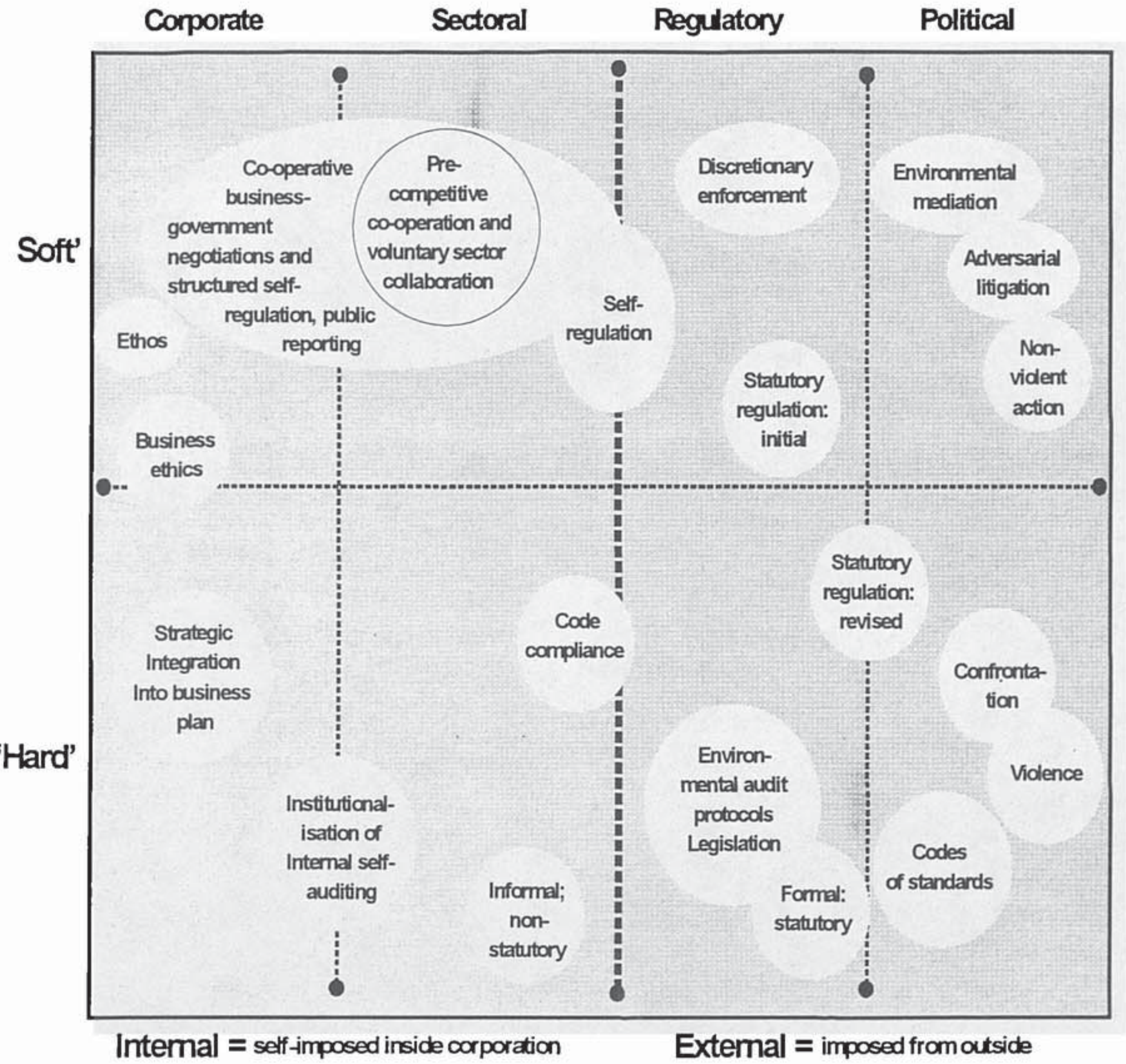
Approximately half of the UK's employment in the ceramics industry is in tableware manufacture. The UK tableware sector is made up of approximately 40 companies employing over 25 staff, and another 200 companies employing less than a dozen. The majority of these producers are located in the Staffordshire region. This reflects the industry's geographical roots in the Industrial Revolution, close to supplies of raw material and coal fuel. In 1907, at the height of its fame, the Limousin (Limoges *région*) porcelain manufacturers employed over 15,000 people and exported 80% of their production. Today, Limoges employs 2,130 people on some 41 sites (28 companies) and its production accounts for 52% of the French porcelain turnover and 63% of French porcelain exports. Porcelain dinnerware, in 1994, represents 72% of the total production of tableware manufactured in France and generated a turnover of ECU 170 million.

The main strength of the UK and French manufacturers is the public image of high quality products often combined with high price. This image is essential for the luxury market and is reinforced by brand names known all over the world, such as Wedgwood or Limoges. To strengthen this image, English and French tableware products are often sold only in exclusive retail outlets. However, when the purchase is for daily use this strength could sometimes be perceived as a handicap as people are not willing to spend so much money and fear breakage. Furthermore, year after year the luxury market is losing its market share (minus 10% over the last 2 years) to middle range products made in low labour countries which often adopt a copying policy. These cheaper products represent an increasing share of the market and may be purchased in shops visited frequently by people i.e. supermarkets. So far, the response to these new competitors has been greater in the UK, where larger manufacturers have rapidly created brand names specifically dedicated to supermarkets and which are more affordable. Over the last decade the production of porcelain in France has decreased by 30%, due to a slowing down of consumption and, more alarming, an inadequacy on the suppliers side to heed consumer demand. Between 1991 and 1994, 80 porcelain companies were declared bankrupt. French manufacturers, until very recently, were still owned by founder families who either did not want to merge with other manufacturers to realise economies of scale or refused to accept new shareholders who were able to bring capital i.e. multinational groups, banks, etc.. Over the last few years, prestigious companies have been forced to merge in order to survive and thus international groups have emerged. Mergers and acquisition were aimed at strengthening their position allowing them to enter new markets and vertically integrate the tableware market (Cutlery ware, crystal ware, porcelain, etc.) so as to gain a sustained competitive advantage.

OVERALL ROLE OF REGULATORY PRESSURES AND COST SAVINGS

Figure 54 shows a range of methods by which governments can gain compliance from organisations within their environmental control.

Figure 54: Modes of gaining environmental compliance, ranging from incentivisation to legal penalty



3.1 *Environmental awareness, tighter standards, more regulation and market based instruments*

Over the past twenty years or so, since the Commission on the state of the Environment in Stockholm in 1972, there has been an increasing awareness, and understanding, of environmental problems. This was often reflected in the widespread debates on the quality of life and of the concept of sustainable development, the latter becoming a buzzword. Regulation continues to become more rigorous, not only in terms of the levels of emissions demanded, but also in terms of the scope of controls ('new' pollution issues), tightening the scope of liability, and the stringency of enforcement. These are proving to be increasingly important drivers in the environmental industry.

As illustrated in chapter 2, policy makers have in recent years given greater emphasis to the overall policy goal of preventing pollution rather than just abating it. Consequently, the 'command-and-control' methods of regulations and standards are also increasingly being complemented by alternative measures such as market based instruments (taxes such as the landfill levy and carbon tax, and tradable emissions permits) and voluntary schemes (eco-labelling or accreditation schemes, environmental management systems or even 'value-driven' corporate approaches). The choice of economic instruments adopted has direct implications for the supply side. For instance, a command-and-control approach may require the fitting of an end-of-pipe technological solution to achieve SO_2 emissions reductions (using flue gas desulphurisation equipment). Using tradable permits, on the other hand, can reduce the demand for such expensive end-of-pipe measures, as it allows other measures to be taken up, such as switching to low sulphur fuels.

3.2 *Outline of environmental responses and firms' characteristics*

Nearly three quarters of respondents see the environment as a source of legislative constraint. The environment appears primarily as a requirement to limit emissions from operations and products, a requirement arising both from public concern and from regulatory bodies. Legislative and administrative measures directly influence environmental protection. Indirectly, economic sanctions, incentives or informative measures such as environmental education influence future demand. Such indirect pressures will grow along with the increased awareness of the public. Companies frequently accused both the European Commission and national governments of taking a short-term view of environmental policy, responding only to short-term political pressures and not taking their specific problems into consideration.

As a whole, the ceramics sector expresses a strong preference, for simple and well-defined regulation. The issue of using economic instruments is complex, and most companies interviewed had little direct experience of them. If governments are to use novel policy instruments in a European context, industry will have to be drawn more effectively into the decision making process. Indeed, so far Governments communicate with trade associations; but for over 75% of micro and small companies interviewed the information does not necessarily filter down to, or within, original companies. Many companies surveyed consider it vital that governments establish clear key policy guidelines, to stimulate cost-effective compliance. Responses within the ceramics industry indicate that the current legislative framework in both countries does not encourage companies to innovate, and inhibits transition to environmentally cleaner technologies. Legislative uncertainty is a key point, arising from the inadequacies of communication between governments and industry. Uncertainty about emerging legislation deters companies from taking the higher risk, and making the often more expensive investments, associated with inherently cleaner production systems. Moreover, this research has also revealed that SMEs operating in a highly regulated market face difficulties in complying with legislation due to time constraints, lack of resources and awareness available. To respond to these pressures companies have generally adopted a rapid growth strategy, typically via mergers and acquisitions to increase market power, and improve efficiency through rationalisation and economies of scale. Another governmental strategy, so far neglected in this sector, would be a shift from a regulatory approach to a more self-regulated approach since this would encourage a collective answer to specific issues.

The potential impact and relative importance of the environment varies somewhat from company to company. At one end of the spectrum, organisations perceived environmental issues as obstacles, while companies at the other end saw the environment as providing opportunities for enhancing their business. The view of environmental issues as obstacles is, on one hand, characterised by a compliance orientation and decision-making based on total resistance to environmental values and rules. The view that environmental issues provide new opportunities, on the other hand, results in decision-making based on either a search for new opportunities or a desire to act according to a core cultural ethic that being environmentally responsive is 'the right thing to do'.

On the basis of the differences in their attitudes the companies interviewed can be categorised into five groups.

3.2.1 Group 1: Defensive

Companies are defensive if they take corrective steps only when pushed by law. In general, companies in this group would:

- be absolutely unresponsive and reactive to environmental initiatives.
- view concern for the environment as a hindrance to their growth and do their best to hinder the passing of environmental laws.
- assume that concern for the environment is a passing phase and that their impact on the environment is negligible, but also assume that their competitors feel the same and hence do nothing to conserve the environment.

The tableware sector is characterised by a defensive approach based on taking corrective steps only when pushed by the law. The large majority of respondents in this sector (68% in the UK and 50% in France) have not put in place a formal corporate environmental policy and do not see any need to do so. In both countries, approximately 40% of the tableware respondents share the idea that an environmental policy does not benefit their company. Tableware companies see the environment as an increasing pressure on their businesses. Their capacity to influence developing governmental agendas is currently limited by scarce management resources. Approximately, half of the respondents in both countries "don't know" if environmental impact alone encouraged the environmental performance of their company. Furthermore, a vast majority of SMEs in this sector do not expect that reducing environmental impact would subsequently have significant cost benefit. Respondents believe they are penalised by higher enforcement costs compared to those applied to their competitors. Finally, 70% of the respondents in the tableware sector (72% for the UK and 67% for France) viewed financial constraints as one of the key reasons for not doing more to improve their environmental performance. Nevertheless, the vast majority of respondents in this sector agreed that if better advice was available, it would be easier for them to tackle environmental issues more effectively. Establishing clear environmental objectives is seen as a prime task for Government. However, less consensus was evident on the best legislative mechanisms for achieving them.

The overall attitude reflective of this group are : "Our activity is not detrimental to the environment. We have used the same process for many decades with no problem"; 'Regulations are voted by technocrats who know nothing of our business"; "We can't afford to spend extra money on processes which cannot be guaranteed to be significantly cost beneficial as our profit margin is already reduced to the minimum".

3.2.2 Group 2: Laggard

Companies are laggard if they are aware of the environmental challenges facing them, but are unable to combat those challenges because of cost constraints, lack of trained manpower, lack of knowledge, etc. These firms:

- observe environmental laws, but actions reflect lack of ability to comply.
- are more inclined to undertake operational changes that do not require too much investment in time and capital.
- are far more operationally orientated than strategic in nature.

Manifestly, the brick industry has a laggard attitude towards environmental issues. Few companies take a forward view of environmentally-driven opportunities. Indeed, when a company in this sector has introduced a change to improve environmental performance it was a managerial change which led to a specific cost benefit for approximately half of the company interviewed in both country. The impetus of this change is the requirement to meet legislation (25% of the overall responses in the UK and 37% in France) followed by reducing costs for a quarter of the people interviewed in France whilst for the UK they were 13%. Moreover, the French Brick sector faces difficulties to change its image within the local community as a polluting industry and a vast majority of respondents pursue the objective of improving their perceived image. The vast majority of respondents in the UK (78%) agreed that their activity impacts on the environment whilst they were only 44% in France. Among respondents of the brick industry convinced that their company have an environmental impact only 30% have a formal corporate environmental policy and less than a third for the UK and 14% for France have set up reduction targets for emissions and waste. More than half of the respondents in the UK and an outstanding 79% in France felt that financial constraints hindered them from doing more to improve their environmental performance. Most companies stated that profitability remains a more important corporate objective than environmental performance. For most companies the evolution of corporate environmental policy development is based on a philosophy of complying with legislation, rather than identifying opportunities.

Attitudes reflective of this group are : 'We are aware of the environmental issues, but because of fierce competition and very low profit margins the adoption of new procedure will increased costs and lead to a loss in market share' ; ' We do not have enough time and information to tackle this issues.'

3.2.3 Group 3: Compliance

Companies in this category focus on maintaining a strong compliance record. They show the following general characteristics:

- They try to keep up and comply with regulations.

- They are primarily reactive, either to regulations or to specific customer requirements.

- They participate in environmental activities that are either required by law or are least-cost alternatives.

- They have the primary motivation to avoid problems, stay out of trouble, or stay in business.

By virtue of its diversity (in process/product terms), the industrial & refractory sector is difficult to classify. As illustrated in chapter 4, this industry includes both advanced industrial ceramics and refractories materials. Refractories manufacturers which represent the more traditional segment of this industry serve principally the steel industry and have adopted a co-operative attitude, by making a sincere effort to comply with standards of their own accord. Although the majority of companies interviewed consider the environment an important corporate priority, most clearly consider profitability as more important. Analysis of the responses suggests that few companies have a strategic plan to generate additional profitability from their environmental positioning and expenditure. One possible reason for this is that most companies cannot see how future environmental values and standards will evolve. Indeed, 38% of Industrial & Refractory sector in the UK (48% in France) who regarded it as important to comply with relevant legislation also agreed that they only take environmental action to comply with legislation. A third of respondents in the UK and 38% in France declared having a formal corporate environmental policy in place and approximately one quarter are considering one. Moreover, half of the respondents of the Industrial & Refractory sector declared not monitoring the levels of waste or emissions and only a third have set-up reduction targets for emissions and waste. As a whole, this sector lacks the confidence to take a leading position. Many respondents mentioned, for example, their preference for a 'middle of the road' corporate policy - following emerging standards closely, but not pre-empting or exceeding them.

The attitudes reflective of this group are : 'any other way would have required more changes'; 'Our environmental programme grew out of an environmental problem'; 'We are expecting a reinforcement of the legislation in the near future if we do not show a willingness to curve our environmental impact'; 'To be able to address modern issues, in particular environmental ones, it is essential to constitute large companies which would have more human and financial resources to tackle this issue'.

3.2.4 Group 4: Reactive

This group recognises that environmental issues and trends can open up new cost savings areas and market opportunities. The idea that being environmentally responsive is 'the right thing to do' comes to light in this group. However, behaviour in relation to environmental issues is still driven more from a desire to minimise risk and avoid compliance problems. By setting their own targets, these companies see that they can minimise planning risk and their vulnerability to changing regulations within their planning horizon. These firms:

- Try to keep ahead of regulations through early compliance.
- Often participate in voluntary compliance programmes.
- Recognise that addressing environmental issues can be profitable.
- Primarily address environmental issues that relate to, or that are an extension of, compliance issues, business survival issues, or changing market conditions.
- Are generally unwilling to make significant investments in non-mandatory environmental activities that do not have expected measurable returns.
- Have motivations that include a desire to be ahead of compliance issues, potential economic benefits, and being responsive to changes in market demand.

In line with the above criteria, the results of the analysis indicate that the Sanitaryware & Tiles sector has a reactive attitude towards environmental issues. For instance, in both countries, this industry agreed, or strongly agreed, that improving environmental performance usually improves production efficiency, with no disagreement from any companies interviewed. However, the overwhelming view was that few customers would pay a higher price for a 'greener' product. Therefore, manufacturers cannot treat environmental performance in the same way as other parameters: they feel unable to offer environmental quality at the expense of other traditional qualities like luxury. The vast majority of respondents in each country, agreed that financial constraints restrained them from doing more to improve their environmental performance. For instance, the French Sanitaryware & Tiles sector (63%) was the highest to regard environmental impact alone as important due to customer and competitor pressure. This sector, as a whole, has experienced clear benefits from the environmental improvement they adopted and are willing to adopt new procedures which will both save money and be environmentally compatible. The survey also shows that market requirements, that is, the perceived needs of customers, encourage companies to change. Moreover, firms interviewed see the European Commission as the principal focus of emerging legislative pressure, because complying with legislation across the European Community is a prerequisite for trading between member states.

The overall attitudes reflective of this group are : 'Compliance is the focus unless the project can save money' ; 'We did most of these environmental activities because we were driven by compliance forces. We recognise a value-added component, but compliance has been the main thing' ; 'Our company is sensitive to the people who work here. We try to go beyond compliance.'

3.2.5 Group 5: Proactive

Among companies in this group, a search for opportunities or an environmental ethic takes precedent over compliance concerns. Companies in this group see environmental issues as opportunities to improve their business. In addition, many companies in this group exhibit an intensified environmental ethic in which 'doing the right thing' environmentally is the expected behaviour, where it is feasible and financially realistic.

The opportunities presented by environmental issues are more readily identified, and environmental concerns take a higher priority within the company. In general, companies in this group:

- Work to influence regulations in a positive way.

- Are characterised by a broader frame of reference and by the development and implementation of programmes that go beyond areas of compliance, survival, and market changes.

- Have a wider range of environmental activities, which include programmes that involve customers, suppliers, and the community and that address facilities-related environmental issues in addition to manufacturing process issues.

- Often have comprehensive waste minimisation or pollution prevention programmes.

- Have elements of an environmental management system and a willingness to experiment continually.

By the nature of the processes (clean technology), the hi-tech industries of the Industrial & Refractory sector have clearly adopted a proactive attitude. This segment is at the forefront of developments using high tech technology. They see the environment primarily as a business opportunity, while recognising that they have to spend money both to comply with environmental constraints and to exploit business opportunities. This segment of the ceramics industry is actively seeking to develop meaningful dialogues with government, pressure groups and the public. The key objective of such dialogues is to define 'sustainable' approaches to business activities. In particular, the industry is keen to see that emerging environmental legislation acts to focus scarce financial resources, in a way that maximises environmental benefits. Moreover, most companies emphasise that obtaining a clear perspective on evolving government agendas is important, be it the European Commission specifying new directives, or national governments defining the details of implementing legislation. In France, this issue was deemed particularly important.

The attitudes reflective of this group are : 'These programmes were set up because they were the right thing to do and they minimise our environmental impact' ; 'We want to minimise our environmental impact at the lowest conceivable. Because, undoubtedly, it would lead to social and economic benefit. Everyone has to get involved in the environmental pollution battle'; 'Business needs to understand that society has the right to determine how land, air and water are used.'

4. *RATIONALE FOR NOT INTRODUCING ENVIRONMENTAL IMPROVEMENT*

The results of this survey suggest that the levels of awareness and actions towards environmental issues are limited. The ceramics industry sees environmental issues in terms of increased costs rather than new business opportunities. Import substitution from countries with lower environmental standards is seen as a particular threat.

Over a third of the companies interviewed in the UK and France have not introduced any managerial and process changes or installed new equipment to improve their environmental performance over the last 2 years. Among companies who did not take any action to improve their environmental performance, 89% in the UK and 78% in France were in the micro and small sized segment, while only 1 company in the UK and 2 for France were in the large-sized range. Furthermore, they generally felt that improving environmental performance does not necessarily improve production efficiency and/or lead to significant cost benefit.

4.1 Insufficient financial incentive

Approximately 20% in the UK and 15% in France of respondents who have not introduced any changes over the last 2 years also believe that improving environmental performance would not yield financial benefit. Unsurprisingly, for both the UK and France the breakdown by size reveals that they are either micro companies (78% in the UK and 71% in France) or small companies (22% in the UK and 14% in France). The breakdown by sector confirms that in both countries the tableware industry, 55% in the UK and 43% in France of respondents have not introduced any change and do not expect any financial benefit either, has a very defensive approach vis-à-vis environmental issues based on taking corrective steps only when pushed by the law. Interestingly, 44% of UK respondents in the industrial & refractory sector against only 14% in France share this idea. The UK industrial & refractory sector is still dominated by a large number of medium sized companies whilst their French counterparts have undergone a series of mergers and acquisitions which has led to the creation of two major companies who hold 65% of the total production. This breakdown confirms also that the French brick industry, 29% compare to none in the UK, considers that it is not financially beneficial to introduce any changes which could improve its environmental performance. The French Brick sector is much smaller than the UK one due to differences in the construction styles and increase competition with concrete blocks which has led to the erosion of this market. Moreover, on the environmental issues and more precisely on the air issue this industry is particularly protective, especially in France. Indeed, for several years now, air pollution has increasingly been of concern at European level and has led to the enactment of numerous regulation requiring higher standards of emissions control.

4.2 Inadequacy of environmental regulation

The results of this survey suggest that the ceramics industry sees environmental issues in terms of increased costs rather than new business opportunities. Import substitution from countries with lower environmental standards is seen as a particular threat. The levels of awareness and actions towards environmental issues are limited in this sector. More particularly, the responses reveal that in both countries the vast majority (approximately 60%) of micro and small-sized companies did not support the idea that an environmental policy would benefit their companies. Companies do not seem to be keeping abreast of, or complying with, the relevant environmental regulations, and that environmental actions are largely driven by regulation. Overall results show that the smaller the company, the more likely it is to find environmental issues a constraint, a financial burden which reduces their competitiveness and profitability. Partly because smaller companies have less time and money available along with a lack of trained manpower and knowledge to address these issues than their larger counterparts. Indeed, micro and small firms appeared to deal largely with the environment in an *ad hoc* manner concentrated their attention on everyday operational issues rather than producing a holistic strategic plan. This may well be due to the lack of relevant resources and stringent time constraints that apply to smaller firms, and also to faults in the diffusive information pathways from support organisations to address the problems. Information sources on environmental issues exist, and are largely available to companies. However, the large majority (80%) of respondents especially from micro and small companies agreed that they were looking for advice on environmental issues only when they are forced to comply with a new legislation or when they are planning to purchase a new piece of equipment. When they look for information on environmental issues respondents contact primarily their trade/industry associations. These associations have therefore a central role to play for increasing the overall strategic perception of the SMEs vis-à-vis the environment and should probably allocate more time, money, and be more innovative in the way they are tackling this issue.

CHAPTER 8

CONCLUSION

1. INTRODUCTION

This research has sought to learn more about the complex process in which new environmental market pressures and environmental governance impinge on 'traditional' industry competitiveness. Environmental issues are causing rapid changes in Europe, partly because of Europe's diverse political, economic and social structure and partly because of its relatively long industrial history. Environmental pressures on European businesses are significant and increasing, and will be an increasingly key element in corporate planning. Whilst all companies interwieved expect environmental standards to tighten, smaller companies feel particularly pressed both by the financial costs and management time required to meet complex and changing legislation.

1.1 Background

As discussed in chapter 2, many studies on industries' attitudes towards environmental concerns have observed that companies see environmental issues as more specific to industries than to countries. The potential impact and relative importance of the environment, however, varies somewhat from industry to industry. Some sectors see the environment as a business opportunity, some as a source of legislative constraint, and some as an integral part of business philosophy. Recent studies have provided partial insights into current corporate environmental thinking. However, these studies have concentrated mainly on establishing - through interviews - the views on 'best practice' in a very limited number of 'progressive' companies (chemicals, biotechnology, computer manufacturers). This research has investigated the environmental views within the ceramics industry principally because it includes a wide range of companies in terms of size - from the very small to the very large - and focus of activity, ranging from refractories suppliers to fine porcelain tableware manufacturers. The project has looked at two European countries, the UK and France, because of their long industrial history in this domain.

In recent years, the relationship between firms and the environment has been subject to a rapidly growing body of legislation (as discussed in Chapter 2) which has forced companies to internalise environmental issues within their corporate management structure. But, as indicated by Meredith and Wolters (Meredith *et al*, 1995), legislation has only been partially successful due to inadequate implementation and poor compliance. In essence, therefore, sustainability cannot be reached in the absence of proactive environmental strategies by individual firms promoting clean products and processes. It is now broadly accepted that it is the management and direction of economic growth and technological innovation that offer the main opportunity for paving the way towards 'sustainable development'.

However, the ultimate test for the firm lies in the market place, where revenues have to compensate for the costs incurred to secure a profit. Indeed, a firm's strategic choices are determined by its financial, technological and organisational reserves or, in other words, its internal strengths and weaknesses. For instance, these internal factors may explain differences in the strategic courses of action taken by small and large companies operating under similar market conditions. Moreover as technology plays such a crucial role, it is important to recognise that technological developments depend not only on a single firm, but also on a wider innovation complex. Such a complex, inter alia, involves the supplier-user relations, comprising a chain of economic activities needed to develop, produce and sell a product (Kemp *et al*, 1992). Also, related industries using comparable technologies, and research institutes, form part of a firm's techno-economic system (Meredith, 1995). Even though environmental issues loom large in today's economies, the strategic role of businesses vis-à-vis the environment remains a puzzling subject.

1.2 Research focus

This research principally focused upon these areas:

- to present a comprehensive analysis of contemporary approaches to corporate environmental management;
- to determine environmental governance, i.e. techniques and instruments - legal, voluntary, persuasive, contractual, etc. - by which 'the environment' is used to achieve a framework of compliance with political and economic imperatives;
- to provide a quantitative and qualitative representation of the ceramics industry;
- to assess the attitudes to environmental issues and environmental strategies[1] within the ceramics industry;
- to identify the most significant initiatives taken by industrial firms to protect the environment and to determine any obstacles to the success of these initiatives.

[1] Steger (1988), in particular, distinguished three different environmental strategies: defensive, offensive and innovative strategies.

2. CHARACTERISTICS OF THE SECTOR

As presented in Chapter 4, Europe is regarded as the world's largest ceramic producing region. The demand for the majority of European ceramic goods is very elastic[2] due to fierce competition among Far Eastern, Japanese, American and European manufacturers. This sector is, as a whole, positioned in a mature/declining market which forces industries operating in this market to be highly competitive in order to survive. The nineties have seen the creation of several multinational groups in each sub-sector. The most significant degree of concentration has taken place in the refractories sector where five companies now account for about 65% of total European (EU plus EFTA) production (Panorama, 1995). The tableware and ornamental ware sector is still characterised by the presence of a small number of multinational companies amongst numerous small firms. The sanitary ware sector is dominated by three major groups operating on a European level and accounts for 40% of total EU production (Panorama, 1995). The EU wall and floor tile industry is dominated by medium sized producers in Italy and Spain.

Traditionally, the UK and French ceramics sector tends to be under-capitalised and oligopolistic - dominated by few large companies, principally in the tableware/domestic goods sub-sector. These companies have generally been long-established and have occupied the same sites for many years. The buildings are often old and multi-floored, which means that they cannot introduce the modern efficient production technologies that work best when on one/ground floor and laid out in a straight line. Opportunities for in-situ expansion may be constrained by development which has occurred around them. Moreover, some of their basic processes and practices have remained essentially unchanged for many decades and even centuries. As a result, the perception exists within this sector that no significant process efficiency improvements can be achieved.

2.1 Impact of the ceramics industry on the environment

The impact of the ceramics industry on the environment is derived from the overall process parameters such as clay material preparation, energy consumption, raw material employed, production organisation, packaging and product transportation. As illustrated in Chapter 5, waste - typically in solid, sludge, and gaseous form - is generated by the ceramics manufacturing process. The volumes and content of these arisings, like the manufacturing process itself, vary between the different ceramic sub-sectors and also between competitors within specific sub-sectors. Indeed, the volume of waste generated is affected to a large

[2] Implying that close substitutes are readily available and that a small price increase will cause many consumers to transfer to the substitutes, resulting in a large fall in demand for European products.

extent by the level of production control, quality of product design, quality of production equipment, quality of raw material inputs, quality of management, and quality of production-line workforce.

The main environmental concerns relate to emissions into the air. These can be either directly detrimental to the health of the workforce, due to toxic inhalation, or can contribute to global warming, transboundary pollution - such as acid deposition - and localised pollution problems, such as ground level ozone depletion. Releases to water are also of concern as the nature and quantity of the waste water output are financially and environmentally significant. Releases to land consist mainly of sludges from waste water, waste from unfired clay materials and rejected or broken fired products (bricks, plates, etc.) and non-hazardous waste including paper, cardboard, plastics, wooden pallets and plastic stripping. Indeed, the fragility of many ceramic products require large volumes of packaging. Noise is another issue which is becoming increasingly important especially if the site is located at proximity to other land uses (particularly residential populations). This problem varies according to the nature of activities performed on site and the effectiveness of noise-screening measures.

2.2 *Principal sources of legislative pressure affecting the ceramics industry*

Over the years the EU has become more involved in promoting environmental protection, as illustrated in chapter 2. Since the first Environmental Action Programme in 1973, European environmental policy has gradually evolved to a state where it now comprises a substantial body of legislation. It is also foreseen that these policies are likely to be further strengthened in the near future so as to integrate greatly 'the environment' into industrial activities. Among regulatory bodies, the European Commission is seen by most companies interviewed as playing a leading role. However, companies complain that the Commission and national governments have short-term horizons. This, and sometimes the nature of compliance procedures, leads to a focus on clean-up technologies and compliance detail, rather than more strategic development.

As in other European industrial sectors, the UK and French ceramics industry is now facing tougher environmental legislative and regulatory instruments aimed at forcing companies to comply with certain standards and taxing firms which pollute. The so-called 'polluter pays principle' is now central to legislation. Air pollution is increasingly of concern at national and international level and numerous regulations have recently been introduced, requiring progressively higher standards of emissions control, and enforcing compliance with new emissions standards much more strictly. Management of water resources is also one of the issues which has been increasingly regulated at national and European level in the last decade. The impetus is the need to put in place mechanisms and procedures which will improve the overall quality of water, reduce pollution and rationalise the use of water. Since the nineties a wide range of legislation on contaminated land has been enacted, introducing legal liability for cleaning up contamination. The impact of these regulatory changes has been a substantial increase in landfill costs reducing subsequently reliance on landfill and increasing the promotion of reducing, recycling and other forms of 'recovery'. Moreover, a wide range of legislation on waste management has been recently adopted to ensure that the waste which still arises is recovered or disposed of in a manner which does not damage human or animal health or cause harm to the environment. Reducing and recycling packaging has also been a key feature of government policy within Europe and has directly affected the ceramics industry which uses large amounts of packaging to transport and protect goods from breakage. Finally, as with other industrial manufacturing processes, the production of ceramics goods emits noise. However, this aspect of pollution is currently tackled only very superficially both by domestic and international legislation.

3. CORPORATE ATTITUDES AND PERCEPTIONS OF THE ENVIRONMENT

The actual programme of valid interviews carried out, both at pilot stage and in the main interview programme, totalled 185 (94 in the UK and 91 in France) which represents approximately a quarter of the UK and French ceramics industry and was large enough to make significant and non-biased conclusions. As a whole the vast majority of respondents in both countries (67% in the UK and 56% in France) agreed that their activity impacts on the environment. The four most frequently cited environmental impacts the ceramics industry might generate on the environment were: gaseous emissions, disposal of non-toxic wastes, outdoor dust (UK), liquid effluent discharged to sewers (France) and finally, indoor dust.

The results of this survey suggest that the ceramics industry sees environmental issues in terms of increased costs rather than new business opportunities. Import substitution from countries with lower environmental standards is seen as a particular threat. The levels of awareness and actions towards environmental issues are limited in this sector. Moreover, although a majority of companies consider the environment an important corporate priority, most clearly consider profitability more important. Analysis of the responses suggests that few companies have a strategic plan to generate additional profitability from their environmental positioning and expenditure. One possible reason for this is that most companies cannot see how future environmental values and standards will evolve. Therefore they lack the confidence to take a leading position. Many respondents mentioned, for example, their preference for a 'middle of the road' corporate policy - following emerging standards closely, but not pre-empting or exceeding them.

According to the analysis conducted in chapter 2, the corporate environmental management of the ceramics industry can be categorised into five stage groups. At one end, firms perceived environmental issues as a barrier while companies at the other end perceived the environment as a stimulus to their activities as illustrated in Table 61 .

Table 61: Taxonomy of the ceramics industry according to its attitudes to environment

SECTOR & GROUP	COMPANIES' CHARACTERISTICS
TABLEWARE **Defensive**	• Take corrective step only when pushed by law. • Are unresponsive and reactive to environmental initiatives. • View concern for the environment as a hindrance to their growth.
BRICK **Laggard**	• Are aware of the environmental challenges facing them, but are unable to combat those challenges because of cost constraints, lack of trained manpower, lack of knowledge, etc. • Observe environmental laws but actions reflect lack of ability to comply. • Are far more operationally orientated than strategic in nature.
INDUSTRIAL & REFRACTORY (The more traditional segment of this industry i.e. refractories manufacturers) **Compliance**	• They try to keep up and comply with regulations. • They are primarily reactive, either to regulations or to specific customer requirements. • They have the primary motivation of avoiding problems, stay out of trouble, or stay in business.
SANITARYWARE & TILES **Reactive**	• They recognise that environmental issues can open up new cost savings areas and market opportunities. • Try to keep ahead of regulations through early compliance. • Often participate In voluntary compliance programmes.
INDUSTRIAL & REFRACTORY (Hi-tech industries of this sector) **Proactive**	• They see environmental issues as opportunities to improve their business. • Work to influence regulations in a positive way • Often have comprehensive waste minimisation or pollution prevention programmes. • Have elements of an environmental management system and a willingness to experiment continually.

As a whole, in each country, only a third of the people who agreed that their company impacts on the environment have established a formal corporate environmental policy. Furthermore, only half of the large-sized companies, in the UK and France in favour of an environmental policy, currently have in place a formal corporate environmental policy.

Therefore one can say that this industry has a laggard approach to environmental issues, which encourages reactive management of the environment as a business issue.

This is the antithesis of the proactive response required to establish the proposed environmental management systems solutions. The responses reveal that in both countries, companies do not seem to be keeping abreast of, or complying with, the relevant environmental regulations, and that environmental actions are largely driven by regulation. On average, for both countries, half of the respondents agreed that their company only took environmental action to meet legislation, and approximately 80% agreed that it was not always clear how environmental legislation affected their companies. These replies confirm the general idea that the current legislative framework in both countries does not encourage companies to innovate, and inhibits transition to environmentally cleaner technologies.

Consequently, companies call for a shift from a total regulatory approach to a more self-regulated approach since this would encourage a collective answer to specific issues and would improve long-range corporate environmental planning. As illustrated in chapter 2, policy makers have in recent years given greater emphasis to the overall policy goal of preventing pollution rather than just abating it. Consequently, 'new' policy instruments have been introduced, supplementing such 'first generation' instruments as the widely used science-based emission standards. These 'second generation instruments' include technology-forcing standards, the introduction of inducive instruments such as labelling, consultant services and voluntary agreements between government and specific sectors of industry. However, most companies are sceptical about the feasibility of tradeable emission permits and hostile to direct pollution taxes.

The regulatory approach has certainly encouraged the creation of a large market for abatement technologies though many pollution problems have not been solved, but merely displaced elsewhere. This approach has not given sufficient incentive to polluting companies to find more innovative solutions to their environmental problems, rather than merely adding on pollution abatement equipment. Therefore, the introduction of economic instruments which provide continuing incentives to reduce environmentally harmful behaviour can be interpreted as a response to the problems inherent in the traditional 'command and control' approach. It has also been observed that the self-regulated approach is associated with higher levels of compliance since they offer the involved companies a degree of flexibility that can reduce some of the uncertainties associated with the traditional regulatory approach (such as ratcheting), and since the responsibility for enforcing regulatory demands has in part been shifted to the firms themselves. Thus, companies are publicly responsible for achieving the environmental goals and puts their credibility on the line, if they do not adhere to the rules which they have been active in creating. Furthermore, by making some concessions business may be able to stave off more intrusive regulatory actions.

Having established that in both countries micro and small firms have a low level of awareness of environmental legislation and regulation, the next stage was to consider if this low level of awareness of systems translates itself into a reactive approach towards specific environmental policies and practices. Once again there is a clear difference between responses that do not require factual substantiation and those that do. As a whole, a majority of firms in both countries (64% in the UK and 48% in France) monitored levels of waste or emissions and the number of companies setting reduction targets for emission and waste followed the same pattern. However, a vast majority of micro and small companies had not introduced any change to improve environmental performance over the last 2 years. Furthermore, they generally felt that improving environmental performance does not necessarily improve production efficiency and/or lead to significant cost benefit.

Concerning the difference in response between large and small companies, overall results show that the larger the company the more likely it would be to find environmental issues important. Partly because larger companies have more time and money available to address these issues than their smaller counterparts and partly because of the fear of adverse publicity. Indeed, micro and small firms appeared to have largely concentrated their attention on everyday operational issues rather than producing a holistic strategic plan for the environment requiring proactive planning.

At the moment, it seems that the ceramics industry is willing to take more care of the environment but companies, especially small and micro, are unable to change their practice. This may well be due to the lack of relevant resources and stringent time constraints that apply to smaller firms, and also to faults in the diffusive information pathways from support organisations to address the problems. It is noticeable that overall strategic plans do not exist to deal with the environment. This could be because management systems like BS7750, EMAS, ISO 1400 have not yet trickled down into this traditional sector as the systems proposed are not appropriate to them or senior level commitment to the environment is not present.

As a whole, the results of this survey suggest that the ceramics industry in both countries is aware of the environmental challenges facing the sector, but, for the vast majority of companies, they are not able to respond because of cost constraints, lack of trained manpower, lack of knowledge, and its market position. British and French ceramics industry recognised that the European Commission and national and local governments are important sources of environmental pressure on their businesses. However, their capacity to influence developing governmental agendas is currently limited by scarce management resources making their 'lobbying' less effective. Ceramics companies in the UK and France tend to prefer the simplicity associated with direct environmental regulation over market-based approaches. Companies also want adequate time for the implementation of standards, and strategic vision on the part of government. Despite companies' environmental concern, in importance it ranks behind issues like safeguard the business from bankruptcy, corporate profitability, and employee health and safety. The lack of environmental awareness of this sector compared to over producing countries such as Germany (refer to Chapter 4) could well, in the medium/long term backfire as a result of adverse publicity and through loss of business to environmentally conscious buyers. As already stressed, the ceramics industry is positioned in a mature/declining market, the attractiveness and growth of the sector is therefore limited, except in the sanitary ware segment.

Thus, in order to move towards a more sustainable business and gain competitive advantage, the UK and French ceramics manufacturers should :

- make the present environmental impact acceptable by identifying issues that require immediate action and by setting up realistic targets and future action plans.

- identify and realise potential by minimising pollution, reducing energy and raw material consumption, and explore new business opportunities by giving more consideration to their product- differentiating and positioning strategies (i.e. market leader, challenger, follower or nicher).

- change to a sustainable business by involving all the staff at all levels of the organisation. This can be achieved by creating environmental awareness and training, changing the organisation's culture and developing cleaner and more efficient production processes.

4. CONCLUSIONS AND FURTHER RESEARCH

This research, has suggested that a traditional manufacturing sector is more inclined to undertake operational changes if they do not require too much investment in time and capital. Operational improvements are easier to implement and certainly more likely to occur within traditional sectors than larger scale strategic implementation, designed to encompass all areas of business practice. However, the introduction of either strategic or operational environmental changes requires individual company commitment. Both are self-regulatory and therefore open to abstention, leaving the success of environmental improvement largely determined by the responsiveness of business. Moreover, this research has also revealed that SMEs operating in a highly regulated market face difficulties complying with legislation due to a lack of time, awareness and resources available. Generally, to respond to these constraints companies have pursued rapid growth strategies, typically by mergers and acquisitions, in order to increase market power, and improve efficiency through rationalisation and economies of scale. However, various studies are moving away from this strategy and emphasise that any of the restraints to environmental self regulation - like cost, time and initial lack of commitment - faced by industries will be overcome within the present economic system. Hence, these advocate bioregionalism and fair trade as an alternative.

It will, therefore, be of interest to further research the concept of bioregionalism. Indeed, there is already a whole host of material (Callenbach, 1975; Sale, 1985; LeGuin, 1986; Dobson *et al*, 1991; Hutchinson *et al*, 1994). Bioregionalism could be defined quite well as meaning, to fit ourselves to a particular place and not to fit a place to our predetermined tastes (Mellor, 1992). The ultimate socio-economic scenario would then be a form of Green subsidiarity where the region is reinhabited and people learn to live in an area again. With this change of emphasis would come a new regional consciousness 'a sense of place' (Hutchinson *et al*, 1994) which would place more value on the environment. According to these proponents, companies generally consider the environment as an external business threat and only address seriously environmental issues when they feel that they are likely to be caught falling short of the legislative requirements, or by a minority of interested individuals. Therefore, their first concern is to redefine the economic priorities and trade locally in order to internalise the environmental externalities as trading locally induces regional environmental awareness. The ultimate goal is self regulation, where individuals and businesses recognise and respect the environment on a more holistic level. It will therefore be of interest to investigate the level of relationship, and the impact that regional trading might have on a companies' environmental awareness. The ceramics industry will be an interesting sector to study as it is highly regionalised.

The election in May 1st 1997 of Tony Blair in the UK and the victory in June 1st 1997 of the Socialist Lionel Jospin and his plural left alliance in France (radical, socialist, communist and ecologists) raised hopes that the environmental legislation and regulations currently in force will in the near future be amended. Indeed, both governments are willing to follow an intermediary way, standing between strict interventionism and laisser-faire approaches. It will, therefore, be important to thoroughly assess the impact of their policies on companies' awareness and actions towards environmental issues. Already in the UK, a radical overhaul of the tax system designed to make polluters pay for cuts in employment taxes was considered by Gordon Brown, the chancellor who declared in *Labour's manifesto:*

> *Work should be encouraged through the tax system whilst environmental pollution should be discouraged.*

Indeed, in his first budget the Chancellor announced the setting up of a commission to study ways of greening the tax system. Environmental groups claim that such a shift could yield £21 billion and create 700,000 new jobs within a decade (The Economist, 1997). In France, in line with his alliance, the new Prime Minister, Lionel Jospin appointed Ms Dominique Voynet (head of the Green Party) as the new environment and regional development minister. Nevertheless, it is far too soon to thoroughly discuss the environmental policy of these two governments given the time period spent in office and would only lead to purely speculative comments.

In order to validate the findings of this research more radical assessment of corporate environmental strategy than we have seen today is required to be conducted at national and international level. It will be of interest to undertake further investigation on how traditional sectors, such as the cement, paper or metalworking industry, react to new environmental market pressures. Furthermore, in order to draw further conclusions it would also be interesting to assess the attitudes, awareness and responses to environmental legislation and regulations of a hi-tech sector dominated by SME companies and compare the results with this research.

Nevertheless, it will be a long journey before the concept of sustainable management is fully operational in a meaningful sense. But even the longest journey starts with a single step, and an increasing number of companies have already overcome the first step: to move from rhetoric to action.

BIBLIOGRAPHY

Ansoff, H. (1979) *The changing shape of the strategic problem,* **Strategic Management: A new view of business and policy planning little,** Brown and Co, Boston.

Arrêté du 1er mars 1993 (1993) *Installations classées,* Journal Officiel, March 28th 1993.

Artis,M.J. and Lee, N. (1994) *The economics of the european union: policy and analysis,* Oxford University Press, Oxford.

Babbie, E. (1990) *Survey research methods (2nd ed.),* Wadsworth, Belmont.

Bailey, J.E. (1995) *The UK ceramics industry: an Overview,* **Industrial Ceramics,** Vol. 15, No 2, pp. 103-108.

Ball, S. and Bell, S. (1991) *Environmental law,* Blackstone Press Limited, London.

Banque de France (1995) *L'industrie porcelainière en Limousin,* Banque de France, Secrétariat Régional du Limousin.

Banque de France (1996) *Les fabricants de porcelaines de Limoges agissent pour reconquérir les marchés,* **L'industrie Céramique & Verrière,** No 911, 1/96, pp. 24-25.

Baptista, J.L. and Fonseca, A.T. (1995) *The Portuguese ceramic industry,* **Industrial Ceramics,** Vol. 15, No2, pp. 87-93.

Barbier, E.B., Markandya, A. (1990) *The conditions for achieving environmentally sustainable growth,* **European Economic Review,** 34, pp. 659-669.

Barclays (1994) *France,* **Barclays Economic department,** November 1994.

Barde, J.P. (1994) *L'universel et le particulier: l'environnement facteur d'interdépendance internationale,* **Cahiers Français,** No 263, pp. 47-52.

Barkham, J. (1993) *Is there a future for nature?,* **Ecos,** Vol.14, No 1.

Barnes, P. (1993) *Industrial competitiveness and the environment: The need for EU policy integration,* **European Environment,** Vol. 3, Part 6, December 1993.

Barrett, S. (1991) *Environmental Regulation for Competitve Advantage,* **Business Strategy Review,** Spring 1991, pp.1-15.

Barrett, S. (1992) *Policy analysis paper,* CSERGE, London.

Bateman, I.J. and Turner, R.K. (1993) *Evaluation of the environment: the contingent valuation method,* CSERGE, GEC 92-18.

Baumol, W.J. and Oates, W.E. (1971) *The use of standards and Prices for protection of the environment,* **Swedish Journal of Economics,** 73(1).

Baumol, W.J. and Oates, W.E. (1988) *The theory of environmental policy,* 2nd ed., Cambridge University Press, New York.

Beaumont, C. and Stray, S. (1984) *Sample design and survey methodology,* University of Aston, Management Centre, Birmingham.

Beaumont, J.R.; Pedersen, L.M. and Whitaker, B.D. (1993) *Managing the Environment*, Butterworth-Heinemann Ltd, Oxford.

Bekkada, Z. (1995) *Helleau, Helleau, Helleau*, **Water Services,** July 1994, p4.

Bekkada, Z. (1995) *French Water Giants aim to be Top of the (British) Tips*, **Water Services,** May 1995, p6.

Bekkada, Z. (1995) *Lyonnaise puts its case as French water corruption crisis deepens*, **Water Services,** January, pp. 10-11.

Bekkada, Z. (1995) *Lyonnaise insists customers would benefit from Northumbrian takeover*, **Water Services,** March 1995, p2.

Belson, W. (1986) *Validity in survey research*, Gower Publishing Company, Aldershot.

Belz, F. and Hugenschmidt, H. (1995) *Ecology and competitiveness in swiss industry*, **Business Strategy and the Environment,** Vol. 4, No 4, October - December 1995.

Bennett, D. and Wilson, S. (1992) *The entrepreneur in the driving seat - Go green or go bust ?*, **Paper submitted to the 22nd European Small Business Seminar,** 23-25th September 1992.

Bennett, R. (1990) *Successful big business strategies for small firms*, Kogan Page Limited, London.

Bezou, E. (1996) *Qualité et environnement en fait, c'est simple!*, **Décision Environnement,** No 46, May, pp. 25-38.

Bickman, L. (1981) *Some distinctions between basic and applied approaches. In L. Bickman (Ed.)*, **Applied social psychology annual,** Sage, Vol. 2, Newbury Park.

Bickman, L. (1989) *Barriers to the use of program theory: the theory-driven perspective*, **Evaluation and Program Planning,** 12 (4), pp. 387-390.

Biffa (1993) *Waste : somebody else's problem? our choice and resposabilities*, Biffa Water Services, London.

Biffa (1994) *Waste : a game of snakes and ladders*, Biffa Water Services, London.

Biod, A., Probert, J. and Jones, C. (1994) *EU waste management: lessons to be learnt from french experience?*, **European Environment,** Vol. 4, Part 3, June 1994, pp. 21-25.

Biondi, V. and Frey, M. (1995) *Participation in the EU eco-management and audit schemes*, **European Environment,** Vol. 5, September-October 1995, pp. 128-133.

Bipe Conseil (1993) *Prospective de l'environnement en France à l'horizon 2010*, Study realised by Bipe Conseil for the French ministry of environment, February 1993.

Bipe Conseil (1994) *The environmental industry in Europe: a British and French survey*, **Enviroscope conference,** November 10th 1994.

Blouet, A. and Lebail, S. (1994) *Conseil en environnement : a la recherche d'un second soufle*, **Décision Environnement,** No 27, Juin 1994, pp. 24-32.

Board, N. (1993) *The Urban Wastewater Treatment Directive*, **Industrial Waste Management,** Vol. 3, Issue 10, p17.

Boehmer-Christiansen, S. (1994) *Politics and environmental management*, **Journal of Environmental Planning and Management,** Vol 37, No 1.

Bogdan, R. and Taylor, S. (1975) *Introduction to qualitative research methods*, John Wiley, New York.

Bostrum, T. and Poysti, E. (1992) *Environmental Strategy in the Enterprise*, Helsinki School of Economics, Helsinki.

Bowers, J. (1990) *Economics of the Environment: a conservationists response to the Pearce report*, B.A.N.C., Newbury.

Brard, J.P. (1995) *Vers un PIB vert? pour la prise en comptes de l'environnement*, Assemblée Nationale: les documents d'information, Rapport No 1912.

Bréas, J. (1996) *Les progrès importants de l'assainissement collectif depuis trente ans*, **Les données de l'environnement, ifen,** No 20, February-March 1996.

brinkhorst, L.J. and Klatt, E.R. (1993) *EG-Milieubeleid evolutie en perspectieven in internationaal milieubeleid*, SDU-uitgeverij, Den Haag.

British Chamber of Commerce (1994) *Small Business Survey 7- Environment*, Association of British Chamber of Commerce, London.

Bryman, A. (1989) *Quality and quantity in social research*, Allen and Unwin, London.

Cabanes, A. (1994) *TVA sur ordures ménagères: 18.6% ou 5.5%*, **Décision Environnement,** No 27, Juin 1994, p9.

Caccia, G. (1995) *Actions to be taken in order to develop a quality system in the brick industry*, **European Ceramic Society, 4th Euro-ceramics conference,** 2-6 October, Vol.12, pp. 21-32.

Cairncross, F. (1992) *Costing the Earth: the challenge for governments, the opportunities for business*, Harvard Business School Press, Boston.

Cairncross, F. (1993) *A survey of waste and the environment*, **The Economist,** May 29th 1993.

Cairncross, F. (1994) *GATT's unclear message*, **Tomorrow,** Vol. 4, No 3, July - September 1994, pp. 54-56.

Callenbach, E. (1975) *Ecotopia*, Banyam Tree Books, London.

Campbell, D. and Stanley, J. (1966) *Experimental and quasi-experimental designs for research*, Rand McNally, Chicago.

Capel, J. (1995) *Building materials: an abnormal cycle*, James Capel & Co. Limited, London.

CCI Limoges (1992) *La filière céramique secteurs et marchés*, CCI Limoges, Limoges.

CCI Limoges (1995) *La porcelaine de Limoges: permanences et mutations*, CCI Limoges, Limoges.

CCI Limoges (1995) *Les manufactures de porcelaine de Limoges*, CCI Limoges, Limoges.

CERAM Research (1997) *World ceramics abstracts*, CERAM Research, Vol. 9, No 4, April 1997.

CERAME UNIE (1995) *Standardisation - Technology*, **CERAME UNIE Courrier,** No 95/1, pp. 6-8, Bruxelles.

CERAME UNIE (1995) *Environment - Energy*, **CERAME UNIE Courrier,** No 95/2, pp. 7-8, Bruxelles.

CERAME UNIE (1995) *Environment - Energy*, **CERAME UNIE Courrier,** No 95/3, pp. 7-9, Bruxelles.

CERAME UNIE (1995) *Standardisation - Technology*, **CERAME UNIE Courrier,** No 95/4, pp. 5-6, Bruxelles.

CERAME UNIE (1996) *Environment - Energy - Raw materials*, **CERAME UNIE Courrier,** No 96/1, pp. 7-9, Bruxelles.

CERAME UNIE (1997) *Environment - Energy*, **CERAME UNIE Courrier,** No 97/1, pp. 7-9, Bruxelles.

Charter, M. (Ed.) (1992) *Greener Marketing: Responsible Business*, Green Leaf Publishing, Sheffield.

Chen, H. and Rossi, p. (Eds). (1992) *Using theory to improve program and policy evaluations*, Greenwood, New York.

Chorus, R. (1995) *The European environmental policy and the tiles & Bricks industry*, **European Ceramic Society, 4th Euro-ceramics conference,** 2-6 October, Vol.12, pp. 53-58.

Chorus, R. (1995) *The status and prospects of the tableware industry in Europe*, **European Ceramic Society, 4th Euro-ceramics conference,** 2-6 October, Vol.10, pp. 173-175.

Christie, S. and Teeuw, R. (1996) *European perspectives on contaminated land*, **European Environment,** Vol. 6, pp. 85-94.

Cicorella, M. (1996) *Tableware production: from traditional to rapid - a forced choice*, **International Ceramics Journal,** February 1996, pp. 11-15.

Clement, K. and Bachtler, J. (1997) *Regional development and environmental gain: strategic assessment in the EU structural funds*, **European Environment,** Vol. 7, pp. 7-15.

Clifford Chance (1993) *The CCH guide to 1993: changes in EEC law*, CCH Editions Ltd, Second edition.

Clifford Chance (1995) *The environmental law guide*, Clifford Chance, London.

Coline (1994) *Commerce international et protection de l'environnement*, Coline, Comité législatif d'informantion écologique, January 1994.

Commission of the European Communities (CEC) (1992) *Towards sustainability*, CEC, COM (92) II, Brussels.

Commission of the European Communities (CEC) (1993) *Growth, competitiveness, employment: the challenges and ways forward into the 21st century*, CEC, 6/93, Brussels.

Commission of the European Communities (CEC) (1994) *Proposal for a council directive on ambient air quality assesment and management*, Office for Official Publications of the European Communities, COM (94) 109 final.

Commission of the European Communities (CEC) (1996) *Progress report from the Commission*, CEC, COM (95), p625, Brussels.

Comolet, A. (1995) *Greening of the economy*, **Ecodecision,** No 16, pp. 42-46.

Confédération des Industries Céramiques de France (1994) *Annuaire 1994-1995*, SEPTIMA, Paris.

Contaminated land (1994) *Policy & Remediation update*, **Environment Business Magazine,** September 1994, p31.

Cook, T. and Campbell, D. (1979) *Quasi-experimentation: design and analysis issues for field settings*, Rand McNally, Chicago.

Cook, T. and Reichardt, C. (Eds) (1979) *Qualitative and Quantitative methods in evaluation research*, Sage Publications, London.

Coope & Partners (1994) *Panorama*, Cerame-Unie, Bruxelles.

Copeland, B.R. (1994) *International trade and the environment: policy reform in a pollutted small open economy*, **Journal of Environmental Economics and Management,** Vol. 26, No 1, January 1994, pp. 44-47.

Costanza, R. (Editor) (1991) *Ecological Economics: The sciences and Management of Sustainability*, Columbia University Press, New York.

Counsell, D. and King, B. (1995) *Implementation of environmental policy using the Eco-management and audit scheme for UK local govern*, **European Environment,** Vol. 5, No 4, July-August, pp. 106-111.

Crabbé, P. (1993) *Concilier l'histoire, l'écologie et l'économie*, **Ecodécision,** June 1993, pp. 27-30.

Creswell, J. (1994) *Qualitative & Quantitative approaches*, Sages Publications, London.

Criado, E. and Navarro, J.E.E. (1995) *General trends in Spanish ceramic and refractory industries*, **Industrial Ceramics,** Vol. 15, No 2.

Crouzet, P. and Leonard, J. (1995) *Les lacs de grands barrages en France et en Europe*, **Les données de l'environnement, ifen,** No 17, October 1995.

CTTC (1991) *Lettre du CTTC*, **Centre de Transfert des Technologies Céramiques,** January.

Cubbon, R.C.P. (1994) *The impact of environmental issues on the ceramic industry,* **Cookson Technical Bulletin,** No 6, pp. 3-4.

CWR (1996) *Growth and concentration in the sanitaryware sector,* **Ceramic World Review,** No 2/96, pp62-64.

d'Albis, J. and Romanet, J. (1985) *Laporcelaine de Limoges,* Massin Editeur, Limoges.

DAFSA (1995) *Produits en céramique,* DAFSA, Paris.

De Gioia, R., Fiori, C., Tognana, A. and Vincenzini, P. (1995) *The Italian industry of traditional ceramics,* **Industrial Ceramics,** Vol. 5, No 2.

De Ruyt, J. (1992) *L'acte unique Européen,* Université de Bruxelles, Collection Etudes Européennes.

Deketelaere, K. (1996) *European environmental tax policy reconsidered,* **European Environment,** Vol. 6, pp. 114-118.

Delaunay, F. (1997) *French companies wake up to environmental management,* **Décision Environnement,** January, pp. 15-16.

Delors, J. (1993) *Delors raises prospect of greater EC involvement in environment issues,* **Industrial Waste Management,** Vol. 3, Issue 11, p6.

Dente, B. (Ed) (1995) *Environmental policy in search of new instruments,* Kluwer Academic Publishers, The Netherlands.

Department of the Environment (1992) *Economics instruments and recovery of resources from waste,* HMSO, London.

Dillman, D. (1978) *Mail and telephone surveys: the total design method,* John Wiley, New York.

Dilts, J. and Prough, G. (1989) *Strategic options for environmental management: a comparative study of small vs large enterprises,* **Journal of Small Business Management,** July, pp. 43-58.

Directorate General XI (1993) *Administrative Structures for Environmental Management in the European Community,* Commission of the European Communities, DG XI.

Dobré, M. and Hammer, B. (1995) *Opinion publique et environnement: une préoccupation toujours forte mais pas à n'importe quel prix,* **Les données de l'environnement, ifen,** No 14, May 1995.

Dobré, M. and Lavoux, T. (1994) *Environnement: quelles formations pour quels emlois?,* **Les données de l'environnement, ifen,** No 10, December 1994.

Dobré, M. and Piveteau, V. (1995) *L'espace vert, reflet des inégalités urbaines,* **Les données de l'environnement, ifen,** No 13, April 1995.

DoE (1989) *Sustaining our common future,* Department of the Environment, London.

Donati, N. and Lagadec, O. (1994) *L'environnement est-il un bon vecteur d'insertion?,* Ademe, September 1994.

Doyle, P. (1994) *Marketeing management & strategy*, Prentice Hall, London.

E.E. (1995) *Policy review: 5th environmental action programme*, **European Environment,** Vol. 5, pp. 61-62.

EEA (1996) *Environmental taxes: implementation and environmental effectiveness*, European Environment Agency, Copenhagen, 1996.

EFILWC (1996) *Environmental taxes & charges: national experiences & plans*, European Foundation for the Improvement of Living and Working Conditions, Dublin.

Emmott, N. (1997) *The theory and practice of IPPC: case studies from the UK and Hungary*, **European Environment,** Vol. 7, pp. 1-6.

Ends (1994) *A fresh start on contaminated land*, **The Ends Report,** No 238, November 1994, pp. 3-21.

Ends (1994) *Ministers lower sights on recycling target*, **The Ends Report,** No 230, March 1994.

ENDS (1996) *Arguments over the landfill tax get down to the nitty-gritty*, **ENDS Report,** No 252, January, pp. 1-6.

Erskine, C. and Collins, L. (1996) *Eco-labelling in the EU: a comparative study of the pulp and paper industry in the UK and Sweden*, **European Environment,** Vol. 6, pp. 40-47.

Europe environment (1994) *Update of community legislation on waste*, **Europe environment,** Supplement, No 443, November 22nd 1994.

Europe environment (1994) *European commission: environmental matters in the XXIIIrd competition report*, **Europe environment,** Supplement, No 433, May 31st 1994.

Europe environment (1995) *European parliamant: report on environmental indicators and green accounting*, **Europe environment,** Supplement No 463, October 17th 1995.

Europe environment (1996) *Proposal to review the fifth action programme on the environment*, **Europe environment,** Supplement, No 470, February 6th 1996.

Europe environment (1996) *Progress report on the Vth environment action programme*, **Europe environment,** Supplement, No 469, January 23rd 1996.

Evertson, C. and Green, J. (1985) *Observation as inquiry and method. In M.C. Wittrock (Ed.)*, **Handbook of research on teaching.,** Macmillan, New York.

Fait, C. (1995) *European standard for sanitaryware*, **European Ceramic Society, 4th Euro-ceramics conference,** 2-6 October, Vol.10, pp. 173-175.

Faucheux, S. and Noël, J.F. (1995) *Economie des ressources naturelles et de l'environnement*, Armand Colin, Paris.

Faucheux, S., Pearce, D.W., Proops, J.L.R. (1995) *Models of sustainable development: complementary or exclusive approaches*, Edward Elgar, London.

Finance North (1994) *When it's time to take advice*, **Finance North,** January - February 1994.

Finance North (1994) *Getting in on the environmental act*, **Finance North,** January - February 1994.

Fink, A. (1995) *How to sample in surveys*, Sage publications, London.

Fink, A. & Kosecoff, J. (1985) *How to conduct surveys: a step-by-step guide*, Sage publications, Beverly Hills.

Fisher, K. and Schot, J. (1993) *Environmental strategies for industry*, Island Press, Washington, D.C.

Fleet, B. (1993) *Measuring the true costs of industrial pollution control*, **Ecodécision,** September, 1993.

Foddy, W. (1993) *Constructing questions for interviews and questionnaires*, Cambridge University Press, Cambridge.

Fontaine, G. (1993) *Tuiles et briques : les exportations à la rescousse*, **Le moniteur,** October 8, p89.

Fontelle, J.P., Boiret, P. and Desaulty, D. (1995) *La géographie des émissions polluantes par départements*, **Les données de l'environnement, ifen,** No 12, February - March 1995.

Forestier, N. (1994) *Arts de la table: le chambardement*, **Le Figaro,** September 2nd 1994, p11.

Fowler, F. (1988) *Survey research methods*, Sage publications, London.

Francis, C. (1994) *Technology and the French connection*, **Water Services,** January 1994, pp. 30-32.

Franke, J. and Watzold, F. (1995) *Political evolution of EMAS: perspectives from the EU, national governments and industrial groups*, **European Environment,** Vol.5, No 6, Nov-Dec, pp. 155-159.

Freeman, A.M. (1979) *The benefits of environmental improvement: theory and practice*, Johns Hopkins University Press, Baltimore, MD.

Frey, J. and Mertens-Oishi, S. (1995) *How to conduct interviews by telephone and in person*, Sage Publications, London.

Fumarola, G. (1995) *Use of industrial wastes in the brick production - air pollution aspects*, **European Ceramic Society, 4th Euro-ceramics conference,** 2-6 October, Vol.12, pp. 47-52.

Gabel, H. and Sinclair-Désgagné, B. (1994) *From market failure to organisational failure*, **Business Strategy and the Environment,** Vol. 3 Part 2 Summer 1994, pp. 50-58.

Gay, P.A. (1992) *Les fragiles porcelainiers de Limoges*, **Le Monde,** 14 July, p15.

Georg, S. (1994) *Regulating the environment: changing from constraint to gentle coercion*, **Business Strategy and the Environment,** Vol. 3, Part 2, Summer 1994, pp. 11-20.

Ghewy, X., Rouillé, G. and Thauvin, P. (1995) *En 1993, les décharges restaient la destination principale des déchets*, **Les données de l'environnement, ifen,** No 18, November - December 1995.

Gibb, A. and Davis, L. (1990) *In pursuit of the development of growth models of the small business*, **International Small Business Journal,** Vol. 9, No 1, pp. 15-31.

Giraud, H. (1995) *L'eau pomme de discorde*, **Les Echos,** 21st December 1995, p.19.

Glachant, M. (1994) *The setting of voluntary agreements between industry and government: bargaining and efficiency*, **Business Strategy and the Environment,** Vol. 3, Part 2, Summer 1994, pp. 43-49.

Glachant, M. (1994) *The setting of Voluntary Agreements between industry and government: bargaining and efficiency.*, **Business Strategy and the Environment,** Vol. 3, No 2, pp. 43-49.

Glachant, M. (1995) *The regulatory Processes in Packaging Recycling:cooperation between industry&regulatory authorities*, ERIC Report for the European Commission (DGXII/D-5), CERNA, Paris.

Glaser, B. and Strauss, A. (1967) *The discovery of grounded theory*, Aldine, Chicago.

Gomez-Lobo, A., Hamilton, K., Young, C. E. (1993) *Three essays on sustainable developement*, CSERGE, London.

Gore, A. (1993) *Earth in the balance : Ecology and the human spirit*, Penguin, New York.
Gouldson, A. (1996) *Policy review*, **European Environment,** Vol. 6, pp. 210-211.

Gouldson, A. (1996) *Review of the 5th environmental action programme*, **European Environment,** Vol. 6, pp. 102-103.

Guizol, C. (1995) *The French heavy clay ceramics market and manufacturing technologies*, **Tile & Brick International,** No 3, pp. 208-211.

Gummer, J. (1994) *The economy and the environment*, NatWest Lecture, 21st April 1994.

Gummer, J. (1994) *UK environmental & waste management technology*, **Pollution Prevention,** Vol. 4, Issue 3, June 1994, pp. 24-32.

Gunningham, N. (1995) *Environment, self-regulation and the chemical industry: Assessing Responsible care*, Australian Center for Environmental Law, Environmental Law and Policy Papers.

Hall, C.P. (1992) *The impact of environmental legislation on the ceramics industry*, **Paper presented at the Institute of Ceramics course,** May 26th 1992, Stoke-on-Trent.

Hamilton, K. (1993) *Sustainable development, the hartwick rule and optimal growth*, CSERGE, London.

Harou, P., Daly, H. and Goodland, R. (1994) *Environmental sustainability through project appraisals*, **Sustainable development,** Vol. 2, Part 3, Winter 1994.

Harris, M. (1993) *UK policy on contaminated land*, **Chemistry & Industry,** August 16th 1993.

Haznews (1993) *France passes Class 1Landfill laws*, **Haznews,** No 63, June 1993, p10.

Haznews (1994) *Cheap and Nasty landfill*, **Haznews,** No 75, June 1994, p.11.

Haznews (1994) *Europe's environmental market: factors & finance*, **Haznews,** No 79, October 1994, p18.

Hedrick, T., Bickman, L. and Rog, D. (1993) *Applied research design: a practical guide*, Sage Publications, London.

Heilbroner, R. (1980) *The worldly philosophers: the lives, times and ideas of the great economic thinkers*, Touchstone Book, 5th Edition, New York.

Hemming, C. (1992) *Business success from seizing the environmental initiatives*, Technical communications Ltd, London.

Henerson, M., Morris, L. and Fitz-Gibbon (1978) *How to measure attitudes*, Sage publications, London.

Her Majesty's Inspectorate of Pollution (1992) *Chief inspector's guidance to inspectors: ceramic processes*, HMSO, London.

Hildebrandt, E. and Schmidt, E. (1994) *Industrial Relations and Environmental Protection in Europe*, European Foundation for the Improvement of Living and Working Conditions, Luxembourg.

Hors-Série (1995) *Europe: le défi de l'eau*, **Décision Environnement,** May - June 1995.

Hutchinson, A. and Chaston, I. (1994) *Environmental Management in Devon and Cornwall's SME sector*, **Business Strategy and the Environment,** Vol. 3, Part I, Spring 1994, pp.15-22.

Hutchinson, C. (1992) *Corporate Strategy and the Environment*, **Long Range Planning,** 25 (4), pp. 9-21.

ICC Information Group Ltd (1995) *Financial Survey: Ceramics Manufacturers*, ICC Business Publications, Hampton, Middlesex.

Ifo Institut (1994) *Inventory on Subsidies for environmental purposes*, Ifo Institute for Economic Research, Munich.

Industrial Environmental Management (1995) *No friends for chancellor's landfill levy*, **Industrial Environmental Management,** Vol. 5, Issue 8, January 1995, pp. 5-8.

Industrial Waste Management (1994) *Contaminated land review enters final phase*, **Industrial Waste Management,** Vol. 5, Issue 11, April 1994, p5.

Industrial Waste Management (1994) *Still awaiting judgement on 7750*, **Industrial Waste Management,** Vol. 5, Issue 11, April 1994, p38.

Industrial Waste Management (1994) *Producers clean up their landfill*, **Industrial Waste Management,** Vol. 5, Issue 4, September 1994, p6.

Industrial Waste Management (1994) *Drive to boost profits by saving waste,* **Industrial Waste Management,** Vol. 5, Issue 3, August 1994, p5.

INSEE & Banque de France (1995) *Les comptes des services,* INSEE, Paris.

Institute for European Environmental Policy (1994) *The realization of Dutch Environmental Policy Objectives through EU and OECD Policies,* IEEP, Arnhem, the Netherlands.

Irwin, A. and Hooper, P.D. (1992) *Clean technology, successful innovation and the greening of industry: a case study analysis,* **Business Strategy and the Environment,** 1 (2), pp. 1-10.

Italian Ceramic Society (1995) *Solid Waste : the current situation and future prospects,* **European Ceramic Society, 4th Euro-ceramics conference,** 2-6 October, Vol.11, pp. 199-206.

Italian Ceramic Society (1995) *Rational use of water in ceramic tile processing,* **European Ceramic Society, 4th Euro-ceramics conference,** 2-6 October, Vol.11, pp. 189-197.

Jacobs, M. (1991) *The green economy: environment, sustainable developement andthe politics of the future,* Pluto Press, London.

James, P. (1992) *The Corporate Response,* **in Greener Marketing (Charter, M. (ed)),** Greenleaf Publishing, Sheffield.

James, P. (1994) *Business environmental performance measurement,* **Business Strategy and the Environment,** Vol. 3, Part 2, Summer 1994, pp. 59-66.

Joyce, F. (1989) *Market opportunities for environmental protection technologies in europe for 1992,* **IFEST conference,** October 13th 1989.

Kemp, R. and Soete, L. (1992) *The greening of technological progress - an evolutionary perspective,* **Futures,** June, pp. 437-457.

Ketola, T. (1993) *The seven sisters: Snow whites, dwarfs or evil queens?,* **Business Strategy and the Environment,** vol 2 (3), pp.22-33.

Kiss, A. (1992) *Le droit international de l'environnement,* **Problèmes politiques et sociaux, La documentation Française,** No 672, January 24th 1992.

Knight, P. (1994) *Europe's growth slow, steady ans stratified,* **Tomorrow,** Vol. 4, No 3, July - September 1994, pp. 50-51.

Kohn, R.E. (1994) *Do we need the Entry-Exit condition on polluting firms,* **Journal of Environmental Economics and Management,** Vol. 27, No 1, July 1994.

Konijn, H. S. (1973) *Statistical theory of sample survey design and analysis,* North-Holland Publishing, London.

Kotler, P. (1991) *Marketing and management: analysis, planning, implementation, and control,* Prentice-Hall International, London.

L'industrie céramique (1992) *L'industrie céramique en France,* **L'industrie céramique,** No 872, 6/92.

L'industrie céramique (1992) *Les traitements d'eaux dans l'industrie céramique*, **L'industrie céramique,** No 874, 9/92.

L'industrie Céramique & Verrière (1995) *Lindustrie Française du carreau céramique*, **L'industrie Céramique & Verrière,** No 902, 3/95, p165.

L'industrie de la Céramique (1990) *Le développement industriel des céramiques nouvelles dans le monde*, **L'industrie de la Céramique,** March, pp. 30-37.

laramée, V. (1995) *Identifying contaminated land: a very political list*, **Environment Business Magazine,** June 1995, p15.

Lascoumes, P. (1994) *L'Eco-pouvoir: environnement et politiques*, Edition la découverte, Paris.

Lavallée, A. (1993) *Le paradoxe de l'économie et l'écologie*, **Ecodécision,** June 1993, pp. 45-47.

Le Doussal, H. (1995) *State of European standardization in the field of refractory products*, **Industrial Ceramics,** Vol. 15, No 3, pp. 168-170.

Le Sech, A. (1995) *Status of traditional ceramics in France*, **Industrial Ceramics,** Vol. 15, No 2, pp. 74-76.

Leake, J. (1994) *ISO 9000 Certification for the ceramic industry*, **Turkish Ceramic Society, International Ceramic Congress,** 24-28 October, Vol. 1, pp. 43-45.

Lee, B.W. and Green, K. (1994) *Towards commercial and environmental excellence: a green portfolio matrix*, **Business Strategy and the Environment,** Vol. 3, Part 3, Autumn 1994, pp. 1-9.

Leedy, P. (1985) *Practical Research*, Macmillan Publishing Company, New York.

Leek, F. and de Savornin Lohman, A. (1996) *Charges in water quality management in the EU*, **European Environment,** Vol. 6, pp. 33-39.

LeGuin, U. (1986) *Always coming home*, Bantam, London.

LEK and DRI Europe (1994) *Panorama of EU industry 1994*, European Commission, Eurostat.

Lévêque, F. (Ed) (1996) *Environmental policy in Europe*, Edward Elgar Publishing Ltd, Cheltenham.

Lévêque, F. (Ed) (1996) *Environmental policy in europe: industry, competition, and the policy process*, Edward Elgar, Cheltenham, UK.

Little, A.D. (1991) *Seizing strategic environmental advantage*, Centre for Environmental Assurance, London.

Liverani, G. (1959) *Premières porcelaines européennes: les essais des Médicis*, **Cahiers de la Céramique,** No 15, p141.

Lucas, T. (1990) *Céramiques techniques: fiabilité renforcée*, **L'usine nouvelle,** June, pp. 15-23.

Maddox, B. (1994) *Politics aheah of science*, **Financial Time,** February 2nd 1994, p.5.

Management Guide (1994) *Solid waste management*, **Environment Business Magazine,** July - August 1994.

Management Guide (1995) *Solid Waste Management Guide*, **Environment Business Magazine,** June 1995, pp. 47-58.

Mark, M. (1993) *Looking back at the ceramic industry in 1993*, **Interceram,** Vol. 42, No 6, pp. 363-366.

Marshall, C. and Rossman, G. (1989) *Designing qualitative research*, Sage Publications, London.

Matharan, X. (1995) *Les principaux textes français et internationaux concernant le droit des déchets industriels.*, **Décision Environnement,** No 37, Juin 1995, pp. 42-43.

Maurisset, P. (1995) *Tendances du marché des équipements sanitaires en Europe*, **L'industrie Céramique & Verrière,** No 907, Septembre 95, pp. 572-573.

Mc Cormick, J. (1991) *British politics and the environment*, Earthscan publications Ltd, London.

Mc Laren, D. (1996) *Achieving sustainability through the concept of "environmental space" : a trans-european project*, **European Environment,** Vol. 6, pp. 69-76.

McGrew, A. (1993) *The political dynamics of the 'new' environmentalism*, **In: Business and the Environment - Implications of the new Environmentalism (Ed. D. Smith),** Paul Chapman Publishing, London, pp. 12-26.

McIntyre, O. (1994) *the guiding principles of European community environmental law-making*, **European Environment,** Vol. 4, Part 2, April 1994, pp. 23-31.

McKinsey & Company (1991) *The corporate response to the environmental challenge*, McKinsey & Company, Amsterdam.

Mellor, M. (1992) *Breaking the boundaries*, Virago, London.

Meredith, S. and Wolters, T.J.J.B. (1994) *Proactive environmental strategies in the paint and coatings industry in the UK and the Netherlands*, TNO Report, Centre for Technology and Policy Studies, Apeldoorm.

Metzger, B., Shopley, J. and Edson, D.V. (1993) *Europe's markets for environmental goods and services*, **Environmental Information Digest,** August 1993, pp. 4-12.

Miles, M. A. and Huberman, A. M. (1994) *Qualitative data analysis*, Sage publications, London.

Ministère de l'environnement (1994) *Mesure destinées à développer l'emploi dans le secteur de l'environnement*, **Ministère de l'environnement note,** February 1994.

Mitchell, D. (1995) *Learning the hard way: the EC and the eco-label*, **European Environment,** Vol. 5, No 6, Nov-Dec, pp. 165-170.

Molenkamp, G.C. (1995) *De verzakelijking van het milieu: onomkeerbare ontwikkelingen in het bedrijfsleven*, KPMG, Den Haag.

Molitor, W. (1995) *L'industrie du sanitaire*, **L'industrie Céramique & Verrière,** No 900, 1/95, pp. 50-51.

Moretti, A. and Teisseri, S. (1995) *France: gradual growth*, **Ceramic World Review,** No 16/95, pp. 70-90.

Morris, C. (1993) *Quantitative approaches in business studies*, Pitman publishing, London.

Nath (Editor) (1991) *International Conference on Environmental Pollution*, European Centre for Pollution research, Indersciences Enterprises Ltd.

Norcia, V. (1993) *Environmental Performance and Competitive Advantage in Canada's paper Industry*, **Business Strategy and the Environment,** 2 (4), pp. 1-9.

Norgaard, R. B., Howarth, R. B. (1993) *Resolving economic and environmental perspectives on the future*, JAI Press Inc., London.

O'Riordan, T. (1994) *Environmental taxation*, CSERGE, London.

OECD (1989) *Environmental policy benefits: monetary valuation*, OECD, Paris.

OECD (1991) *Environmental policy: how to apply economic instruments*, OECD, Paris.

OECD (1992) *The OECD environment industry: situation, prospects and government policies*, **Paper presented at an OECD conference on Environmental Policies and Industrial Competitiveness,** February 18th 1992, Paris.

OECD (1994) *Managing the environment: the roles of economic instruments*, OECD, Paris.

OECD (1995) *Environmental taxes in OECD countries*, OECD, Paris.

OECD (1995) *OECD Economic outlook*, OECD, No 58, Paris.

Offrir (1995) *La faïence et la porcelaine: les grandes dames des arts de la table*, **Offrir,** No 322, pp. 9-13.

Offrir (1995) *Faïencerie de Charolles: plus que centenaire et poutant si jeune*, **Offrir,** No 322, pp. 22-23.

Offrir (1995) *La vérité sur l'état du luxe... en France*, **Offrir,** No 327, pp. 43-46.

Offrir, (1995) *Arts de la table: un secteur en mutation*, **Offrir,** No 326, pp.14-17.

Oppenheim, A. (1966) *Questionnaire design and attitude measurement*, Heinemann Educational Books, London.

Oppenheim, A. N. (1992) *Questionnaire design, interviewing and attitude measurement*, Pinter Publishers Limited, London.

Paleokrassas, Y. (1993) *EC environmental policy remains reactive and robust*, **Pollution Prevention,** Vol. 3, Issue 5, October 1995, pp. 13-17.

Palvarini, A. (1995) *The modern evolution in quality management and implementation of certified quality systems*, **European Ceramic Society, 4th Euro-ceramics conference,** 2-6 October, Vol.10, pp. 167-171.

Panorama (1995) *Panorama 95*, European Commission, Brussels.

Passerini, P. (1995) *Certification procedures of brick production companies*, **European Ceramic Society, 4th Euro-ceramics conference,** 2-6 October, Vol.12, pp. 33-41.

Pearce, D (1993) *Economics values and the natural world*, Earthscan Publications, London.

Pearce, D. (1992) *Towards sustainable development through environmental assessment*, CSERGE, London.

Pearce, D. (1993) *Blueprint: measuring sustainable development*, Earthscan Publications Limited, London.

Pearce, D. (1994) *The corporate sector and values for the environment*, CSERGE, PA 94-03.

Pearce, D. Turner, K. (1992) *Packaging waste and the Polluter Pays Principle - a taxation solution*, CSERGE, London.

Pearce, D., Atkinson, G. (1992) *Are national economies sustainable? Measuring sustainable development*, CSERGE, London.

Pearce, D., Barbier, E. and Markandya, A. (1990) *Sustainable Development: Economics and Environment in the third World*, Earthscan Publications Ltd, London.

Pearce, D., Markandya, A., Barbier, E. B. (1989) *Blueprint for a green economy*, Earthscan Publications Limited, London.

Pearce, D.W., Atkinson, G.D. and Dubourg, W.R. (1994) *The economics of sustainable development*, **Annual Review of Energy and the Environment,** Vol. 19, pp. 457-474.

Perry, C. (1986) *Growth Strategies for Small Firms: principles and case studies*, **International Small Business Journal,** Vol. 5, No 2, pp. 17-25.

Phillips, A. (Ed) (1975) *Promoting competition in regulated markets*, The Brookings Institution, Washington.

Pigou, A.C. (1946) *The economics of welfare*, Mac Millan, Fourth edition, London.

Pollution Prevention (1993) *Landfill directive compromise reached by EC and EP*, **Pollution Prevention,** Vol. 3, Issue 2, April 1993, p15.

Porter, M. (1991) *America's green strategy*, **Scientific American,** April.

Porter, M.E. (1985) *Competitive Advantage*, The Free Press, New York.

Powell, J.C. and Brisson, I. (1994) *The assessment of social costs and benefits of waste disposal*, CSERGE, WM 94-06.

Prieur, C. (1995) *Réduction des rejets polluants dans l'environnement des usines céramiques en Europe*, **L'industrie Céramique & Verrière,** No 903, 4/95.

Problèmes Economiques (1994) *Environnement,* **Problèmes Economiques,** No 2364, February 23rd 1994.

Rado, P. (1988) *An introduction to the technology of pottery,* Pergamon Press, 2nd edition, Oxford.

Rae, A. and Steiger, R. (1994) *Green, ceramics manufacturing,* **American Ceramic Society Bulletin,** Vol. 73, No 7, July 1994.

République Française (1995) *Plan départemental d'élimination des déchets ménagers et assimilés,* **Unpublished article,** June 1995.

Rice, G. (1983) *Strategic decision making in small businesses,* **Journal of General Management,** Vol. 9, No 1, pp. 58-65.

Riecken, W., Boruch, R., Campbell, D., Caplan, N., Glenan, T., Pratt, J., (1974) *Social experimentation: a method for planning and evaluation social intervention,* Academic Press, New York.

Rist, R. (1979) *On the utility of ethnographic case studies for federal policy,* **Presented at the American Educational Research Association annual meeting,** San Francisco.

Roberts, P. (1992) *Business and the environment: an initial review of the recent litterature,* **Business Strategy and the Environment,** Vol. 1, Part 2, Summer 1992, pp. 41-50.

Robins, N. (1996) *Greening European foreign policy,* **European Environment,** Vol. 6, pp. 173-182.

Rogelin, T. (1995) *Du concret pour les salons de janvier,* **Offrir,** No 329, pp. 33-35.

Roome, N. (1992) *Developing environmental management strategies,* **Business Strategy and the Environment,** Spring, Vol. 1, Part 1, pp. 11-24.

Roome, N. (1994) *Business Strategy, R&D Management and Environmental Imperative,* **R&D Management,** 24, pp. 65-82.

Rose, J. (1994) *Keeping the lid on waste,* **The Waste Manager,** July - August 1994.

Sagoff, M. (1988) *Some problems with environmental economics,* **Environmental Ethics,** Vol. 10, Spring 1988.

Sale, K. (1985) *Dwellers in the land,* **,** Sierra Club.

Sapsford, R. and Jupp, V. (Eds) (1996) *Data collection and analysis,* Sage Publications, London.

SBRC (1992) *The state of British enterprise,* Small Business Research Centre, University of Cambridge.

Schmidt, G. (1995) *L'industrie céramique Allemande,* **L'industrie Céramique & Verrière,** No 900, 1/95.

Schmidt, G., Fiebiger, W. and Reh, H. (1995) *The classical ceramics industry in Germany,* **Industrial Ceramics,** Vol. 15, No 2, pp. 67-73.

Scholl, G. (1994) *Product-oriented environmental policy in Europe*, **European Environment,** Vol. 4, Part 5, September-October 1994, pp. 8-13.

Scholl, G. (1996) *Sustainable product policy in Europe*, **European Environment,** Vol. 6, pp. 183-193.

Schulteiss, D. (1995) *L'industrie céramique en l'an 2000 - Marchés, produits, technologies*, **L'industrie Céramique & Verrière,** No 901, 2/95, p113.

Selkirk, K. E. (1978) *Rediguide 4 : sampling*, Nottingham University School of Education, Nottingham.

SESSI (1995) *La situation de l'industrie (tome 1)*, Ministère de l'Industrie, de la Poste et des Télécommunications, Paris.

SESSI (1995) *La dispersion des performances des entreprises*, Ministère de l'Industrie, de la Poste et des Télécommunications, Paris.

SESSI (1996) *Bulletin mensuel de statistique industrielle*, SESSI, No 256, Janvier 1996.

Sezzi, G. (1995) *World production and consumption of ceramic tiles*, **Ceramic World Review,** No 16/95, pp. 36-39.

Shrivastava, P. and Scott, H.I. (1992) *Corporate self-greenewal: strategic responses to environmentalism*, **Business Strategy and the Environment,** 1 (3), pp. 9-20.

Sibieude, C. and Sibieude, T. (1993) *Les rouages économiques de l'environnement*, Les éditions de l'atelier, Paris.

Sieber, S. (1973) *The integration of field work and survey methods*, **American Journal of Sociology,** 28, pp. 1335-1359.

Simpson, A. (1991) *How the environment, ethics and politics are reshaping strategies*, The Economist Publications, London.

Smith, D. (1990) *Managing for a better environment*, **Chemistry in Britain,** August, p758.

Smith, D. (1992) *Strategic Management and the Business Environment: What lies beyond the rhetoric of Greening?*, **Business Strategy and the environment,** Vol. 1, Part 1, pp. 1-9.

Smith, J. (1983) *Quantitative versus qualitative research: an attempt to clarify the issue*, **Educational Researcher,** March, pp. 6-13.

Somers, F. (1994) *European Community Economies*, Pitman Publishing, London.

Souet, P. (1992) *Waste Management in France*, **ADEME,** April 7th 1992.

Stefanov, S. (1995) *The world market of Ceramics tiles*, **Tile & Brick Int.,** Vol. 11, No 4, pp. 314-319.

Steger, U. (1988) *Umweltmanagement -Erfahrungen und instrumente einer umweltorientierten Unternehmensstrategie*, **Frankfurter Allgemeine Zeitung,** Frankfurt am Main/Gabler, Wiesbaden.

Stern, A. (1991) *The case of the environmental impasse,* **Harvard Business Review,** May/June.

Stigler, G.J. (1971) *The theory of economic regulation,* **Bell Journal of Economic and Management Science,** Vol. 2, No 1, Spring, pp. 3-21.

Stikker, A. (1992) *Sustainability and Business Management,* **Business Strategy and the Environment,** 1 (3), pp. 1-8.

Storey, D. (ed) (1983) *The small firm: an international survey,* Croom Helm, Australia.

Storey, D., Keasey, K., Watson, R. and Wynarezyk, P. (1987) *The performance of small firms,* Croom Helm, Australia.

Strachan, P., Haque, M., McCulloch, A. and Moxen, J. (1997) *The Eco-management and audit scheme: recent experiences of UK participating organizations,* **European Environment,** Vol. 7, pp. 25-33.

Supplement to Environment Business (1994) *Environmental Management Systems & Auditing,* **Environment Business Magazine,** July 1994, pp. 1-20.

Supplement to Environment Business (1994) *European Community environmental policy guide,* **Environment Business Magazine,** June 1994, pp. 1-8.

Supplement to Environment Business (1995) *EU environmental policy guide,* **Environment Business Magazine,** June 1995, pp. 1-8.

Syngellakis, A. (1995) *Enforcement of European Union environmental legisaltion,* **European Environment,** Vol. 5, No 5, September-October, pp. 123-127.

Taylor, S.R. (1992) *Green Management: the next competitive weapon,* Futures Sept, pp. 669-680.

Technology guide (1994) *Contaminated Land : Assessment & Remediation,* **Environment Business Magazine,** January - February 1994, pp. 13-23.

Technology guide (1994) *Air pollution abatement and treatment,* **Environment Business Magazine,** September 1994, pp. 13-23.

Technology guide (1994) *Effluent and wastewater treatment,* **Environment Business Magazine,** June 1994, pp. 13-28.

Technology guide (1995) *Contaminated land : Assessment & Remediation,* **Environment Business Magazine,** January - February 1995, pp. 21-32.

Telster, L.G. (1985) *Co-operation, competition, and efficiency,* **Journal of Law and Economics,** Vol. 28, pp.271-295.

Teman, D. (1992) *Economie et environnement,* **Ecoflash,** No 74, Decenber 1992.

Tenaglia, A. (1992) *Re-use of wastes,* **Ceramic Industries International,** October 1992, pp. 21-23.

Tenaglia, A. (1993) *Re-use of wastes from waste waters of the ceramic industry,* **L'industrie céramique,** No 879, 2/93, pp. 111-115.

The Economist (1997) *Green taxes: Brown's bite*, **The Economist,** May 24th, p3.

The World Commission on Environment and Development (WCED) (1987) *Our common Future*, Oxford University Press, Oxford.

Theys, J. (1991) *Environnement et gestion de la planète*, **Cahier Français,** No 250, March - April 1991.

Thomas, C. (1992) *The environment in international relations*, The royal institute of International Affairrs, London.

Thomas, J and Lavoux, T. (1995) *Comparaison France-Allemagne: réduction du CO2 dans les années 80: l'efficacité energétique à la clé*, **Les données de l'environnement, ifen,** No 15, June - Jully 1995.

Thomas, K. C. (1978) *Rediguide 7 : attitude assessment*, Nottingham University School of Education, Nottingham.

Timellini, G., Busani, G., Palmonari, C. (1995) *The handbook "Ceramic tile and environment"*, **European Ceramic Society, 4th Euro-ceramics conference,** 2-6 October, Vol.11, pp. 207-217.

Tirole, J. (1994) *The internal organisation of government*, **Oxford Ecconomic Papers,** No 46, pp.1-29.

Turner, K. (Editor) (1993) *Sustainable Environmental Economics and Management: Principle and Practice*, Belhaven Press, New York.

Turner, R. K., Pearce, D. W. (1992) *Sustainable development: ethics and economics*, CSERGE, London.

Van Muijen, M.L. (1995) *Strengthening EU environmental policy implementation by fine tunig*, **European Environment,** Vol.5, No 6, Nov-Dec, pp. 160-164.

Van Someren, T.C.R. (1995) *Sustainable Development and the firm: organisational innovations and environmental strategy*, **Business Strategy and the Environment,** Vol. 4, No 1, January - March 1995, pp. 23-33.

Vandermerwe, S. and Oliff, M.D. (1990) *Customers drive corporations green*, **Long Range Plannig,** 23 (6), pp. 10-16.

Vivian, B. (1996) *Policy review: integrated pollution prevention and control*, **European Environment,** Vol. 6, pp. 34-36.

Von Boch, W. (1993) *Marketing of the ceramic tableware worldwide and in particular in the EC-Markets*, **Industrial Ceramics,** Vol. 13, No 1, pp. 24-27.

Waldrop, T. (1994) *Too few companies have a proactive attitude*, **Tomorrow,** Vol. 4, No 3, July - September 1994, pp. 42-43.

Walley, N. and Whitehead, B. (1994) *It's not easy being green*, **Harward Business Review,** May - June 1994, pp. 46-52.

Webb, A. (1990) *French policy on the environment*, The Economist Intelligence Unit, October 1990.

Weber, A. (1997) *The choice between emission taxes and output taxes under imperfect monitoring*, **Journal of Environmental Economics and Management,** No 32, pp. 51-64.

Weiss, R. and Rein, M. (1972) *The evaluation of broad-aim programs: difficulties in experimental design and an alternative.*, **in C. Weiss (Ed.) Evaluation action programs: reading in social action and education,** Allyn and Bacon, Boston.

Welch, R. (1997) *Local government and sustainable environment: European perspectives,* **European Environment,** Vol. 7, pp. 16-24.

Welford, R.J. (1992) *Linking quality and the environment,* **Business Strategy and the Environment,** 1, p.1.

Welford, R.J. (1994) *Cases in Environmental Management and Business Strategy,* Pitman Publishing, London.

Welford, R.J. (1995) *Environmental Strategy and Sustainable Developement: The corporate challenge of the 21st century,* Routledge, London.

Welford, R.J. (1996) *Corporate Environmental Management,* Earthscan Publications Ltd, London.

Welford, R.J. and Gouldson, A.P. (1993) *Environmental Management and Business Strategy,* Pitman Publishing, London.

Weller, P. (1992) *Development and current situation of the European brick and tile industry,* **Brick and Tile industry International,** ZI 12/92, pp. 621-625.

Weller, P. (1992) *Development and situation, in the European brick and clay tile industry,* **International Ceramics Journal,** No 56, November, pp. 31-34.

Wetenschappelijke Raad voor het Regeringsbeleid (WRR) (1992) *Milieubeleid: strategie, instrumenten en handhaafbaarheid,* WRR, Den Haag, rapportnr 41.

Whitaker, B. (1993) *Advisory Committee for Business and the Environment,* **ACBE Environmental Management Working Group,** The Business Case for the Environment.

Whitelock, E. (1993) *Towards a "green" enamel industry,* **The Vitreous Enameller,** Vol 44, No 1, pp. 11-16.

Wilkes, A. (1992) *The business implications of future EC environmental policy,* **Business Strategy and the Environment,** Vol. 1, No 3, Autumn 1992, pp. 43-51.

Wragg, E. C. (1978) *Rediguide 11 : conducting and analysing interviews,* Nottingham University School of Education, Nottingham.

Wright, M. (1994) *Special survey: the state of Europe's environment, 1994,* **Tomorrow,** No 1, January - March 1994, pp. 19-29.

Wright, M. (1994) *Not waiting for waste to waste away,* **Tomorrow,** Vol. 4, No 2, April - June 1994, pp. 76-77.

Yin, R. (1994) *Case study research: design and methods,* Sage Publications, London.
Youngman, M. B. (1978) *Rediguide 25 : Presenting research results,* Nottingham University School of Education, Nottingham.

Youngman, M. B. (1978) *Rediguide 12 : designing and analysing questionnaires,* Nottingham University School of Education, Nottingham.

APPENDICES

APPENDIX A : SOURCES

a. Official sources for France

- Services d'Etudes des Stratégies et des Statistiques Industrielles (SESSI)
  20, avenue de Ségur, 75353 PARIS 07 SP
  Tel: 00 33 1 43 19 41 07
- Institut National de la Statistique et des Etudes Economiques (INSEE)
  Tour Gamma A
  195, rue de Bercy, 75582 PARIS Cedex 12
  Tel: 00 33 1 41 17 50 50
- Assemblée Nationale
  126, rue de l'Université, 75355 PARIS cedex 07
  Tel: 00 33 1 40 63 60 00
- Sénat
  Palais du Luxembourg
  75291 Paris Cx 06
  Tel: 00 33 1 42 34 20 21
- Direction Générale des Douanes et Droits Indirects (DGDI)
  Centre des renseignements douaniers et statitisques
  23, rue de l'université, 75700 PARIS 07 SP
  Tel: 00 33 1 44 74 47 08
- Chambre de Commerce et d'Industrie de Paris
  27, avenue de Friedland, 75008 PARIS
  Tel: 00 33 1 42 89 70 00
- Ministère de l'environnement
  20, avenue de Ségur, 75302 PARIS O7 SP
  Tel: 0033 1 42 1920 21
- Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME)
  27, rue Louis Vicat, 75737 PARIS CX 15
  Tel: 00 33 1 47 65 20 00

b. Official sources for the United Kingdom

- Department of the Environment
  Eland House, Bressenden Place, London SW1E 5DU
  Tel: 0171 890 3000

- Joint Environmental Market Unit (JEMU)
  Department of Trade and Industry, 1 Victoria Street, London SW1H 0ET
  Tel: 0171 215 5000
- Central Statistical Office
  Government Offices, GreatGeorge Street, London SW1 P3AQ
  Tel: 0171 270 3000
- Environment Agency (formerly: National Rivers Authority)
  Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol BS12 4UD
  Tel: 01454 624 400
- National Ceramics Centre of Staffordshire University
  Tel: 01782 8294961
- CERAM Research (British Ceramic Research)
  Queens Road, Penkhull, Stoke-on-Trent, ST4 7LQ
  Tel: 01782 845431
- Institute of Ceramics
  Shelton House, Stoke-on-Trent, ST4 2DR
- Tableware Distributors Associations
  North Staffordshire
  Chamber of Commerce & Industry
  Commerce House, Festival Park, Stoke-on-Trent, ST1 5BE
  Tel: 01782 202 222

c. Trade unions and employer's federations for France

- Confédération des Industries Céramiques de France (CICF)
  15, avenue Victor Hugo, 75116 PARIS
  Tel: 00 33 1 45 00 18 56

N.B.: 10 trade federations representing almost all the French ceramics manufacturers are regrouped under The Confédération des Industries Céramiques de France:

- Syndicat National des Industries Françaises de Produits Réfractaires (SNIFPR)
- Syndicat Poudres, Fibres, Céramiques Techniques (SPFCT)
- Chambre Syndicale du Carreau Céramique de France (CSCCF)
- Association Française des Industries de Céramique Sanitaire (AFICS)
- Syndicat National de la Porcelaine Française (SNPF)
- Chambre Syndicale Française de la Céramique-Table et Ornementation
- Chambre des Industries Française de la Poterie (CIFP)

- Syndicat National des Producteurs de Matières Premières pour la Céramique et la Verrerie
- Syndicat National des Producteurs de Feldspaths Français
- Syndicat National des Producteurs de Kaolin

d. Trade unions and employer's federations for the United Kingdom

- British Ceramics Confederation
  Federation House, Stoke-On-Trent, ST4 2SA
  Tel: 01782 744631

- Craftsmen Potters' Association of Great Britain
  William Blake House, 7 Marshall Street, London W1V 1LP
  Tel: 0171 437 7605

e. Trade unions and employer's federations for Europe

- Cerame Unie
  Bureau de Liaison des Industries Céramiques Européennes
  18/24, rue des colonies, B100 Bruxelles
  Tel: 00 32 2- 511 30 12

N.B.: Cerame Unie also acts as an umbrella organisation to six other international trade federations which represent the interests of individual subsectors:

- Groupement des Producteurs de Carreaux Céramiques du Marché Commun (CMC)
- Fédération Européenne des Industries de Porcelaine et de Faïence de Table et d'Ornementation (FEPF)
- Groupement de Producteurs d'Isolateurs et de pièces Isolantes Minérales à usage Electrotechnique de l'EU (GROUPISOL)
- Fédération Européenne des Fabricants de Produits Réfractaires (PRE)
- Fédération Européenne des Fabricants de Céramiques Sanitaires (FECS)
- European Federation of Tile and Brick Manufacturers (TBE)

f. Technical magazines for France

- Industrie céramique et verrière
  14, rue Falguière, 75015 PARIS
  Tel: 00 33 1 42 73 03 59

- Revue de la céramique et du verre
  61, rue Marconi, B.P.3, 62280 VENDIN-LE-VIEIL
  Tel: 00 33 21 79 44 44

- Le moniteur des travaux publics et du bâtiment
  17, rue d'Uzès, 75002 PARIS
  Tel: 00 33 1 40 13 30 30
- Table et Cadeau
  25, rue Dagorno, 75012 PARIS
  Tel: 00 33 1 43 47 30 20

g. Technical magazines for the United Kingdom

- Ceramic Industries International
  Turret Group Plc
  Turret House, 171-173 High Street, Rickmansworth, Hertfordshire WD3 1SN
  Tel: 01923 777 000
- Global Ceramic Review
  BCPMMA
  POBox 28, Biddulph, Stoke-on-Trent, Staffordshire ST8 7AZ
- Tableware International
  International Trade Publications Ltd
  Queensway House, 2 Queensway, Redhill, Surrey RH11 1QS
  Tel: 01737 768 611

h. International technical magazines

- Ceramic World Review
  Via Circonvallazione Nord Est, 16511, 41049 Sassuolo (MO), Italy
  Tel: 0536 80 7121
- Ceramic Industry
  The magazine for refractories, traditional & advanced ceramic manufacturer
  Business New Publishing Co.
  755 W. Big Beaver Road, Suite 1000, Try, Mich 48084-4900
- Industrial Ceramics
  Techna Srl, Corso Mazzini 52, I-48018 Faenza, Italy
  Tel: 0546 224 61
- Tile & Brick International
  Verlag Schmid GMBH
  POBox 6609, D. 79042 Freiburg, Germany
  Tel: 49- 761 820 56
- American Ceramic Society Bulletin
  POBox 6136, Westerville, OH 43086-6136

APPENDIX B : LIST OF BRITISH AND FRENCH CERAMICS MANUFACTURERS

a. British companies

A. Bell & Co Ltd
Kingsthorpe Rd, Northampton, NN2 6LT
Tel: 01604- 712505 **Fax:** 01604- 721028 **Turnover:** £2 - £5M
Directors: J. E. Kirkham (MD)
Product Groups: 33-81.0
Employees: 51-100

A. G. Hackney & Co. Ltd
Royal Works, Westport Rd, Burslem, Stoke-on-Trent, ST6 4AP
Tel: 01782- 577575 **Fax:** N/A **Turnover:** £2 - £5M
Directors: N. L. Wright
Product Groups:
Employees: 101-250

A. T. Finney & Sons Ltd
Duchess China Works, Uttoxeter Rd, Longton, Stoke-on-Trent, ST3 1PB
Tel: 01782- 313061 **Fax:** N/A **Turnover:** £5 - £10M
Directors: G. R. Tams
Product Groups:
Employees: 101-250

Ace International
International House, 209 Walsall Rd, Perry Barr, Birmingham, B42 1BS
Tel: 0121- 356 3155 **Fax:** 0121- 356 3171 **Turnover:** Up to £0.250
Directors: N/A
Product Groups: 33- 70.0; 70.1; 82.0
Employees: 1-10

Adinolfi (Importers & Exporters) Ltd
Sintacel House, 43/45 High Rd, Bushey Heath, Hertfordshire, WD2 1EE
Tel: N/A **Fax:** N/A **Turnover:** £0.500 - £1M
Directors: A. Adinolfi
Product Groups:
Employees: 21-50

Aegis Advanced materials Ltd
Crundalls Farmhouse, Crundalls La, Bewdley, Worcs, DY12 1NB
Tel: 01299- 404153 **Fax:** 01299- 401468 **Turnover:** £0.500 - £1M
Directors: M. J. Kingsley (MD)
Product Groups: 33 -76.0; 74.0
Employees: 1-10

Alexander Russell P. L. C.
Tannochside Pk, Uddingston, Glasgow, G71 5PH
Tel: 01698- 811118 **Fax:** 01698- 816110 **Turnover:** £20 - £50M
Directors: S. R. Nicolson (Ch)
Product Groups: 33-82.0
Employees: 251-500

Aqua Blue Designs
24 Hazelmere Gdns, Worcester Park, Surrey, KT4 8AH
Tel: 0181- 3375401 **Fax:** 0181- 3303964 **Turnover:** Up to £0.250
Directors: R. A. Stempfer (MD)
Product Groups: 33- 81.0; 82.0
Employees: 1-10

Armour Plastic Ltd
Unit 13b, Pennywell Industrial Estate, Sunderland, Tyne & Wear, SR4 9EN
Tel: N/A **Fax:** N/A **Turnover:** £1 - £2M
Directors: J. Mulloy
Product Groups:
Employees: 21-50

Arthur Wood & Son (Longport) P.L.C.
Davenport St, Longport, Stoke-on-Trent, ST6 4LL
Tel: 01782- 577158 **Fax:** 01782- 835749 **Turnover:** £2 - £5M
Directors: A. F. Wood (MD)
Product Groups: 33-70.0,1
Employees: 101-250

Ashdale Pottery Products Ltd
Ashdale Ho, King Street, Longton, Stoke-on-Trent, ST3 1HD
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Directors: D. J. Colclough
Product Groups:
Employees: 1-10

Attwater Group
PO Box 39, Preston, PR1 1TA
Tel: 01772- 258245 **Fax:** 01772- 203361 **Turnover:** £2 - £5M
Directors: R. Attwater (MD)
Product Groups: 33-76.0
Employees: 21-50

Automated Transfers Ltd
Morley St, Hanley, Stoke-on-Trent, ST7 4HB
Tel: 01782- 267522 **Fax:** N/A **Turnover:** Up to £0.250
Directors: P. R. Capper
Product Groups:
Employees: 1-10

Ayshford China Ltd
Aysford St, Longton, Stoke-on-Trent, ST3 2PP
Tel: 01782- 42905 **Fax:** N/A **Turnover:** Up to £0.250
Directors: K. R. Alcock
Product Groups:
Employees: 1-10

Baggeridge Brick P. L. C.
Fir St, Sedgley, Dudley, W. Midlands, DY3 4AA
Tel: 01902- 880555 **Fax:** 01902- 880432 **Turnover:** £20 - £50M
Directors: The Hon P. A. Ward (Ch)
Product Groups: 33-81.0
Employees: 251-500

Barrats of Staffs Ltd
Royal Overhouse Pottery, Burslem, Stoke-on-Trent, ST6 4EE
Tel: 01782- 388477 **Fax:** N/A **Turnover:** £5 - £10M
Directors: S. S. Cohen
Product Groups:
Employees: 101-250

Beck Electronics Ltd
Main Cross Rd, South Denes, Great Yarmouth, Norfolk, NR30 2PP
Tel: 01493- 856282 **Fax:** 01493- 850169 **Turnover:** £2 - £5M
Directors: A. S. K. Franks (Ch)
Product Groups: 33-76.0
Employees: 101-250

Bilston & Battersea Enamels P.L.C
Unit16, Barton Park, Mount Pleasant, Bilston, W. Midlands, WV14 7LH
Tel: 01902- 353485 **Fax:** N/A **Turnover:** £2 - £5M
Directors: H. Gledhill
Product Groups:
Employees: 51-100

Blockleys Brick Ltd
Sommerfeld Rd, Trench Lock, Telford, Shropshire, TF1 4RY
Tel: 01952- 251933 **Fax:** 01952- 641900 **Turnover:** £5 - £10M
Directors: B. J. Taylor (Ch & MD)
Product Groups: 33-81.0
Employees: 101-250

Boddingtons Ltd (Tape Division)
Unit 10, Chelmsford Road Industrial Estate, Chelmsford Rd, Dunmow, Essex, CM6 1HF
Directors: R. M. Boddington (MD)
Product Groups: 33-81.0

Tel: 01371- 875101 **Fax:** 01371- 874906 **Turnover:** £2 - £5M **Employees:** 21-50

Border Fine Arts Co. Ltd **Directors:** J. H. Hammond
Townfoot, langholm, Dumfriesshire, DG13 0ET **Product Groups:**
Tel: 013873- 80977 **Fax:** N/A **Turnover:** £5 - £10M **Employees:** 251-500

Bovingdon Brickworks Ltd **Directors:** K. H. A. Smith (Ch)
Pudds Cross, Bovingdon, Hemel Hempstead, Herts, HP3 0NV **Product Groups:** 33-81.0
Tel: 01442- 833176 **Fax:** 01442- 834539 **Turnover:** £1 - £2M **Employees:** 21-50

Bridgewater Pottery Ltd **Directors:** P. M. H. Pollen
739 Fulham Rd, London, SW6 5UI **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250 **Employees:** 1-10

British Ceramic Tile Council Ltd **Directors:** J. E. Troth
Federation Ho, Station Rd, Stoke-on-Trent, ST4 2RT **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250 **Employees:** 1-10

Broadmoor Brickworks Ltd **Directors:** R. Hall (Ch)
Broadmoor Works, Whimsey, Cinderford, Glos, GL14 3JA **Product Groups:** 33-81.0
Tel: 01594- 822255 **Fax:** 01594- 826782 **Turnover:** £0.500 - £1M **Employees:** 21-50

Brush Wellman Ltd **Directors:** W. Taylor (MD)
4-5 Ely Rd, Theale Commercial Estate, Theale, Reading, RG7 4BQ **Product Groups:** 33 -76.0; 74.0
Tel: 0118- 9303733 **Fax:** 0118- 9303635 **Turnover:** £2 - £5M **Employees:** 21-50

Bullers P.L.C. **Directors:** J.W. Wilson
65 Slone Street, London, SW1X 9SH **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** £2 - £5M **Employees:** 251-500

Burgess & Leigh Ltd **Directors:** R.E.K. Leigh
Middleport Pottery, Port St, Burslem, Stoke-on-Trent, ST6 3PE **Product Groups:** 33-70.0,1
Tel: 01782- 577866 **Fax:** 01782- 575529 **Turnover:** N/A **Employees:** 51-100

C. W. Holdings Ltd **Directors:** C. M. Wolley
Cedar Ho, 698 Green Lanes, Winchmore Hill, London, N21 3RE **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** £0.500 - £1M **Employees:** 11-20

C.C.S. Electronics Ltd **Directors:** S. P. White (MD)
Delfa Ho, Haddenham Aerodrome Industrial Estate, Dollicot, Aylesbury, Bucks, HP17 8LJ **Product Groups:** 33 -74.0
Tel: 01844- 292191 **Fax:** 01844- 291799 **Turnover:** N/A **Employees:** 1-10

C.M.S. Colours Ltd **Directors:** P. Cartwright

Sneyd St, Sneyd Green, Stoke-on-Trent, ST6 2 NP
Tel: 01782- 202244 **Fax:** N/A **Turnover:** £2 - £5M
Product Groups:
Employees: 21-50
Directors: P. R. Capper

Capper Rataud Ltd
Morley St, Hanley, Stoke-on-Trent, ST1 4QF
Tel: 01782- 287521 **Fax:** N/A **Turnover:** £10 - £20M
Product Groups:
Employees: 101-250
Directors: G. McClean (MD)

Caradon Bathrooms Ltd
Lawton Rd, Alsager, Stoke-on-Trent, ST7 2DF
Tel: 01270- 879777 **Fax:** 01270- 413374 **Turnover:** £75 - £125M
Product Groups: 33-72.0
Employees: 1001-1500
Directors: E.C. Fenna (Ch)

Carron Bathrooms Ltd
Po Box 32, Falkirk, FK2 8DW
Tel: 01324- 638407 **Fax:** 01324- 611490 **Turnover:** £5 - £10M
Product Groups: 33-72.0
Employees: 51-100
Directors: C. J. Fox

Castle Crockery Ltd
Po Box 1, 27 Portland Terrace, Jesmond, Newcastle Upon Tyne, NE99 1XR
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10
Directors: S. Bell

Cathedral Tableware Ltd
Meir Park, Stoke-on-Trent, ST3 7AA
Tel: 01782- 315251 **Fax:** N/A **Turnover:** £20 - £50M
Product Groups:
Employees: 251-500
Directors: K. Berrisford

Central Ceramic Services Ltd
Unit 3, Etruscan Estate, Etruria Rd, Hanley, Stoke-on-Trent, ST4 4AQ
Tel: 01782- 202131 **Fax:** N/A **Turnover:** £0.500 - £1M
Product Groups:
Employees: 11-20
Directors: S. Rafferty

Ceramatech Ltd
Unit 16, Queen St, London, N17
Tel: 0181- 8854492 **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10
Directors: P. L. Dunn

Ceramic Bathrooms Distribution Ltd
Swan Meadow Mills, Swan Meadow Road, Wigan, Gtr Manchester, WN3 5BE
Tel: N/A **Fax:** N/A **Turnover:** £0.500 - £1M
Product Groups:
Employees: 21-50
Directors: R. Edwards

Ceramic Decals Ltd
The Chubb Buildings, Fryer Street, Wolverhampton, W. Midlands, WV1 1HT
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10
Directors: A. W. Tweedale

Ceramic Gas Cleaning P. L. C.
213 Upper Richmond Road West, London, SW14 8QT
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10

Ceramic Prints Ltd
George St, Armytage Rd Industrial Estate, Brighouse, W. Yorkshire, HD6 1PU
Tel: N/A **Fax:** N/A **Turnover:** £2 - £5M
Directors: A. J. Taylor
Product Groups:
Employees: 21-50

Ceramics Seals Ltd
Unit V Westwood Industrial Estate, Arkwright St, Oldham, OL9 9LZ.
Tel: 0161- 6272353 **Fax:** 0161- 6272356 **Turnover:** £1 - £2M
Directors: R.C. Pearson (MD)
Product Groups: 33 -76.0; 74.0
Employees: 11-20

Cerel Ltd
Unit 3, 12 Coventry Rd, Hinckley, Leics, LE10 0JT
Tel: 01455- 233977 **Fax:** N/A **Turnover:** Up to £0.250
Directors: G. Smith
Product Groups:
Employees: 1-10

Charnwood Forest Brick & Tile Works Ltd
Old Station Cl, Shepshed, Loughborough, Leics, LE12 9NJ
Tel: 01509- 503203 **Fax:** 01509- 507566 **Turnover:** £2 - £5M
Directors: P. J. Clift (MD)
Product Groups: 33- 81.0; 81.1
Employees: 21-50

Chatsworth Ceramics Ltd
Unit 1, Stud Farm Work Shop, Pilsley, Bakewell, Derbys, DE4 1UF
Tel: 01246- 582424 **Fax:** N/A **Turnover:** Up to £0.250
Directors: N/A
Product Groups:
Employees: 1-10

Chessell Pottery (I.O.W.) Ltd
Chessell Pottery, Chessell, Yarmouth, Isle-of-Wight, PO41 0UE
Tel: 01983- 78248 **Fax:** N/A **Turnover:** Up to £0.250
Directors: J. H. Francis
Product Groups:
Employees: 1-10

Chiltern Collection (1985) Ltd
Lorne Cresecent, Denton Holme, Carlisle, CA2 5XW
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Directors: J. H. Hammond
Product Groups:
Employees: 1-10

Churchill Fine Bone China Ltd
Grays Ho, Whieldon Rd, Stoke-on-Trent, ST4 4ST
Tel: 01782- 747555 **Fax:** 01782- 747565 **Turnover:** £5 - £10M
Directors: P.J. Coleman
Product Groups: 33-70.0,1;
Employees: 101-250

Churchill Tableware Ltd
Marlborough Works, High St, Tunstall, Stoke-on-Trent, ST6 5NZ
Tel: 01782- 577566 **Fax:** 01782- 810318 **Turnover:** £20 - £50M
Directors: A.D. Roper (MD)
Product Groups: 33-70.0,1; 33-72.0
Employees: 501-1000

Cladding Components Ltd
17 Trinity St, Leamington Spa, Warwicks, CV32 5RH
Tel: 01926- 420825 **Fax:** N/A **Turnover:** Up to £0.250
Directors: R. F. Phillips
Product Groups:
Employees: 1-10

Clover Leaf Group Ltd
Church Gresley, Swadlincote, Derbyshire, DE11 8EF
Directors: R. Smith (MD)
Product Groups: 33-70.0,1

Tel: 01283- 217981 **Fax:** 01283- 550243 **Turnover:** N/A **Employees:** 101-250

Coleford Brick & Tile Co. Ltd **Directors:** C. T. Evans (MD)
Hawkwell Grn, Cinderford, Glos, GL14 3JJ **Product Groups:** 33- 81.0; 81.1
Tel: 01594- 822160 **Fax:** 01594- 826655 **Turnover:** £1 - £2M **Employees:** 21-50

Combustion & Plasma Services Ltd **Directors:** k. Bown (MD)
16 Hawfinch, Wilnecote, Tamworth, Staffs, B77 5NU **Product Groups:** 33 -74.0
Tel: 01827- 261686 **Fax:** 01827- 250824 **Turnover:** £0.250 - £0.500 **Employees:** 1-10

Commercial Clay Ltd **Directors:** P. T. Stokes
Sandbach Rd, Cobridge, Stoke-on-Trent **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250 **Employees:** 1-10

Cookson Group P.L.C. **Directors:** R. Malpas (Ch)
130 Wood Street, London, EC2V 6EQ **Product Groups:**
Tel: 0171- 6064400 **Fax:** 0171- 6062851 **Turnover:** N/A **Employees:** Over 1501

Coors Ceramics Electronics Ltd **Directors:** R. Thomsen
64 Cavendish Way, Southfield Industrial Estate, Glenrothes, Fife, KY6 2SB **Product Groups:**
Tel: 01592- 773743 **Fax:** N/A **Turnover:** £5 - £10M **Employees:** 101-250

Corning Ltd **Directors:** R. *Thompson*
Wear Glass Works, Sunderland, SR4 6EJ **Product Groups:** 33 -74.0
Tel: 0191- 5676222 **Fax:** 0191- 5640110 **Turnover:** £20 - £50M **Employees:** 101-250

Cottsmore Ltd **Directors:** R. G. Simpson
Newtown Rd, Bovey Tracey, Devon, TQ13 9DX **Product Groups:**
Tel: 01626- 833081 **Fax:** N/A **Turnover:** £0.500 - £1M **Employees:** 1-10

Crown Tools & Fixings Ltd **Directors:** D. Hyslop (MD)
Watermill Ho, Restmor Way, Hackbridge Rd, Wallington, Surrey, SM6 7AH **Product Groups:** 33 -74.0
Tel: 0181- 7733993 **Fax:** 0181- 6695889 **Turnover:** £0.250 - £0.500 **Employees:** 1-10

Crummles & Co. Ltd **Directors:** L. Beriker
Units 2&3, Albion Close, Newtown Business Park, Poole Dorset, BH12 3LL **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** £0.500 - £1M **Employees:** 51-100

Czech & Speake Ltd **Directors:** F. Sawkins (Ch)
244-254 Cambridge Heath Rd, London, E2 9DA **Product Groups:** 33-72.0
Tel: 0181- 9804567 **Fax:** 0181- 9817232 **Turnover:** £2 - £5M **Employees:** 21-50

Dalehall Mills Ltd **Directors:** R. E. K. Leigh

Dalehall Mills, Newport Lane, Burslem, Staffs, ST6 3PJ
Tel: N/A **Fax:** N/A **Turnover:** £1 - £2M
Product Groups:
Employees: 21-50
Directors: S.B. Heath (MD)

Dartmouth Pottery Ltd
Leopold St, Birmingham, B12 OUJ
Tel: 0121- 7722303 **Fax:** 0121- 7723334 **Turnover:** N/A
Product Groups: 33-70.0,1
Employees: 11-20
Directors: W. D. C. Johns-Powell

David Powell Potteries Ltd
21 St Andrews Crescent, Cardiff, CF1 3DB
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10
Directors: R. Newton

Decorative Products Group Ltd
Heathfield, Newton Abbot, Devon, TQ12 6RF
Tel: 01626- 832641 **Fax:** N/A **Turnover:** £5 - £10M
Product Groups:
Employees: 251-500
Directors: M. J. Ryan

Denmead Pottery Ltd
Parklands Business Park, Denmead, Hampshire, PO7 6TT
Tel: N/A **Fax:** N/A **Turnover:** £0.500 - £1M
Product Groups:
Employees: 11-20
Directors: J. W. Poulter

Doulton Insulators Ltd
PO Box 17, Leek New Rd, Milton, Stoke-on-Trent, ST2 7EE
Tel: 01782- 534321 **Fax:** N/A **Turnover:** £2 - £5M
Product Groups:
Employees: 101-250
Directors: C.B. Dudson (Ch)

Dudson Brothers Ltd
200 Scotia Rd, Tunstall, Stoke-on-Trent. ST6 4JD
Tel: 01782- 819337 **Fax:** 01782- 813230 **Turnover:** N/A
Product Groups: 33-70.0,1
Employees: 21-50
Directors: G. W. Smith

Dunoon Ceramics Ltd
Unit 5, Walton Industrial Estate, Stone, ST15 0RY
Tel: 01785- 817414 **Fax:** N/A **Turnover:** £2 - £5M
Product Groups:
Employees: 51-100
Directors: R. D. Field (Ch)

Dyson Industries Ltd
Griffs Works, Stopes Rd, Stannington, Sheffield, S6 6BW
Tel: 0114- 2348663 **Fax:** 0114- 2322519 **Turnover:** £20 - £50M
Product Groups: 33-81.0
Employees: 51-100
Directors: K. H. A. Smith (Ch)

E. H. Smith (Westhaven) Ltd
1 Sherbourne Rd, Acocks Green, Birmingham, B27 6AB
Tel: 0121- 7066100 **Fax:** 0121- 7071890 **Turnover:** £20 - £50M
Product Groups: 33- 81.0; 81.1
Employees: 251-500
Directors: B. Slawson

East Midlands Ceramics Ltd
Mansfield Rd, Sherwood, Nottingham, NG5 2FR
Tel: 01602- 625532 **Fax:** N/A **Turnover:** £0.500 - £1M
Product Groups:
Employees: 11-20

Ele-Flex Ltd
Quarry La, Chichester, W. Sussex, PO19 2NY
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Directors: D. R. Beaven
Product Groups:
Employees: 1-10

Elliott Brothers Ltd
Millbank Wharf, Millbank St, Northam, Southampton, SO14 5AG
Tel: 01703- 226852 **Fax:** 01703- 638780 **Turnover:** £10 - £20M
Directors: G. E. N. Mason Elliott (Ch)
Product Groups: 33-81.0
Employees: 101-250

Emery Reimbold & Strick Ltd
Boving Works, Napier St, Fenton, Stoke-on-Trent, ST4 4NX
Tel: N/A **Fax:** N/A **Turnover:** £2 - £5M
Directors: K. A. Alexander
Product Groups:
Employees: 51-100

English Country Pottery Ltd
Station Rd, Wickwar, Wotton Under Edge, Glos., GL12 8NB
Tel: 01454- 299100 **Fax:** N/A **Turnover:** Up to £0.250
Directors: E. J. G. Collett
Product Groups:
Employees: 1-10

Esmalglass (UK) Ltd
Eastfields Rd, Uttoxeter, Staffs, ST14 5LT
Tel: 01889- 567277 **Fax:** N/A **Turnover:** £2 - £5M
Directors: G. T. Parry
Product Groups:
Employees: 21-50

F & P Bathrooms
Unit 3B, The Rainbow Industrial Pk, 7 Station Approach, London, SW20 0JY
Tel: 0181- 9471201 **Fax:** 0181- 9474729 **Turnover:** N/A
Directors: D.S. Norden (Ch)
Product Groups: 33-72.0
Employees: 11-20

F.G.F. (Aston) Ltd
Shadwell Ho, Shadwell St, Birmingham, B4 6LJ
Tel: 0121- 2331144 **Fax:** 0121- 2122539 **Turnover:** £20 - £50M
Directors: F. S. Mayman (Ch)
Product Groups: 33 -74.0
Employees: 101-250

Fairey Industrial Ceramics Ltd
Filleybrooks, Stone, Staffs, ST15 0PU
Tel: 01785- 813241 **Fax:** N/A **Turnover:** *£5 - £10M*
Directors: C. E. Webb
Product Groups:
Employees: *101-250*

Farnell Components Ltd
Canal Rd, Leeds, LS12 2TU
Tel: 0113- 2636311 **Fax:** 0113- 2633411 **Turnover:** £125 - £250M
Directors: C.P. Emptage (MD)
Product Groups: 33-76.0
Employees: 501-1000

Ferroperm UK Ltd
Vauxhall, Industrial Estate, Ruabon, Wrexham, Clwyd, LL14 6HA
Tel: 01978- 823990 **Fax:** 01978- 810128 **Turnover:** £0.500 - £1M
Directors: N/A
Product Groups: 33-76.0
Employees: 21-50

Finsbury China Ltd
1 Elsing St, Fenton, Stoke-on-Trent, ST4 2PR
Directors: D. Bramwell
Product Groups:

Tel: 01782- 47979 **Fax:** N/A **Turnover:** Up to £0.250
Employees: 1-10
Directors: G. C. Hinckley

Flogates Ltd
Neilson Rd A. W., Goole, Humberside, DN14 6XF
Tel: 01405- 720120 **Fax:** N/A **Turnover:** £10 - £20M
Product Groups:
Employees: 101-250
Directors: J. A. Evans

Fordham Pottery Co. Ltd
Muncey's Mill, 37 Mildenhall Rd, Fordham Ely, Cambs, CB7 5NW
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10
Directors: G. McKeown (MD)

G. McKeown & Son Ltd
Ballinderry Industrial Estate, Ballinderry Rd, Lisburn, Co. Antrim, BT28 2SA
Tel: 01846- 662414 **Fax:** 01846- 660541 **Turnover:** Up to £0.250
Product Groups: 33-81.0
Employees: 11-20
Directors: N/A

G.M.S. Co.
Gamasco Ho, 38 Saffron Court, Southfields Industrial Pk, Basildon, Essex, SS15 6SS
Tel: 01268- 419909 **Fax:** 01268- 544346 **Turnover:** £1 - £2M
Product Groups: 33 -74.0
Employees: 11-20
Directors: M.H. Sullivan (MD)

Gelson Industries
Bradford Street, Birmingham, B12 2PX
Tel: 0121- 3562208 **Fax:** 0121- 7722322 **Turnover:** £5 - £10M
Product Groups: 33-72.0
Employees: 101-250
Directors: N. J. Goold (MD)

Gibson & Goold Ltd
1-3 Scotland St, Glasgow, G5 8LS
Tel: 0141- 4297997 **Fax:** 0141- 4296606 **Turnover:** £1 - £2M
Product Groups: 33-81.0
Employees: 21-50
Directors: W. Rickatson

Goonvean Ceramic Materials Ltd
Goonvean, St Stephen, St Austell, Cornwall, PL26 7QF
Tel: N/A **Fax:** N/A **Turnover:** £2 - £5M
Product Groups:
Employees: 21-50
Directors: D. W. Dry (MD)

H & R Johnson (Tiles) Ltd
Highgate Tile Works, Brownhills Rd, Tunstall, Stoke-on-Trent, ST6 4JX
Tel: 01782- 575575 **Fax:** 01782- 577377 **Turnover:** £50 - £75M
Product Groups: 33- 81.0; 81.1
Employees: 1001-1500
Directors: G.M. Thrower (MD)

H. Bradley Ltd (t/a Lumleys)
123-129 Portland Rd, Hove, E. Sussex, BN3 5QW
Tel: 01273- 746161 **Fax:** 01273- 203943 **Turnover:** £5 - £10M
Product Groups: 33-72.0
Employees: 21-50
Directors: K. H. L. Barnes

Hammersley Ltd
Portland Works, Sutherland Rd, Longton, Staffs, ST3 1HS
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10
Directors: M.F. Neate (Chief Exec)

Harrison Drape

Bradford Street, Birmingham, B12 0PE
Tel: 0121- 7666111 **Fax:** 0121- 7720692 **Turnover:** £20 - £50M
Product Groups: 33-72.0
Employees: 501-1000

Henry Watson's Potteries Ltd
Directors: H.E. Watson (Ch)
Wattisfield, Diss, Norfolk, IP22 1NH
Tel: 01359- 251239 **Fax:** 01359- 250984 **Turnover:** £2 - £5M
Product Groups: 33-70.0
Employees: 51-100

Hepworth Minerals & Chemicals Ltd (Ind. Ceramics)
Directors: D. Fretwell (Unit Mgr)
Hazlehead, Stocksbridge, Sheffield, S30 5HG
Tel: 01226- 761194 **Fax:** 01226- 765279 **Turnover:** £2 - £5M
Product Groups: 33 -76.0; 74.0
Employees: 21-50

Hewitt Refractories Ltd
Directors: M. I. Chilton
Fenton Low Works, Victoria Rd, Fenton, Stoke-on-Trent, ST4 2HR
Tel: 01782- 47151 **Fax:** N/A **Turnover:** £5 - £10M
Product Groups:
Employees: 101-250

Highbank Porcelain Ltd
Directors: P. E. Burrell
Factory Highland Ind. Estate, Lodgilphead, Argyll, G83 8BS
Tel: 01546- 602044 **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10

Highland Stoneware (Scotland) Ltd
Directors: D. Grant
The Old Hall, East Tuddenham, Dereham, Norfolk, NR20 3ND
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10

Hoben Davies Ltd
Directors: J. W. Goodwin
Ivy Ho Foundry, Hanley, Stoke-on-Trent, ST1 3NR
Tel: N/A **Fax:** N/A **Turnover:** £2 - £5M
Product Groups:
Employees: 101-250

Holdenby Designs Ltd
Directors: N/A
Holcot Rd, Brixworth, Northants, NN6 9EJ
Tel: 01604- 880800 **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10

Hornsea Pottery Ltd
Directors: D. M. Leather
Edenfield Works, Marlborough Ave, Hornsea, N. Humberside, HU18 1UD
Tel: 01964- 532161 **Fax:** N/A **Turnover:** £5 - £10M
Product Groups:
Employees: 251-500

Hudson & Middleton Ltd
Directors: C.M. Thomas
Sutherlands Works, Normacot Rd, Longton, Stoke-on-Trent, ST3 7HF
Tel: 01782- 319256 **Fax:** 01782- 343300 **Turnover:** £1 - £2M
Product Groups: 33-70.0,1
Employees: 51-100

I.C.I. Ceramics Ltd
Directors: J. Brothers (USA)
TDS Ho, Terrace Road South, Binfield, Bracknell, Berks, RG42 4BH
Tel: 01344- 867086 **Fax:** 01344- 868371 **Turnover:** N/A
Product Groups: 33 -76.0; 74.0
Employees: 1-10

Ibercalco (UK) Ltd — **Directors:** S. J. Lowe
65 The Bulevard, Tunstall, Stoke-on-Trent, ST6 6BD — **Product Groups:**
Tel: 01782- 577802 **Fax:** N/A **Turnover:** £0.500 - £1M — **Employees:** 11-20

Ibstock Brick Cattybrook Ltd — **Directors:** C. Hope (Ch)
Over La, Almondsbury, Bristol, BS12 4BX — **Product Groups:** 33-81.0
Tel: 01454- 614573 **Fax:** 01454- 617031 **Turnover:** £10 - £20M — **Employees:** 101-250

Ideal-Standard Ltd — **Directors:** P.R. Cooper (MD)
Po Box 60, Hull, HU5 4HS — **Product Groups:** 33-72.0
Tel: 01482- 346461 **Fax:** 01482- 445886 **Turnover:** £20 - £50M — **Employees:** 501-1000

Intastor Display Co. — **Directors:** M. D. Keech (MD)
Ground Floor D. E. Block, Boscombe Rd, Dunstable, Beds, LU5 4LU — **Product Groups:** 33-81.0
Tel: 01582- 477455 **Fax:** 01582- 477461 **Turnover:** N/A — **Employees:** 21-50

Island Porcelain Ltd — **Directors:** I. Ash
The Old School, Brodick, Isle of Aran, KA27 8EB — **Product Groups:**
Tel: 0177- 087360 **Fax:** N/A **Turnover:** Up to £0.250 — **Employees:** 1-10

J. Fryer Ltd — **Directors:** J. Fryer
Roundwell St, Tunstall, Stoke-on-Trent, ST6 5AN — **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250 — **Employees:** 1-10

J. W. Ratcliffe & Sons (Engineers) Ltd — **Directors:** K. L. Amos
Rope St, Shelton New Rd, Stoke-on-Trent, ST4 6DJ — **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** £0.500 - £1M — **Employees:** 11-20

J.H. Weatherby & Sons Ltd — **Directors:** C.S. Weatherby (MD)
Falcon Pottery, Old Town Rd, Hanley, Stoke-on-Trent, ST1 2LB — **Product Groups:** 33-70.0,1
Tel: 01782- 213711 **Fax:** 01782- 283827 **Turnover:** £1 - £2M — **Employees:** 51-100

James Sadler & Sons Ltd — **Directors:** E.P. Sadler (Ch)
Market Pl, Burslem, Stoke-on-trent, ST6 4AZ — **Product Groups:** 33-70.0,1
Tel: 01782- 811211 **Fax:** 01782- 575003 **Turnover:** £5 - £10M — **Employees:** 101-250

Jetform Services Ltd — **Directors:** T. J. Wakefield
Unit 4 Byron Works, Russell Gdns, Wickford, Essex, SS11 8QG — **Product Groups:** 33-81.0
Tel: 01268- 570017 **Fax:** 01268- 560098 **Turnover:** £0.250 - £0.500 — **Employees:** 1-10

John Tams Group P.L.C. — **Directors:** G.R. Tams (Ch)
111-113 The Strand, Longton, Stoke-on-Trent, ST3 2PG — **Product Groups:** 33-70.0,1

Tel: 01782- 599226 **Fax:** 01782- 599149 **Turnover:** £50 - £75M **Employees:** 501-1000
Directors: B. Patterson

Johnson Bros
Barlaston, Stoke-on-Trent, ST12 9ES **Product Groups:** 33.70.0,1
Tel: 01782- 204141 **Fax:** 01782- 204402 **Turnover:** £125 - £250M **Employees:** Over 1501
Directors: E.M. Gnyla (MD)

Just Mugs Ltd
Washington Works, College Rd, Stoke-on-Trent, ST4 2QR **Product Groups:** 33-70.0
Tel: 01782- 847911 **Fax:** 01782- 744420 **Turnover:** £10 - £20M **Employees:** 101-250
Directors: G. C. Hinckley

K.S.R. International Ltd
Sandiron Ho, 449-453 Abbey La, Beauchief, Sheffield, S7 2RA **Product Groups:**
Tel: 01142- 369011 **Fax:** N/A **Turnover:** £10 - £20M **Employees:** 251-500
Directors: R. W. Mutch

Ker Monolithics Ltd
5 Whitehall Industrial Estate, Ashfield Way, Leeds, LS12 4UH **Product Groups:**
Tel: 01532- 636268 **Fax:** N/A **Turnover:** £5 - £10M **Employees:** 21-50
Directors: C. R. Lee)Mrs)

Keramikos Ltd
Unit 5 Lumsdale Mill, Lower Lumsdale, Matlock, Derbyshire, DE4 5EX **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250 **Employees:** 1-10
Directors: N/A

Key Electronics Components
4 Kitwood drive, Lower Earley, Reading, RG6 3TA **Product Groups:** 33-76.0
Tel: 0118- 9351546 **Fax:** 0118- 9660294 **Turnover:** Up to £0.250 **Employees:** 1-10
Directors: K. N. Ireland (MD)

KnitMesh Ltd
Sanderstead Station Approach, South Croydon, Surrey, CR2 0YY **Product Groups:** 33 -74.0
Tel: 0181- 6516321 **Fax:** 0181- 6514095 **Turnover:** N/A **Employees:** 101-250
Directors: R. S. Smith (MD)

Langley London Ltd
163-167 Borough High St, London, SE1 1HU **Product Groups:** 33-81.0
Tel: 0171- 4074444 **Fax:** 0171- 4033584 **Turnover:** £5 - £10M **Employees:** 51-100
Directors: Sir Michael Grylls (MD)

Le Carbone (Great Britain) Ltd
South St, Portslade, Brighton, BN41 2LX **Product Groups:** 33-76.0
Tel: 01273- 415701 **Fax:** 01273- 415673 **Turnover:** £10 - £20M **Employees:** 101-250
Directors: R. Constable (MD)

Linatex Ltd
Wilkinson Ho, Blackbushe Business Pk, Galway Rd, Yateley, Camberley, Surrey, GU17 7GE **Product Groups:** 33 -74.0
Tel: 01252- 743000 **Fax:** 01252- 743030 **Turnover:** £5 - £10M **Employees:** 101-250
Directors: D. R. Birch

London Pottery Co. Ltd

96 Kingston Rd, London, SW19 1LX
Tel: 0181- 5432588 **Fax:** N/A **Turnover:** £1 - £2M
Product Groups:
Employees: 11-20
Directors: D. Johnson

LSM Teox Technical Ceramics Ltd
5 Stem Lane, New Milton, Hants, BH25 5NE
Tel: 01425- 619440 **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10
Directors: C. Woods (Chief Exec)

M.D.H. Ltd
Walworth Rd, Walworth Industrial Estate, Andover, Hants, SP10 5AA
Tel: 01264- 362111 **Fax:** 01264- 356452 **Turnover:** £10 - £20M
Product Groups: 33-72.0
Employees: 101-250
Directors: P. Shakeshaft (MD)

MacGregor & Co.
27-29 West Savile Terr, Edinburgh, EH9 3DU
Tel: 0131- 6679191 **Fax:** 0131- 6623200 **Turnover:** £5 - £10M
Product Groups: 33-70.1
Employees: 51-100
Directors: E. G. M. Cannon (Ch)

Mansfield Sand Co. Ltd
Sandhurst Ave, Mansfield, Notts, NG18 4BE
Tel: 01623- 22441 **Fax:** 01623- 420904 **Turnover:** £5 - £10M
Product Groups: 33-81.0
Employees: 51-100
Directors: K. F. Marshall (Ch)

Marshalls Clay Products Ltd
Robin Hood, Wakefield, W. Yorkshire, WF3 3BP
Tel: 0113- 2822141 **Fax:** 0113- 2829414 **Turnover:** £2 - £5M
Product Groups: 33-81.0
Employees: 251-500
Directors: J.E. Perks (MD)

Mason Cash & Co. Ltd
Pool potteries, Pool St, Church Gresley, Swadlincote, Derbyshire, DE11 8EQ
Tel: 01283- 217521 **Fax:** 01283- 550023 **Turnover:** £2 - £5M
Product Groups: 33-70.0; 70.1; 82.0
Employees: 51-100
Directors: W. S. Smith

McLaggan Smith Mugs Ltd
Jamestown Ind. Estate, Alexandria, G83 8BS
Tel: 01389- 55655 **Fax:** N/A **Turnover:** £0.500 - £1M
Product Groups:
Employees: 11-20
Directors: R.H. Wain (MD)

Melba-Wain (England) Ltd
Corwell Rd, Longton, Stoke-on-Trent, ST3 2JY
Tel: 01782- 319501 **Fax:** 01782- 324708 **Turnover:** £0.500 - £1M
Product Groups: 33-70.1
Employees: 21-50
Directors: R. A. Downes (GenMgr)

Metaref
Spedding Rd, Fenton Industrial Estate, Fenton, Stoke-on-Trent, ST4 2SN
Tel: 01782- 412111 **Fax:** 01782- 744267 **Turnover:** £2 - £5M
Product Groups: 33 -74.0
Employees: 21-50
Directors: M. J. Bridge

Metropolitan Interiors Ltd
Unit 1, Lower Audley Centre, Kent St, Blackburn, BB1 1DE
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10

Milestone Pottery Ltd
Unit 234f, Redwither Industrial Complex, Wrexham Industrial Estate, Wrexham, Clwyd, LL13 9UH
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Directors: R. C. Read
Product Groups:
Employees: 1-10

Milton Ceramics Ltd
Barratt Ho, Chestnut Ave, Guildford, GU2 5HG
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Directors: L. M. Matarazzo
Product Groups:
Employees: 1-10

Minteq UK Ltd
Lynham Works, Aldwarke Rd, Rotherham, S. Yorks, S65 3SR
Tel: 01709- 710072 **Fax:** N/A **Turnover:** £10 - £20M
Directors: J. C. O'Donoghue
Product Groups:
Employees: 251-500

Monolithic Refractories Ltd
Drummau Farm, Drummau, Skewen, Neath, W. Glam., SA10 6NW
Tel: 01792- 816483 **Fax:** N/A **Turnover:** £2 - £5M
Directors: B. Sheppard
Product Groups:
Employees: 21-50

Morgan Matroc Ltd
Bewdley Rd, Stourport-on-Severn, Worcs, DY13 8QR
Tel: 01299- 827000 **Fax:** 01299- 827872 **Turnover:** £20 - £50M
Directors: V. J. Maundrell (Ch)
Product Groups: 33-81.0
Employees: Over 1501

Morganite Thermal Ceramics Ltd
Liverpool Rd, Neston, South Wirral, L64 3RE
Tel: 0151- 3363911 **Fax:** 0151- 3367868 **Turnover:** £20 - £50M
Directors: N. G. Howard (Ch)
Product Groups: 33
Employees: 101-250

Multi-Tile Ltd
Earl Rd, Stanley Green Industrial Estate, Cheadle Hulme, Cheadle, Cheschire, SK8 6PT
Tel: 0161- 4884068 **Fax:** 0161- 4856700 **Turnover:** N/A
Directors: C. Ayliffe (MD)
Product Groups: 33-81.0
Employees: 101-250

Nash Sealing Systems Ltd
Nash Works, Nile St, Bolton, BL3 6DW
Tel: 01204- 388030 **Fax:** 01204- 361541 **Turnover:** £0.500 - £1M
Directors: B. E. Hoyle (Ch)
Product Groups: 33 -74.0
Employees: 11-20

New Metals & Chemicals Ltd
Newmet Ho, Rue de St. Lawrence, Waltham Abbey, Essex, EN9 1PF
Tel: 01992- 711111 **Fax:** 01992- 768393 **Turnover:** £2 - £5M
Directors: Sir T. E. C. Hoare (MD)
Product Groups: 33 -76.0; 74.0
Employees: 21-50

Newname Ltd
6 Redworth Rd, Newton Aycliffe, Co. Durham, DL5 6HD
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Directors: P. L. Monk
Product Groups:
Employees: 1-10

Nicobond Southwest Ltd
Directors: K. S. A. Forbes (Ch)

Curran Bldgs, 14 Curran Rd, Cardiff, CF1 5DF
Tel: 01222- 390146 **Fax:** 01222- 224356 **Turnover:** £2 - £5M
Product Groups: 33-81.0; 82.0
Employees: 21-50
Directors: J. Barlow

North Eastern Ceramics Ltd
162 Brinkburn Street South, Newcastle Upon Tyne, NE6 2AR
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10
Directors: M. J. Seed (MD)

Northern Mill Thread Guides
Mersey, Industrial Estate, Stockport, Cheshire, SK4 3EF
Tel: 0161- 4328581 **Fax:** 0161- 4431477 **Turnover:** Up to £0.250
Product Groups: 33 -74.0
Employees: 1-10
Directors: I. Pawson (MD)

Nuway Matting Systems
Halesfield 19, Telford, Shropshire, TF7 4QT
Tel: 01952- 680400 **Fax:** 01952- 585930 **Turnover:** £5 - £10M
Product Groups: 33-81.0
Employees: 51-100
Directors: R. E. W. Newman

Offertoken Ltd
Millwey Industrial Estate, Axminster, Devon, EX13 5HU
Tel: N/A **Fax:** N/A **Turnover:** £2 - £5M
Product Groups:
Employees: 101-250
Directors: J.L. Ablitt (MD)

Oslers Ltd
Eley Road Industrial Estate, Angel Rd, London, N18 3BH
Tel: 0181- 8035411 **Fax:** 0181- 8076235 **Turnover:** £1 - £2M
Product Groups: 33-70.1
Employees: 1-10
Directors: M. L. Feneron

P. & R. Electro-Ceramics Ltd
1/4 Derwent Yard, Derwent Road, Ealing, W5 4TW
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10
Directors: P. Tempest

P.K.N. Crafts Ltd
Unit 5 Trent Trading Estate, Botteslow St., Hanley, Stoke-on-Trent, ST1 3LY
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10
Directors: J. M. Dibben

Paris Ceramics Ltd
583 Kings Road, London, SW6 2EH
Tel: 0171- 3719666 **Fax:** N/A **Turnover:** £1 - £2M
Product Groups:
Employees: 21-50
Directors: D. E. Parkinson

Parkinson-Spencer Refractories Ltd
Holmfield, Halifax, W. Yorks, HX3 6SX
Tel: 01422- 244472 **Fax:** N/A **Turnover:** £2 - £5M
Product Groups:
Employees: 51-100
Directors: C. Sphikas

Phoenix Pottery Ltd
High Street, Irchester, Northamptonshire, NN9 7AB
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10

Piezo Products Ltd
Crow Arch Lane, Industrial Estate, Ringwood, Hants, BH24 1NZ
Tel: 01425- 479337 **Fax:** 01425- 479914 **Turnover:** £0.250 - £0.500
Directors: M. Horsfield (MD)
Product Groups: 33-76.0
Employees: 1-10

Poole Pottery Ltd
The Quay, Poole, Dorset, BH15 1RF
Tel: 01202- 666200 **Fax:** 01202- 682894 **Turnover:** £2 - £5M
Directors: P.A. Mills (MD)
Product Groups: 33-70.0,1
Employees: 101-250

Porcelain & Fine China Companies Ltd
Spode Works, Church St, Stoke-on-Trent, ST4 1BX
Tel: 01782- 744011 **Fax:** 01782- 744220 **Turnover:** N/A
Directors: A.P. Wood (MD)
Product Groups: 33-70.1
Employees: 501-1000

Portmeirion Potteries Ltd
London Rd, Stoke-on-Trent, ST4 7 QQ
Tel: 01782- 744721 **Fax:** 01782- 744061 **Turnover:** £20 - £50M
Directors: E.S. Cooper-Willis, S. Williams-Ellis
Product Groups: 33-70.0; 70.1; 82.0
Employees: 501-1000

Porvair Ceramics Ltd
Estuary Rd, King's Lynn, Norfolk, PE30 2HS
Tel: 01553- 761111 **Fax:** 01553- 764637 **Turnover:** £10 - £20M
Directors: A. R. Collinson (MD)
Product Groups: 33 -74.0
Employees: 101-250

Precision Ceramics Ltd
124 Electric Ave, Witton, Birmingham, B6 7DZ
Tel: 0121- 3282851 **Fax:** 0121- 3281628 **Turnover:** £0.500 - £1M
Directors: N. Hussain (Ch)
Product Groups: 33 -76.0; 74.0
Employees: 1-10

Print-Flo Ltd
Adelaide St, Burslem, Stoke-on-Trent, ST6 2DB
Tel: 01782- 834311 **Fax:** N/A **Turnover:** £0.500 - £1M
Directors: P. Knott
Product Groups:
Employees: 1-10

Promotional Ceramics Ltd
Bank House, 2 Swan Bank, Congleton, Cheschire, CW12 1AH
Tel: N/A **Fax:** N/A **Turnover:** £0.500 - £1M
Directors: N. Collis
Product Groups:
Employees: 11-20

Purbeck Pottery Ltd
5 Eldon Pl, Westbourne, Bournemouth, BH4 9AZ
Tel: 01202- 766003 **Fax:** 01202- 769442 **Turnover:** £0.250 - £0.500
Directors: P.P. Barnes (MD)
Product Groups: 33.70.1
Employees: 11-20

Qualitas Bathrooms
Hartshorne Rd, Woodville, Swadlincote, Derbyshire, DE11 7JD
Tel: 01283- 550550 **Fax:** 01283- 550314 **Turnover:** £10 - £20M
Directors: K. Flitcroft (MD)
Product Groups: 33-72.0
Employees: 101-250

Queensway Securities Ltd
Lynton Place, 5 Stanmore Hill, Stanmore, Middx, HA7 3DP
Directors: S. S. Cohen
Product Groups:

Tel: 0181- 9540331 **Fax:** N/A **Turnover:** £20 - £50M **Employees:** 251-500

R.C.G. Ltd **Directors:** G. R. Tams

Grafton Works, Marlborough Rd, Longton, Stoke-on-Trent, ST3 1ED **Product Groups:**

Tel: 01782- 599667 **Fax:** N/A **Turnover:** £2 - £5M **Employees:** 101-250

Ramus Tile Co. Ltd **Directors:** C. Glynn (Ch)

Units 1A & 1B Alexandra Pl, Lower Park Rd, London, N11 1ST **Product Groups:** 33-81.0

Tel: 0181- 3616050 **Fax:** 0181- 3614757 **Turnover:** Up to £0.250 **Employees:** 1-10

Redland P. L. C. **Directors:** R. I. Agnew (Ch)

Redland Ho, Reigate, Surrey, RH2 0SJ **Product Groups:** 33-81.0

Tel: 01737- 242488 **Fax:** 01737- 221938 **Turnover:** Over £1,000M **Employees:** Over 1501

Regal Pottery Ltd **Directors:** D. L. Phillips

Unit 5, Robert Hyde Industrial Estate, City Rd, Stoke-on-Trent, Staffordshire, ST4 1DS **Product Groups:**

Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250 **Employees:** 1-10

Reliant Technical Services Ltd **Directors:** P. E. Carr

Bush Ho, 4 Pitgreen Lane, Wolstanton, Newcastle Under Lyme, ST5 0DL **Product Groups:**

Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250 **Employees:** 1-10

Reward-Clayglaze Ltd **Directors:** A. W. Carter

Uint A, Brookhouse Industrial Estate, Cheadle, Stoke-on-Trent, ST10 1QW **Product Groups:**

Tel: N/A **Fax:** N/A **Turnover:** £1 - £2M **Employees:** 21-50

Robert Lickley Refractories Ltd **Directors:** R. Lickley

Dormston Trading Estate, Burton Rd, Dudley, W, Midlands, DY2 7ED **Product Groups:**

Tel: 01902- 880123 **Fax:** N/A **Turnover:** £5 - £10M **Employees:** 21-50

Roman Mosaic Contracts Ltd **Directors:** R. G. Pioli

Bloomfield Rd, Tipton, W. Midlands, DY4 9ES **Product Groups:**

Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250 **Employees:** 1-10

Ross Catherall Ceramics Ltd **Directors:** C. Pritchard (MD)

Derby Rd, Denby, Ripley, Derbyshire, DE5 8NX **Product Groups:** 33 -74.0

Tel: 01773- 570800 **Fax:** 01773- 570152 **Turnover:** £2 - £5M **Employees:** 101-250

Royal Doulton P.L.C. **Directors:** M.W. Burrell (Ch)

Minton Ho, London Road, Stoke-on-Trent, ST4 7QD **Product Groups:** 33-70.0,1

Tel: 01782- 292292 **Fax:** 01782- 292099 **Turnover:** £125 - £250M **Employees:** Over 1501

Royal Grafton China Ltd **Directors:** A.A. Deere

Marlborough Rd, Longton, Stoke-on-Trent, ST3 1 ED
Tel: 01782- 313061 **Fax:** 01782- 596153 **Turnover:** £2 - £5M
Product Groups: 33-70.0,1
Employees: 101-250
Directors: R. P. Nash (Gen Mgr)

Rudgwick Brickworks Co. Ltd
Lynwick St, Rudgwick, Horsham, W. Sussex, RH12 3DH
Tel: 01403- 822212 **Fax:** 01403- 823357 **Turnover:** £1 - £2M
Product Groups: 33-81.0
Employees: 51-100
Directors: G. Lord (MD)

S. D. L. Trophies Ltd
Scaitcliffe Ho, Ormerod St, Accrington, Lancs, BB5 0PF
Tel: 01254- 391568 **Fax:** 01254- 871158 **Turnover:** £1 - £2M
Product Groups: 33-82.0
Employees: 21-50
Directors: Y. Tanaka

S.M.I. Ceramics (UK) Ltd
Orchard Ho, Orchard Parade, Mutton La, Potters Bar, Herts, EN6 3AX
Tel: 01707- 651214 **Fax:** 01707- 651183 **Turnover:** £2 - £5M
Product Groups: 33 -74.0
Employees: 1-10
Directors: R. Widdett (MD)

Schnectady-Europe Ltd
Four Ashes, Wolwerhamton, WV10 7BT
Tel: 01902- 790555 **Fax:** 01902- 791640 **Turnover:** £10 - £20M
Product Groups: 33 -74.0
Employees: 101-250
Directors: J. Griffin

Scientific Optics Ltd
Ponswood Industrial Estate, Drury Lane, Hastings, E. Sussex, TN34 1YA
Tel: 01424- 430371 **Fax:** N/A **Turnover:** £0.500 - £1M
Product Groups:
Employees: 11-20
Directors: M. J. Hyde (MD)

Sharkie & Huntbatch Ltd
Eaton Bank Trading Estate, Congleton, Cheschire, CW12 1PL
Tel: 01260- 274747 **Fax:** 01260- 299017 **Turnover:** Up to £0.250
Product Groups: 33 -74.0
Employees: 11-20
Directors: M. Leaf (Site)

Shaws of Darwen Ltd
Waterside, Darwen, Lancs, BB3 3NX
Tel: 01254- 775111 **Fax:** 01254- 873462 **Turnover:** £1 - £2M
Product Groups: 33-81.0
Employees: 51-100
Directors: S.J.E. Boscawen (Ch)

Shires Ltd
Beckside Rd, Bradford, W. Yorkshire, BD7 2JE
Tel: 01274- 521199 **Fax:** 01274- 521583 **Turnover:** £20 - £50M
Product Groups: 33-72.0
Employees: 501-1000
Directors: D. Simons (MD)

Simons Bros (London) Ltd
27 Old Farm Ave, London, N14 5QR
Tel: 0181- 8866845 **Fax:** 0181- 8868649 **Turnover:** £1 - £2M
Product Groups: 33-70.1
Employees: 11-20
Directors: N/A

Sisu (K.B. 1973) Ltd
62 Aldwick Rd, Bognor Regis, W. Sussex, PO21 2PE
Tel: 01243- 829151 **Fax:** N/A **Turnover:** Up to £0.250
Product Groups:
Employees: 1-10

Spectrum Ceramic Printers Ltd
Unit 7, Bellerton Lane, Norton, Stoke-on-Trent, ST6 8ED
Tel: N/A **Fax:** N/A **Turnover:** £2 - £5M
Directors: S. Boulton
Product Groups:
Employees: 21-50

Spheric Engineering Ltd
Fleming Way, Manor Royal, Crawley, W. Sussex, RH10 2SQ
Tel: 01293- 541377 **Fax:** 01293- 511921 **Turnover:** N/A
Directors: J. R. Pratt (Ch)
Product Groups: 33 -74.0
Employees: 21-50

Staffordshire Clays Ltd
Bute St, Fenton, Stoke-on-Trent, Staffs, ST3 3PW
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Directors: J. Hinks
Product Groups:
Employees: 1-10

Stanelco Products Ltd
Systems Ho, Brunel Way, Segensworth East, Fareham, Hants, PO15 5SD
Tel: 01489- 570991 **Fax:** 01489- 570107 **Turnover:** £2 - £5M
Directors: R. Arrow (MD)
Product Groups: 33 -76.0; 74.0
Employees: 21-50

Stenic Ltd
Kimbolton Rd, Hail Weston, Huntingdon, Cambridgeshire, PE19 4LB
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Directors: A. C. Head
Product Groups:
Employees: 1-10

Stovax Ltd
Falcon Rd, Sowton Industrial Estate, Exeter, EX2 7LF
Tel: 01392- 474011 **Fax:** 01392- 219932 **Turnover:** £5 - £10M
Directors: C. M. Brook (Ch)
Product Groups: 33-81.0
Employees: 51-100

Summerbank Pottery (1970) Ltd
38 High St, Tunstall, Stoke-on-Trent, ST6 5TH
Tel: N/A **Fax:** N/A **Turnover:** £0.500 - £1M
Directors: J. C. Savage
Product Groups:
Employees: 11-20

Surrey Ceramic Co. Ltd
School Rd, Grayshott, Hindhead, Surrey, GU26 6LR
Tel: N/A **Fax:** N/A **Turnover:** £0.500 - £1M
Directors: I. A. Tippetts
Product Groups:
Employees: 11-20

Sutherland Fine China Ltd
12 Spedding Rd, Fenton, Stoke-on-Trent, ST4 2ST
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Directors: P. M. Cooke
Product Groups:
Employees: 1-10

System Floors Ltd
Priory Works, Priory Rd, Kenilworth, Warwickshire, CV8 1QX
Tel: 01926- 59231 **Fax:** 01926- 50359 **Turnover:** £10 - £20M
Directors: D. Godfrey (MD)
Product Groups: 33-81.0
Employees: 101-250

Taylor Tiles Holdings Ltd
Beaufort Rd, Plasmarl Industrial Estate, Morriston, Swansea, SA6 8JG
Directors: J. A. B. Taylor (Ch)
Product Groups: 33-81.0

Tel: 01792- 797712 **Fax:** 01792- 791103 **Turnover:** N/A **Employees:** 21-50
Technomat Ltd **Directors:** N. D. Finan
PO Box 286, Newcastle-under-Lyme, Staffs., ST5 3LP **Product Groups:**
Tel: 01785- 628540 **Fax:** N/A **Turnover:** Up to £0.250 **Employees:** 1-10
The Carborundum Co. Ltd **Directors:** C. G. Burley
Mill Lane, Rainford, St. Helens, Merseyside, WA11 8LP **Product Groups:**
Tel: 01744- 882941 **Fax:** N/A **Turnover:** £20 - £50M **Employees:** 251-500
The imperial Bathroom Co. Ltd **Directors:** G. W. Stevenson
Imperial Buildings, Northgate Way, Walsall, WS9 8SR **Product Groups:**
Tel: 01922- 743536 **Fax:** N/A **Turnover:** £2 - £5M **Employees:** 21-50
The Porcelain & Fine China Companies Ltd **Directors:** A. J. Finden-Crofts
Portacabin, RAF Station, Bury St Edmunds, Suffolk, IP28 8NG **Product Groups:**
Tel: 01638- 717941 **Fax:** N/A **Turnover:** £20 - £50M **Employees:** 251-500
The S.O.L. Group Ltd **Directors:** T. F. Roberts
Brett Drive, Bexhill-on-Sea, E. Sussex, TN40 2JP **Product Groups:**
Tel: 01424- 733128 **Fax:** N/A **Turnover:** £2 - £5M **Employees:** 51-100
Theale Fireplaces (Reading) Ltd **Directors:** Miss J. Woosnam (Ch)
Mile House Farm, Bath Rd, Theale, Reading, RG7 5HJ **Product Groups:** 33-81.0
Tel: 0118- 9302232 **Fax:** 0118- 9323344 **Turnover:** £0.250 - £0.500 **Employees:** 1-10
Thomas McLaughlin Ltd **Directors:** A. McLaughlin (MD)
Cathedral Rd, Armagh, BT61 8AG **Product Groups:** 33-82.0
Tel: 01861- 522487 **Fax:** 01861- 522747 **Turnover:** £5 - £10M **Employees:** 51-100
Thor Ceramics Ltd **Directors:** A. W. Thornton
White Crook Works, Stanford St, Clydebank. Dunbartonshire, G81 1RW **Product Groups:**
Tel: 0141- 9521990 **Fax:** N/A **Turnover:** £20 - £50M **Employees:** 101-250
Tile Warehouses Ltd **Directors:** G. Curtis (Mrs)
Thomasin Works, Thomasin Rd, Burnt Mills, Basildon Essex, SS13 1LG **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250 **Employees:** 1-10
Tooth & Co. Ltd (Bretby Art Pottery) **Directors:** Mrs A.L. Simons
Woodville, Swadlincote, Derbyshire, DE11 8DE **Product Groups:** 33-70.0,1
Tel: 01283- 217434 **Fax:** N/A **Turnover:** £0.500 - £1M **Employees:** 21-50
Topravit Ltd **Directors:** E. Felcuk (MD)

Unit B2, Hubert Road Industrial Estate, Brentwood, Essex, CM14 4JY
Tel: 01277- 218282 **Fax:** 01277- 218284 **Turnover:** £2 - £5M
Product Groups: 33-72.0
Employees: 11-20
Directors: M. Gallagher (MD)

Total Process Cooling Ltd
94 Heaton Rd, Solihull, W. Midlands, B91 2DZ
Tel: 0121- 7114014 **Fax:** 0121- 7054012 **Turnover:** £1 - £2M
Product Groups: 33-82.0
Employees: 1-10
Directors: J. Matthews (MD)

Triton P.L.C.
Triton Ho, Newdegate St, Nuneaton, Warwickshire, CV11 4EU
Tel: 01203- 344441 **Fax:** 01203- 349828 **Turnover:** £20 - £50M
Product Groups: 33-72.0
Employees: 251-500
Directors: P. S. Battin

Tudor P.L.C.
Ceramic House, Camp Hill, Wordsley, Stourbridge, W. Midlands, DY8 4AD
Tel: 01384- 480221 **Fax:** N/A **Turnover:** £10 - £20M
Product Groups:
Employees: 101-250
Directors: D. Cameron

Ulster ceramics P.L.C.
Springtown Industrial Estate, Londonderry, BT48 0LY
Tel: 01504- 265742 **Fax:** 01504- 271259 **Turnover:** N/A
Product Groups: 33-70.0
Employees: 21-50
Directors: H. Cullen (MD)

Ulster Fireclays P.L.C.
Washingbay Rd, Coalisland, Dungannon, Co. Tyrone, BT70 5EG
Tel: 01868- 740436 **Fax:** 01868- 747430 **Turnover:** £0.500 - £1M
Product Groups: 33-72.0
Employees: 21-50
Directors: P. Ward (MD)

Unitec Ceramics Ltd
Doxey Rd, Stafford, ST16 1DZ
Tel: 01785- 223122 **Fax:** 01785- 212259 **Turnover:** N/A
Product Groups: 33 -74.0
Employees: 11-20
Directors: D. Lynes (Works)

V.Z.S. Technical Ceramics Ltd
35 37 Cavendish Way, Southfield Industrial Estate, Glenrothes, Fife, KY6 2SB
Tel: 01592 630505 **Fax:** 01592- 773192 **Turnover:** £2 - £5M
Product Groups: 33 -74.0
Employees: 51-100
Directors: B. Hatton

Vernaware Ltd
Slater St, Bolton, BL1 2HP
Tel: 01204- 33183 **Fax:** N/A **Turnover:** £0.500 - £1M
Product Groups:
Employees: 21-50
Directors: S. W. Valler (MD)

W. B. Simpson & Sons Ltd
27 33 Burr Rd, Wandsworth, London, SW18 4SG
Tel: 0181- 8771020 **Fax:** 0181- 8708401 **Turnover:** £5 - £10M
Product Groups: 33-81.1
Employees: 51-100
Directors: B. Kiely (MD)

W. H. Collier Ltd
Church La, Marks tey, Colchester, CO6 1LN
Tel: 01206- 210301 **Fax:** 01206- 212540 **Turnover:** N/A
Product Groups: 33-81.0
Employees: 21-50

W. T. Knowles & Sons Ltd
Ash Grove Sanitary Pipe Works, Elland, W. Yorkshire, HX5 9JA
Tel: 01422- 372833 **Fax:** 01422- 370900 **Turnover:** £2 - £5M
Directors: D. T. Knowles (MD)
Product Groups: 33-81.0
Employees: 21-50

W.T. Knowles & Sons Ltd
Ash Grove Sanitary Pipe Works, Elland, W. Yorkshire, HX5 9JA
Tel: 01422- 372833 **Fax:** 01422- 370900 **Turnover:** £2 - £5M
Directors: D.T. Knowles (MD)
Product Groups: 33-72.0
Employees: 21-50

Wade Ceramics Ltd
Greenhead St, Burslem, Stoke-on-Trent, ST6 4AE
Tel: 01782- 577321 **Fax:** 01782- 575195 **Turnover:** £10 - £20M
Directors: E. Duke (Ch)
Product Groups: 33 -70.0; 70.1; 74.0
Employees: 501-1000

Waterford Wedgwood P.L.C.
Barlaston, Stoke-on-Trent, ST12 9ES
Tel: 01782- 204141 **Fax:** 01782- 204402 **Turnover:** £250 - £500M
Directors: A.J.F. O'Reilly (non Exec)
Product Groups: 33-70.1
Employees: Over 1501

Wearnes Hollingsworth Ltd
Peveril Ho, Castleton, Sheffield, S30 2WR
Tel: 01433- 621555 **Fax:** 01433- 621290 **Turnover:** £2 - £5M
Directors: F. More (MD)
Product Groups: 33-76.0
Employees: 101-250

Wellhouse Pottery Ltd
The Old Pound House, Milton St, Brixham S. Devon, TQ5 0BX
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250
Directors: P. D. Greenham
Product Groups:
Employees: 1-10

Wesley Coe (Wingents) Ltd
115-117 Cambridge Rd, Milton, Cambridge, CB4 6 AY
Tel: 01223- 420768 **Fax:** 01223- 420516 **Turnover:** £0.500 - £1M
Directors: E. J. Wesley Coe (Ch and MD)
Product Groups: 33-76.0
Employees: 11-20

Williamson Cliff Ltd
Little Casterton Rd, Stamford, Lincs, PE9 2HT
Tel: 01780- 64383 **Fax:** 01780- 53295 **Turnover:** £1 - £2M
Directors: A. J. C. thomas (Ch)
Product Groups: 33-81.0
Employees: 101-250

Winchester Tile Co. Ltd
Unit C1, Pegasus Court, Ardglen Rd, Whitchurch, Hants., RG28 7BB
Tel: 01256- 896922 **Fax:** N/A **Turnover:** Up to £0.250
Directors: V. Leeming
Product Groups:
Employees: 1-10

Woodland Potteries Ltd
Lambert St, Tunstall, Stoke-on-Trent ST6 6AN
Tel: 01782- 811212 **Fax:** 01782- 823520 **Turnover:** £2 - £5M
Directors: R.E.G. Iggulden (Ch)
Product Groups: 33-70.0,1
Employees: 101-250

Wren Technologies
Wren Ho, 51 Farm Drive, Tilehurst, Reading, RG31 4EU
Directors: N/A
Product Groups: 33 -74.0

Tel: 01189- 414123 **Fax:** 01189- 452002 **Turnover:** N/A **Employees:**
Yieldcone Ltd **Directors:** S. P. Singh (Dr)
Unit 3, Williamson St, Tunstall, Stoke-on-Trent, ST6 6EU **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** Up to £0.250 **Employees:** 1-10
Yorkshire Aggregates Ltd **Directors:** M. D. Jones
Forge Cottage, 57 High St, Braithwell, Rotherham, S66 7AW **Product Groups:**
Tel: N/A **Fax:** N/A **Turnover:** £0.500 - £1M **Employees:** 11-20

b. French companies

Aleonard Tuilerie de Pontigny **Directors:**
Aleonard Tuilerie de Pontigny, 29 Route d'Auxerre, CIX 12, 89230 PONTIGNY **Product Groups:** 264B
Tel: 03 86 47 41 52 **Fax:** 03 86 47 55 18 **Turnover:** £2 - £5M **Employees:** 21-50
Allia **Directors:**
Allia, 696 Rue Yves Kermen, 92558 BOULOGNE BILLANCOURT CEDEX **Product Groups:** 262C
Tel: 01 46 94 16 16 **Fax:** 01 46 94 16 00 **Turnover:** £5 - £10M **Employees:** 501-1000
Allia **Directors:**
Allia, ZI de Magre, Rue Stuart Mill, 87000 LIMOGES **Product Groups:** 262C
Tel: 05 55 30 14 43 **Fax:** 05 55 30 78 08 **Turnover:** £0.500 - £1M **Employees:** 101-250
Alsacienne de Produits Réfractaires **Directors:**
Alsacienne de Produits, 36 Route de Rountzenheim, 67620 SOUFFLENHEIM **Product Groups:** 262L
Tel: 03 88 86 61 07 **Fax:** 03 88 86 76 32 **Turnover:** £0.250 - £0.500 **Employees:** 21-50
Argence Santons et Céramique **Directors:**
Argence Santons et Céramique, 80 Boulevard Roume, 13013 MARSEILLE **Product Groups:** 262J
Tel: 04 91 66 00 75 **Fax:** **Turnover:** N/A **Employees:** 1-10
Arts Céramiques R. Delarue **Directors:**
Arts Céramiques R. Delarue, 25 Route de la Brasserie, 62240 LONGFOSSE **Product Groups:** 262A
Tel: 03 21 83 00 10 **Fax:** **Turnover:** Up to £0.250 **Employees:** 1-10
B.E.R.E. **Directors:**
B.E.R.E., 28 Avenue d'Alsace, 59100 ROUBAIX **Product Groups:** 264A
Tel: 03 20 70 42 12 **Fax:** 03 20 75 61 81 **Turnover:** £0.500 - £1M **Employees:** 21-50
Baikowski Chimie **Directors:** Djololian, C.

Les marais noirs ouest, 74330 POISY
Tel: 04 50 22 69 02 **Fax:** 04 50 22 28 92 **Turnover:** £2 - £5M
Product Groups: 241E
Employees:
Directors:

Beka France
Beka France, ZI la Chesnois, BP 204, 54154 BRIEY CEDEX
Tel: 03 82 46 11 64 **Fax:** 03 82 46 65 38 **Turnover:** £2 - £5M
Product Groups: 262L
Employees: 21-50
Directors: Bony

Bony S.A.
Bony S.A., 53 Boulevard Fauriat, BP 42, 42001 ST ETIENNE CEDEX 01
Tel: 04 77 33 39 04 **Fax:** 04 77 33 86 10 **Turnover:** N/A
Product Groups: 262L
Employees: 51-100
Directors:

Briqueterie Quiénot
Briqueterie Quiénot, Rue de Calonne, BP 3, 62260 CAUCHY A LA TOUR CEDEX
Tel: 03 21 27 03 11 **Fax:** 03 21 64 83 89 **Turnover:** £1 - £2M
Product Groups: 264A
Employees: 21-50
Directors:

Briqueteries de l'Entreprise de Roubaix et des Environs
Briqueteries de l'Et. de Roubaix, 187 Rue du Calvaire, 59510 HEM
Tel: 03 20 75 66 42 **Fax:** 03 20 75 61 81 **Turnover:** £0.500 - £1M
Product Groups: 264B
Employees:
Directors:

BSA Produits Céramiques
BSA Produits Céramiques, Route de Viviers, 07700 BOURG ST ANDEOL
Tel: 04 75 54 43 98 **Fax:** 04 75 54 49 67 **Turnover:** £0.500 - £1M
Product Groups: 263Z
Employees: 51-100
Directors: Barrey, J.L.

C.T.E. Constructions Thermiques Européennes
C.T.E., Rue Beau Soleil, 47500 MONSEMPRON LIBOS
Tel: 05 53 71 13 01 **Fax:** 05 53 71 22 00 **Turnover:** £2 - £5M
Product Groups: 262L
Employees: 51-100
Directors:

Carofrance Céramique
Carofrance Céramique, 43230 COUTEUGES CEDEX
Tel: 04 71 76 85 55 **Fax:** 04 71 76 62 87 **Turnover:** £20 - £50M
Product Groups: 263Z
Employees: 101-250
Directors: Sassoli de Bianchi, G.

Carreaux D'Aquitaine
B.P. 15. Pardies, 64150 NOGUERES
Tel: 05 59 60 91 00 **Fax:** 05 59 60 91 33 **Turnover:** N/A
Product Groups: 263Z
Employees:
Directors:

Carrelages de Ravel
Carrelages de Ravel, 63190 RAVEL
Tel: 04 73 68 42 22 **Fax:** 04 73 68 42 33 **Turnover:** Up to £0.250
Product Groups: 263Z
Employees: 1-10
Directors: Canotti, G.

Cerabati Céramique S.A.
22, boulevard d'Anvaux; 36000 CHATEAUROUX
Tel: 02 54 27 27 85 **Fax:** 02 54 27 37 27 **Turnover:** £20 - £50M
Product Groups: 26.3Z
Employees: 251-500

Directors:

Cérafrance CGN
Cérafrance CGN, Route de Marseille en Beauvaisis, BP 12, 76220 FERRIERES EN BRAY CEDEX
Tel: 02 35 90 00 95 **Fax:** 02 35 90 89 88 **Turnover:** £2 - £5M
Product Groups: 262J
Employees: 51-100
Directors:

Ceralep
Ceralep, BP 73, 26240 LAVEYRON CEDEX
Tel: 04 75 23 88 88 **Fax:** 04 75 23 20 26 **Turnover:** N/A
Product Groups: 262E
Employees: 251-500
Directors: Corade, P.

Ceramicor
Chemin des Usines, 60850 ST GERMER DE FLY
Tel: 03 44 82 62 39 **Fax:** 03 44 82 64 58 **Turnover:** N/A
Product Groups: 262A
Employees:
Directors:

Céramique de France
Céramique de France, Rue Bernard de Palissy, 62400 BETHUNE
Tel: 03 21 57 55 55 **Fax:** 03 21 68 49 49 **Turnover:** £0.500 - £1M
Product Groups: 262A
Employees: 51-100
Directors:

Céramique de la Lys
Céramique de la Lys, 32 Rue du Fort Gassion, 62120 AIRE SUR LA LYS
Tel: 03 21 95 60 80 **Fax:** 03 21 39 21 33 **Turnover:** £2 - £5M
Product Groups: 264C
Employees: 51-100
Directors:

Ceramiques Ducrot SA
Ceramiques Ducrot SA, la Cimenterie, 71430 PALINGES
Tel: 03 85 70 23 52 **Fax:** 03 85 88 11 26 **Turnover:** £0.500 - £1M
Product Groups: 264B
Employees: 11-20
Directors: Deny, P.

Céramiques et Composites
Céramiques et Composites, ZI, BP 7, 65460 BAZET CEDEX
Tel: 05 62 33 39 32 **Fax:** 05 62 33 36 15 **Turnover:** £5 - £10M
Product Groups: 262J
Employees:
Directors: Court, G.

Ceraquitaine
24410 SAINT-AULAYE
Tel: 05 53 90 86 11 **Fax:** 05 53 90 86 96 **Turnover:** Up to £0.250
Product Groups: 262L
Employees: 1-10
Directors: Chastagner, G.

Chastagner Porcelaines S.A.
Chastagner S.A., 20 Avenue des Casseaux, BP 101, 87003 LIMOGES CEDEX
Tel: 05 55 33 45 74 **Fax:** 05 55 32 59 58 **Turnover:** £2 - £5M
Product Groups: 262A
Employees: 51-100
Directors:

Clertan
Clertan, Chemin de Labie, 64121 SERRES CASTET
Tel: 05 59 33 18 71 **Fax:** 05 59 33 71 47 **Turnover:** £0.500 - £1M
Product Groups: 262A
Employees: 1-10
Directors:

Coquet

Coquet, 87400 ST LEONARD DE NOBLAT
Tel: 05 55 56 08 28 **Fax:** 05 55 56 13 97 **Turnover:** £2 - £5M
Product Groups: 262A
Employees:
Directors:

Coquet Michel S.A.
Coquet Michel S.A., 66 Rue de Paris, 93100 MONTREUIL
Tel: 01 48 58 57 12 **Fax:** 01 48 58 31 39 **Turnover:** £0.250 - £0.500
Product Groups: 262J
Employees: 21-50
Directors:

D.A.M.
D.A.M., 218B Rue de Menchecourt, BP 42, 80102 ABBEVILLE CEDEX
Tel: 03 22 31 40 12 **Fax:** 03 22 31 24 05 **Turnover:** £2 - £5M
Product Groups: 262L
Employees:
Directors: Westermann, A.

Decize Céramique Industries
4 rue Diderot, 92150 SURESNES
Tel: 01 40 99 95 44 **Fax:** 01 46 97 08 99 **Turnover:** N/A
Product Groups: 262J
Employees:
Directors: Lillo, E.

Desmarquest S.A.
Desmarquest, 63 Rue Beaumarchais, BP 69, 93104 MONTREUIL CEDEX
Tel: 01 48 18 51 00 **Fax:** 01 48 18 51 51 **Turnover:** £20 - £50M
Product Groups: 262L
Employees: 251-500
Directors:

Desvres
Desvres, Centre d'Affaire la Boursidière, BP 50, 92357 LE PLESSIS ROBINSON CEDEX
Tel: 01 46 01 02 02 **Fax:** 01 46 01 03 10 **Turnover:** £50 - £75M
Product Groups: 263Z
Employees:
Directors: Lasserre, A.

Desvres S.A.
Desvres, Rue Eugène Chimot, BP 13, 59168 BOUSSOIS CEDEX
Tel: 03 27 69 14 70 **Fax:** 03 27 68 93 11 **Turnover:** £50 - £75M
Product Groups: 262A
Employees: 501-1000
Directors:

Distrisol SARL
Distrisol SARL, Z I du Sauvoy, 21 Avenue Montboulon, 77165 ST SOUPPLETS
Tel: 01 60 01 45 45 **Fax:** 01 35 32 36 87 **Turnover:** £2 - £5M
Product Groups: 262L
Employees: 21-50
Directors: Vilain, E.

Drimmer SA
Z.I., B.P.8, 12033 RODEZ
Tel: 05 65 67 00 21 **Fax:** 05 65 42 88 56 **Turnover:** N/A
Product Groups: 315C
Employees:
Directors: Westermann, A.

Emaux de Briare Technologies
4 rue Diderot, 92150 SURESNES
Tel: 01 40 99 95 44 **Fax:** 01 46 97 08 99 **Turnover:** N/A
Product Groups: 263Z
Employees:
Directors:

Esteban
Esteban, ZI Sud, BP 15, 34880 LAVERUNE CEDEX
Tel: 04 67 07 05 20 **Fax:** 04 67 07 05 25 **Turnover:** £1 - £2M
Product Groups: 262A
Employees: 21-50

Etablissement Merigous
Rue Marthe Dutheil, Z.I. le Ponteix, B.P. 9, 87220 FEYTIAT
Tel: 05 55 30 23 67 **Fax:** 05 55 30 83 46 **Turnover:** N/A
Directors: Merigous, L.
Product Groups: 262A
Employees:

Etablissements de Schuytener
Route de Grumesnil, 60220 FORMERIE
Tel: 03 44 46 18 27 **Fax:** 03 44 04 04 75 **Turnover:** N/A
Directors: Schuytener, R.
Product Groups: 514S
Employees:

Ets Gelis Poudenx Sans
Ets Gelis Poudenx Sans, Route d'Auch, BP 313, 31773 COLOMIERS CEDEX
Tel: 05 61 30 61 00 **Fax:** 05 61 30 61 07 **Turnover:** £20 - £50M
Directors:
Product Groups: 264A
Employees: 501-1000

Ets Jacques Dumont
Ets Jacques Dumont, 7 Rue Pasteur, 75011 PARIS
Tel: 01 47 00 53 52 **Fax:** 01 43 38 90 95 **Turnover:** £0.500 - £1M
Directors:
Product Groups: 262A
Employees: 1-10

Ets Porcher
Ets Porcher, 151 Avenue de la Libération, BP 53, 42125 LE COTEAU CEDEX
Tel: 04 77 44 81 50 **Fax:** 04 77 44 81 58 **Turnover:** N/A
Directors:
Product Groups: 262J
Employees:

Ets Porcher
Ets Porcher, Z.I. Nø 3, 16160 GOND PONTOUVRE
Tel: 05 45 97 86 00 **Fax:** 05 45 97 86 08 **Turnover:** N/A
Directors:
Product Groups: 262C
Employees:

Ets Simonne Favier
Ets Simonne Favier, Ancien Couvent des Capucins, Route de Moustiers, 04500 RIEZ
Tel: 04 92 77 80 29 **Fax:** **Turnover:** N/A
Directors:
Product Groups: 262A
Employees: 1-10

Ets Winckelmans S.A.
Ets Winckelmans S.A, 584 Avenue de Dunkerque, 59160 LOMME
Tel: 03 20 92 16 54 **Fax:** 03 20 09 54 02 **Turnover:** £2 - £5M
Directors: Winckelmans, J.
Product Groups: 263Z
Employees: 101-250

Eurosil
Eurosil, 116B Avenue du Maréchal Leclerc, 77460 SOUPPES SUR LOING
Tel: 01 64 29 68 91 **Fax:** 01 64 78 20 29 **Turnover:** £0.500 - £1M
Directors:
Product Groups: 262L
Employees: 1-10

Faïencerie d'Art de Clamecy Colas Roger
Faïencerie d'Art de Clamecy, 6 Faubourg de Bethleem, BP 36, 58501 CLAMECY CEDEX
Tel: 03 86 27 11 77 **Fax:** 03 86 27 18 03 **Turnover:** £0.250 - £0.500
Directors:
Product Groups: 262A
Employees: 11-20

Faïencerie de Pornic
Faïencerie de Pornic, Chemin du Cracaud, BP 2, 44210 PORNIC CEDEX
Directors:
Product Groups: 262A

Tel: 02 40 82 01 73 **Fax:** 02 40 82 14 67 **Turnover:** N/A
Employees:
Directors:

Faïencerie du Pot Laval
Faïencerie du Pot Laval, 26160 LE POET LAVAL
Tel: 04 75 46 41 03 **Fax:** 04 75 46 49 75 **Turnover:** £0.500 - £1M
Product Groups: 262A
Employees: 21-50
Directors:

Faïencerie Masse Fourmaintraux
Faïencerie Masse Fourmaintraux, 114 Rue Jean Jaurès, 62240 DESVRES
Tel: 03 21 91 63 99 **Fax:** 03 21 87 49 38 **Turnover:** £1 - £2M
Product Groups: 262A
Employees: 51-100
Directors: Laveniere, J.P.

Fauchon Baudot
Fauchon Baudot, 33 Quai de l'Industrie, 71600 PARAY LE MONIAL
Tel: 03 85 81 07 83 **Fax:** 03 85 81 49 02 **Turnover:** £1 - £2M
Product Groups: 262L
Employees: 51-100
Directors:

Fauvel
Fauvel, La Croix sous l'Ange, 50680 MOON SUR ELLE
Tel: 02 33 56 83 31 **Fax:** 02 33 56 03 10 **Turnover:** N/A
Product Groups: 263Z
Employees: 21-50
Directors:

Ferry M.
Ferry M., Rue des Abbés Mathis et Marion, 88700 RAMBERVILLERS
Tel: 03 29 65 08 32 **Fax:** **Turnover:** N/A
Product Groups: 262A
Employees: 1-10
Directors:

Fotec
Fotec, Les Plantées, 42170 ST MARCELLIN EN FOREZ
Tel: 04 77 52 85 13 **Fax:** 04 77 52 81 48 **Turnover:** £2 - £5M
Product Groups: 264A
Employees: 21-50
Directors: Canotti, G.

France Alfa
France Alfa, ZI du Cérou, BP 62, 81400 CARMAUX CEDEX
Tel: 05 63 36 85 60 **Fax:** 05 63 76 62 58 **Turnover:** £20 - £50M
Product Groups: 263Z
Employees: 101-250
Directors:

G P S
G P S, 81220 DAMIATTE
Tel: 05 63 70 61 02 **Fax:** 05 63 70 60 92 **Turnover:** £2 - £5M
Product Groups: 264A
Employees: 51-100
Directors:

GDA
GDA, 28 Rue Donzelot, 87000 LIMOGES
Tel: 05 55 33 27 37 **Fax:** 05 55 32 09 40 **Turnover:** £2 - £5M
Product Groups: 262A
Employees:
Directors: Valadeau, M.L.

Gerard Serpaut & Cie
52 bis, rue François-Chénieux, 87000 LIMOGES
Tel: 05 55 77 36 47 **Fax:** N/A **Turnover:** N/A
Product Groups: 262A
Employees:
Directors: Dutilleul-Francoeur, J.P.

Grès d'Artois

Grès d'Artois, 2 Rue de la Sauer, 67660 BETSCHDORF
Tel: 03 88 54 43 10 **Fax:** 03 88 54 51 55 **Turnover:** £5 - £10M
Product Groups: 263Z
Employees: 51-100
Directors: Michel, A.

Grès du colombier
Orriule, 64390 SAUVETERRE-DE-BEARN
Tel: 05 59 38 02 02 **Fax:** 05 59 65 06 55 **Turnover:** N/A
Product Groups: 263Z
Employees:
Directors:

Guiraud Frères
Guiraud Frères, 114 Boulevard de l'Embouchure, BP 2139, 31018 TOULOUSE CEDEX
Tel: 05 61 26 54 00 **Fax:** 05 61 26 54 73 **Turnover:** £20 - £50M
Product Groups: 264B
Employees: 501-1000
Directors:

I.R.B.
I.R.B., Avenue de la Falaise, BP 16, 38360 SASSENAGE
Tel: 04 76 27 53 19 **Fax:** 04 76 27 03 83 **Turnover:** £20 - £50M
Product Groups: 264B
Employees: 251-500
Directors:

I.R.B.
I.R.B., ZI, 69650 QUINCIEUX
Tel: 04 72 26 39 39 **Fax:** 04 78 91 17 67 **Turnover:** N/A
Product Groups: 264B
Employees:
Directors:

Jacob Delafon
Jacob Delafon, Hotel le Grand Veneur, 60 Rue de Turenne, 75139 PARIS CEDEX 03
Tel: 01 40 27 53 00 **Fax:** 01 48 04 98 61 **Turnover:** £50 - £75M
Product Groups: 262C
Employees: 1001-1500
Directors: Rembault, P.

Jacob Delafon
Jacob Delafon, ZI de Teinchurier, Rue Frédéric Sauvage, 19100 BRIVE LA GAILLARDE
Tel: 05 55 88 90 20 **Fax:** 05 55 86 02 71 **Turnover:** £50 - £75M
Product Groups: 262C
Employees:
Directors:

Kerlane
Kerlane, les Landelles, BP 9, 22210 PLEMET CEDEX
Tel: 02 96 25 61 01 **Fax:** 02 96 25 64 18 **Turnover:** N/A
Product Groups: 262L
Employees:
Directors: Lorenzo, F.

Kerlane
Kerlane, 17 Rue Antoine Durafour, 42420 LORETTE
Tel: 04 77 73 70 00 **Fax:** 04 77 73 70 01 **Turnover:** N/A
Product Groups: 262L
Employees: 101-250
Directors:

Korzilius
Korzilius, 1 Rue André Kiener, 68012 COLMAR CEDEX
Tel: 03 89 41 00 64 **Fax:** 03 89 23 52 17 **Turnover:** £10 - £20M
Product Groups: 262A
Employees: 101-250
Directors:

L Industrielle Régionale du B-timent
L Industrielle Régionale du, 69610 STE FOY L ARGENTIERE
Tel: 04 74 26 27 28 **Fax:** 04 74 26 12 94 **Turnover:** N/A
Product Groups: 264B
Employees:

Directors:

La Poterie d' Anduze
La Poterie d' Anduze, Quartier La Poterie, 30140 ANDUZE
Tel: 04 66 61 80 86 **Fax:** **Turnover:** N/A
Product Groups: 262A
Employees: 1-10
Directors:

La Poterie Provenale
La Poterie Provenale, 1689 Route de la Mer, 06410 BIOT
Tel: 04 93 65 63 30 **Fax:** 04 93 65 02 82 **Turnover:** Up to £0.250
Product Groups: 262J
Employees: 1-10
Directors:

Lafarge Refractaires Monolithiques
Lafarge Refractaires, Route de Troyes, BP 93, 51120 SEZANNE CEDEX
Tel: 03 26 80 54 44 **Fax:** 03 26 81 34 39 **Turnover:** N/A
Product Groups: 262L
Employees:
Directors:

Lafarge Réfractaires Monolithiques
Lafarge Réfractaires, Route de Balaruc La Peyrade, 34110 FRONTIGNAN
Tel: 04 67 80 14 14 **Fax:** 04 67 48 64 45 **Turnover:** N/A
Product Groups: 262L
Employees:
Directors:

Lamour
Lamour, 77 Rue Faidherbe, BP 25, 59119 WAZIERS CEDEX
Tel: 03 27 96 24 30 **Fax:** 03 27 96 81 23 **Turnover:** £1 - £2M
Product Groups: 264A
Employees: 21-50
Directors: Agneray, L.

LCC - Compagnie Européenne de Composants Electroniques
50, rue Jean-Pierre Timbaud, 92400 COURBEVOIE
Tel: 01 49 05 39 20 **Fax:** 01 49 05 39 01 **Turnover:** N/A
Product Groups:
Employees:
Directors:

Les Carreaux d' Apt
Les Carreaux d' Apt, Halle aux Argiles les Eygaux, 84400 APT
Tel: 04 90 04 79 20 **Fax:** 04 90 74 62 91 **Turnover:** N/A
Product Groups: 262J
Employees: 1-10
Directors:

Les Grès de Bonny
Les Grès de Bonny, 50 Rue du Faubourg Villeneuve, BP 13, 45420 BONNY SUR LOIRE CEDEX
Tel: 02 38 31 65 67 **Fax:** 02 38 31 58 48 **Turnover:** N/A
Product Groups: 262A
Employees: 11-20
Directors:

Les Grès du Ternois
Les Grès du Ternois, 28 Rue Jules Elby, 62150 LA COMTE
Tel: 03 21 41 07 00 **Fax:** 03 21 03 20 52 **Turnover:** £2 - £5M
Product Groups: 263Z
Employees: 21-50
Directors: Pessiot, D.

Les Produits Siliceux
Les Produits Siliceux, Route de Vendoeuvre, 36500 BUZANCAIS
Tel: 02 54 84 02 20 **Fax:** 02 54 02 18 10 **Turnover:** £2 - £5M
Product Groups: 262L
Employees: 51-100
Directors: Labouré, J-P.

Longchamp Carreaux
Longchamp Carreaux, Casamen, 25000 BESANCON
Product Groups: 263Z

Tel: 03 81 51 42 70 **Fax:** 03 81 52 68 04 **Turnover:** £0.500 - £1M
Employees: 11-20
Directors:

M.C.I.

M.C.I., ZI des Chatelets, 8 Rue du Boisillon, 22950 TREGUEUX
Product Groups: 262L
Tel: 02 96 78 79 80 **Fax:** 02 96 78 65 67 **Turnover:** £0.500 - £1M
Employees: 11-20
Directors:

Manufacture de Luneville Saint Clément

Manufacture Luneville St Clément, 3 Cité Paradis, 75010 PARIS
Product Groups: 262A
Tel: 01 47 70 57 53 **Fax:** 01 42 46 53 05 **Turnover:** N/A
Employees: 101-250
Directors: Médard, G.

Medard de Noblat

Medard de Noblat, Rue du Docteur Dourdet, 87400 SAUVIAT SUR VIGE
Product Groups: 262A
Tel: 05 55 75 30 22 **Fax:** 05 55 75 36 66 **Turnover:** £2 - £5M
Employees: 51-100
Directors:

Migeon S.A.

Migeon S.A., 2 Rue de la Tuilerie, BP 2, 68520 BURNHAUPT LE HAUT CEDEX
Product Groups: 264B
Tel: 03 89 48 70 60 **Fax:** 03 89 48 76 55 **Turnover:** N/A
Employees: 251-500
Directors:

Molin (S.A.)

Molin (S.A.), Route de Lugny, BP 12, 71120 CHAROLLES CEDEX
Product Groups: 262A
Tel: 03 85 24 13 46 **Fax:** 03 85 88 33 85 **Turnover:** £0.500 - £1M
Employees: 21-50
Directors:

Montgolfier-Etang

Montgolfier-Etang, BP 6, 49640 DAUMERAY CEDEX
Product Groups: 262A
Tel: 02 41 32 56 99 **Fax:** 02 41 32 59 32 **Turnover:** £0.500 - £1M
Employees: 21-50
Directors:

Morgan - Matroc SA

Morgan - Matroc SA, ZI, 35 Rue Gay Lussac, BP 100, 95504 GONESSE CEDEX
Product Groups: 262J
Tel: 01 39 85 28 00 **Fax:** 01 39 85 75 25 **Turnover:** N/A
Employees:
Directors:

Mosaïques de France

Mosaïques de France, ZI du, Pré Grand, 81400 CARMAUX
Product Groups: 263Z
Tel: 05 63 36 85 60 **Fax:** 05 63 76 62 58 **Turnover:** £2 - £5M
Employees: 51-100
Directors:

Natoli

Natoli, Boulevard des Deux Vallons, 06220 VALLAURIS
Product Groups: 262A
Tel: 04 93 63 90 14 **Fax:** 04 93 63 23 62 **Turnover:** Up to £0.250
Employees: 1-10
Directors: Boissonet, J.L.

Novoceram Exploitation Novex

Novoceram Exploitation Novex, Avenue Eugéne Buissonnet, BP 20, 26240 ST VALLIER CEDEX
Product Groups: 263Z
Tel: 04 75 23 10 55 **Fax:** 04 75 23 32 92 **Turnover:** £2 - £5M
Employees:

Omega Technologies
Omega Technologies, 5 Avenue du Quebec, BP 95, 91943 COURTABOEUF CEDEX
Tel: 01 69 29 86 30 **Fax:** **Turnover:** N/A

Pacema
Pacema, Route de la Roche, 91340 OLLAINVILLE
Tel: 01 64 90 16 56 **Fax:** 01 60 83 43 35 **Turnover:** N/A

Pantin-Réfractaires
Pantin-Réfractaires, 20B Rue Rouget de l'Isle, 93500 PANTIN
Tel: 01 48 45 11 40 **Fax:** 01 48 45 73 40 **Turnover:** £0.250 - £0.500

Paray Céramiques
Paray Céramiques, 21 Square Saint Charles, 75012 PARIS
Tel: 01 44 74 89 10 **Fax:** 01 44 74 00 22 **Turnover:** £5 - £10M

Pasek France
Pasek France, 54890 BAYONVILLE SUR MAD
Tel: 03 83 81 80 35 **Fax:** 03 83 81 85 37 **Turnover:** N/A

Pillivuyt S.A.
Pillivuyt S.A., Allée de la Manufacture, 18500 MEHUN SUR YEVRE
Tel: 02 48 67 31 00 **Fax:** 02 48 57 13 00 **Turnover:** £10 - £20M

Porcelaine Carpenet
Route de Bujaleuf, 87400 ST LEONARD DE NOBLAT
Tel: 05 55 56 02 39 **Fax:** 05 55 56 24 72 **Turnover:** N/A

Porcelaine de Paris - Porcelaine d'Auteuil
Porcelaine de Paris - Porcelaine, 8 Rue de la Pierre Levée, 75011 PARIS
Tel: 01 43 57 40 35 **Fax:** 01 43 57 99 80 **Turnover:** £2 - £5M

Porcelaine J.P.M.
Porcelaine J.P.M., Le Chevrier, BP 35, 87500 ST YRIEIX LA PERCHE CEDEX
Tel: 05 55 75 91 27 **Fax:** 05 55 08 36 09 **Turnover:** £0.500 - £1M

Porcelaines d'Avignon SA et Céramiques Industrielles
Porcelaines Avignon SA et, Route de Noirlac, 18200 BRUERE ALLICHAMPS
Tel: 02 48 61 03 83 **Fax:** 02 48 61 02 22 **Turnover:** £1 - £2M

Porcelaines Limoges Castel
Porcelaines Limoges Castel, ZI Magre, Avenue du Président Kennedy, 87000 LIMOGES

Directors:
Product Groups: 262E
Employees: 21-50
Directors:
Product Groups: 264A
Employees: 51-100
Directors:
Product Groups: 262L
Employees: 1-10
Directors:
Product Groups: 263Z
Employees: 101-250
Directors:
Product Groups: 262L
Employees: 101-250
Directors: Binkertm B.
Product Groups: 262A
Employees: 251-500
Directors: Mme Carpenet
Product Groups: 262A
Employees:
Directors:
Product Groups: 262A
Employees: 21-50
Directors:
Product Groups: 262A
Employees: 21-50
Directors: Detroyes, J.P.
Product Groups: 262A
Employees: 21-50
Directors: Decoster, D.
Product Groups: 262A

Tel:	05 55 30 26 23	**Fax:**	05 55 06 26 91	**Turnover:**	£5 - £10M	**Employees:**	51-100
Poterie Clarous						**Directors:**	Clarous, G.
Poterie Clarous, Route d'Arbas, 31260 MANE						**Product Groups:**	262A
Tel:	05 61 90 54 54	**Fax:**	05 61 90 68 56	**Turnover:**	N/A	**Employees:**	21-50
Poterie d'Alsace Henri Siegfried						**Directors:**	
Poterie d'Alsace Henri Siegfried, 10 Rue Hagenau, 67620 SOUFFLENHEIM						**Product Groups:**	262A
Tel:	03 88 86 60 63	**Fax:**	03 88 86 77 72	**Turnover:**	£0.500 - £1M	**Employees:**	21-50
Poterie de Méditerranée						**Directors:**	Ravel, G.
Poterie de Méditerranée, ZI Les Paluds, Avenue des Caniers, 13400 AUBAGNE						**Product Groups:**	262A
Tel:	04 42 84 47 73	**Fax:**	04 42 82 00 87	**Turnover:**	£0.500 - £1M	**Employees:**	11-20
Poterie Lorraine						**Directors:**	Bertrand, C.
Poterie Lorraine, BP 2, 88700 RAMBERVILLERS						**Product Groups:**	262A
Tel:	03 29 68 52 52	**Fax:**	03 29 65 45 54	**Turnover:**	£2 - £5M	**Employees:**	101-250
Poterie René Beck						**Directors:**	Beck, R.
Poterie René Beck, 8 Rue Montagne, 67620 SOUFFLENHEIM						**Product Groups:**	262A
Tel:	03 88 86 60 36	**Fax:**	03 88 86 77 01	**Turnover:**	£1 - £2M	**Employees:**	21-50
Poteries de Lanveur						**Directors:**	
Poteries de Lanveur, 7 Rue Chauvin, 06000 NICE						**Product Groups:**	262J
Tel:	04 93 80 35 92	**Fax:**	04 93 85 17 17	**Turnover:**	£1 - £2M	**Employees:**	
Pousseur Produits Réfractaires						**Directors:**	Pousseur, E.
Pousseur Produits Réfractaires, R.N. 51, BP 10, 08320 VIREUX MOLHAIN CEDEX						**Product Groups:**	262L
Tel:	03 24 41 82 67	**Fax:**	03 24 41 79 38	**Turnover:**	£0.500 - £1M	**Employees:**	21-50
PREMA						**Directors:**	
PREMA, Avenue de la Gare, BP 09, 30700 UZES						**Product Groups:**	262L
Tel:	04 66 22 11 28	**Fax:**	04 66 22 48 03	**Turnover:**	N/A	**Employees:**	11-20
Produits Céramiques de Touraine						**Directors:**	
Produits Céramiques de Touraine, 27 Rue Bas Bourgeau, 41130 SELLES SUR CHER						**Product Groups:**	262C
Tel:	02 54 97 55 24	**Fax:**	02 54 96 35 78	**Turnover:**	£20 - £50M	**Employees:**	251-500
Promoref						**Directors:**	Wanecq, F.
31 boulevard des Bouvets, 92000 NANTERRE						**Product Groups:**	262L
Tel:	01 46 96 38 60	**Fax:**	01 47 67 02 20	**Turnover:**	N/A	**Employees:**	
Pyrolave						**Directors:**	

Pyrolave, ZI du Chantre, 82100 CASTELSARRASIN
Tel: 05 63 95 05 32 **Fax:** 05 63 95 05 33 **Turnover:** £2 - £5M
Product Groups: 262A
Employees: 21-50
Directors: Montrieux, R.

Rairies (Terres Cuites des)
Rairies (Terres Cuites des), Route de Fouger, 49430 LES RAIRIES
Tel: 02 41 21 15 20 **Fax:** 02 41 21 15 30 **Turnover:** £2 - £5M
Product Groups: 263Z
Employees: 51-100
Directors: Raynaud, B.

Raynaud A. et Cie
Raynaud A. et Cie, 30B Rue de Paradis, 75010 PARIS
Tel: 01 47 70 94 89 **Fax:** 01 42 46 70 79 **Turnover:** N/A
Product Groups: 262A
Employees:
Directors: Bodiou, J.

Refral
Refral, Parc d'activité de Sologne, 41600 LAMOTTE BEUVRON
Tel: 02 54 96 86 50 **Fax:** 02 54 96 86 40 **Turnover:** £2 - £5M
Product Groups: 262L
Employees: 101-250
Directors: Passot, B.

Revol Porcelaine S.A.
Revol Porcelaine S.A., 3 Rue Hector Revol, 26240 ST UZE
Tel: 04 75 03 99 99 **Fax:** 04 75 23 27 49 **Turnover:** £0.500 - £1M
Product Groups: 262A
Employees: 251-500
Directors:

Rivereau Marcel S.A.
Rivereau Marcel S.A., Route d'Ancenis, 44430 LA BOISSIERE DU DORE
Tel: 02 40 33 70 43 **Fax:** 02 40 33 70 60 **Turnover:** £2 - £5M
Product Groups: 264A
Employees: 21-50
Directors:

Rochémail
Rochémail, 78 Quai d'Aubary, 63320 CHAMPEIX
Tel: 04 73 96 75 86 **Fax:** 04 73 96 27 21 **Turnover:** £0.250 - £0.500
Product Groups: 262A
Employees: 11-20
Directors: Kostka, M.

S.A. des Faïenceries et Emaux de Longwy
S.A. des Faïenceries et Emaux, 3 Rue des Emaux, 54400 LONGWY
Tel: 03 82 24 22 79 **Fax:** 03 82 23 53 52 **Turnover:** £0.500 - £1M
Product Groups: 262A
Employees: 21-50
Directors: Von Knoop, D.

S.I.P.C. Didier
S.I.P.C. Didier, 38 Route de Dourdan, BP 37, 91650 BREUILLET
Tel: 01 69 94 63 30 **Fax:** 01 69 94 63 32 **Turnover:** N/A
Product Groups: 262L; 741J
Employees:
Directors:

Saget S.N.
Saget S.N., La Tuilerie, Route Saint Gondon, BP 14, 45720 COULLONS CEDEX
Tel: 02 38 36 11 18 **Fax:** 02 38 29 21 27 **Turnover:** £1 - £2M
Product Groups: 264C
Employees: 21-50
Directors:

Saint Palais - Roca Briques
Saint Palais - Roca Briques, Lieu dit Le Pic Montaigu, 18110 ST PALAIS
Tel: 02 48 66 04 01 **Fax:** 02 48 66 01 71 **Turnover:** N/A
Product Groups: 264A
Employees: 21-50

Sarl Poterie Mallet Michel
Sarl Mallet Michel, Route de Cosne, 58310 ST AMAND EN PUISAYE
Tel: 03 86 39 60 80 **Fax:** 03 86 39 72 62 **Turnover:** N/A
Directors: Mallet, M.
Product Groups: 262A
Employees: 11-20

Sarreguemines Bâtiments S.A.
Sarreguemines Bâtiments, Rue du Colonel Cazal, BP 209, 57202 SARREGUEMINES CEDEX
Tel: 03 87 98 74 30 **Fax:** 03 87 95 72 50 **Turnover:** £20 - £50M
Directors: Fenal, G.
Product Groups: 262A
Employees: 251-500

Saverdun Terres Cuites
Saverdun Terres Cuites, Route de Canté, 09700 SAVERDUN
Tel: 05 61 60 30 28 **Fax:** 05 61 60 34 28 **Turnover:** N/A
Directors:
Product Groups: 264A
Employees: 21-50

Savoie Réfractaires
Savoie Réfractaires, 10 Rue de l'Industrie, BP 1, 69631 VENISSIEUX CEDEX
Tel: 04 78 78 13 00 **Fax:** 04 78 78 13 50 **Turnover:** N/A
Directors: Wanecq, F.
Product Groups: 262L
Employees: 251-500

Schmitter Poterie
Schmitter Poterie, 18 Rue de la Poste, 67660 BETSCHDORF
Tel: 03 88 54 42 44 **Fax:** **Turnover:** Up to £0.250
Directors:
Product Groups: 262A
Employees: 11-20

Segries SA
Segries SA, Route de Riez, 04360 MOUSTIERS STE MARIE
Tel: 04 92 74 66 69 **Fax:** 04 92 74 62 07 **Turnover:** £0.500 - £1M
Directors:
Product Groups: 262A
Employees: 11-20

Setrim
Setrim, ZI, 38570 GONCELIN
Tel: 04 76 71 71 00 **Fax:** 04 76 71 86 43 **Turnover:** £2 - £5M
Directors:
Product Groups: 263Z
Employees:

Smacchia Lazare
Smacchia Lazare, 5 Rue de l'Arceau, 13400 AUBAGNE
Tel: 04 42 03 23 48 **Fax:** **Turnover:** N/A
Directors:
Product Groups: 262A
Employees: 1-10

Société des Faïenceries de Salins
Sté des Faïenceries de Salins, 3 Cité Paradis, 75010 PARIS
Tel: 01 47 70 57 53 **Fax:** 01 42 46 53 05 **Turnover:** £2 - £5M
Directors:
Product Groups: 262C
Employees:

Société Nérac
Sté Nérac, La Relbro, 10 Rue de Milly, 91830 LE COUDRAY MONTCEAUX
Tel: 01 64 93 91 91 **Fax:** 01 64 93 87 56 **Turnover:** £0.500 - £1M
Directors:
Product Groups: 262E
Employees: 21-50

Société Nouvelle Masse et Surget
Sté Nouvelle Masse et Surget, Route de Foecy, 18500 MEHUN SUR YEVRE
Directors:
Product Groups: 262A

Tel: 02 48 57 30 56 **Fax:** 02 48 57 16 88 **Turnover:** £5 - £10M **Employees:** 21-50
Directors: Boutal, P.

Société Pierre Boutal
Sté Pierre Boutal, Quartier Saint Romain, BP 1, 83690 SALERNES CEDEX **Product Groups:** 263Z
Tel: 04 94 70 62 12 **Fax:** 04 94 67 52 73 **Turnover:** £2 - £5M **Employees:** 21-50
Directors:

Sogepo
Sogepo, Route de Villars, 01990 ST TRIVIER SUR MOIGNANS **Product Groups:** 262J
Tel: 04 74 55 81 02 **Fax:** 04 74 55 83 18 **Turnover:** £1 - £2M **Employees:** 21-50
Directors:

Sté Decopierre
Route de champdolent, 17430 BORDS **Product Groups:** 262A
Tel: 05 46 83 86 24 **Fax:** **Turnover:** £0.500 - £1M **Employees:** 21-50
Directors:

T.B.F.
Rue Nationale, 16270 ROUMAZIERES **Product Groups:** 264B
Tel: 05 45 71 80 00 **Fax:** 05 45 71 80 10 **Turnover:** £20 - £50M **Employees:** 251-500
Directors:

T.R.B.
BP 682, 57011 METZ CEDEX **Product Groups:** 262L
Tel: 03 87 50 32 43 **Fax:** 03 87 50 31 24 **Turnover:** N/A **Employees:**
Directors:

T.R.B.
Rue de la Neuville, BP 9, 62152 NESLES CEDEX **Product Groups:** 262L
Tel: 03 21 99 54 54 **Fax:** 03 21 99 54 50 **Turnover:** £10 - £20M **Employees:** 101-250
Directors: Goumot Labesse, Y.

Tharaud Porcelaine
Avenue Léon Blum, 87350 PANAZOL **Product Groups:** 262A
Tel: 05 55 30 25 22 **Fax:** 05 55 06 13 04 **Turnover:** £1 - £2M **Employees:** 51-100
Directors:

Thermal Ceramics de France
Lieu dit les Plantées, BP 4, 42680 ST MARCELLIN EN FOREZ **Product Groups:** 262L
Tel: 04 77 52 88 88 **Fax:** 04 77 52 84 27 **Turnover:** N/A **Employees:**
Directors:

Tuilerie Bisch
25 Rue de la Gare, 67470 SELTZ **Product Groups:** 264B
Tel: 03 88 86 19 19 **Fax:** 03 88 86 88 70 **Turnover:** £0.500 - £1M **Employees:** 101-250
Directors:

Tuilerie Briqueterie Poudenx
40380 ST GEOURS D AURIBAT **Product Groups:** 264B
Tel: 05 58 98 91 00 **Fax:** 05 58 98 96 85 **Turnover:** £5 - £10M **Employees:** 51-100
Directors:

Tuilerie et Briqueterie du Pont d'Avignon

35 Avenue du Général Leclerc, 30400 VILLENEUVE LES AVIGNON
Tel: 04 90 25 54 76 **Fax:** 04 90 25 42 87 **Turnover:** £2 - £5M
Product Groups: 264A
Employees: 21-50
Directors:

Tuileries Huguenot Fenal
Route de Wahagnies, 59133 PHALEMPIN
Tel: 03 20 90 25 02 **Fax:** 03 20 32 72 81 **Turnover:** N/A
Product Groups: 264B
Employees:
Directors:

Tuileries Huguenot-Fenal
Tuileries Huguenot-Fenal, 11 Avenue de la Marne, 51340 PARGNY SUR SAULX
Tel: 03 26 73 68 00 **Fax:** 03 26 73 19 57 **Turnover:** £20 - £50M
Product Groups: 264B
Employees: 251-500
Directors:

Tuileries Jean Philippe Sturm
Tuileries Jean Philippe Sturm, Rue de la Tuillerie, 68250 ROUFFACH
Tel: 03 89 49 62 13 **Fax:** 03 89 49 64 96 **Turnover:** £10 - £20M
Product Groups: 264A
Employees:
Directors:

Tuileries Réunies du Bas-Rhin
Tuileries Réunies du*Bas-Rhin, 234 Rue de la Gare, 67160 WISSEMBOURG
Tel: 03 88 94 03 13 **Fax:** **Turnover:** N/A
Product Groups: 264A
Employees:
Directors:

Tuileries Réunies du Bas-Rhin
Tuileries Réunies du Bas-Rhin, Route de Hindisheim, 67880 KRAUTERGERSHEIM
Tel: 03 88 95 70 21 **Fax:** 03 88 95 76 52 **Turnover:** N/A
Product Groups: 264A
Employees:
Directors:

Tuiles Lambert
Tuiles Lambert, 37 Rue du Pieu, 78130 LES MUREAUX
Tel: 01 30 90 42 00 **Fax:** 01 30 99 75 95 **Turnover:** £20 - £50M
Product Groups: 264B
Employees: 251-500
Directors:

Tuiles Lambert
Tuiles Lambert, Rue Léon Saccard, 71150 CHAGNY
Tel: 03 85 87 05 64 **Fax:** 03 85 87 01 05 **Turnover:** N/A
Product Groups: 264B
Employees:
Directors:

Union Limousine
11, rue Karl Marx, B.P.540 18105 VIERZON
Tel: 02 48 75 26 21 **Fax:** 02 48 71 67 36 **Turnover:** N/A
Product Groups: 262A
Employees:
Directors:

Varicor
Varicor, 30 Rue de la Scierie, 67130 WISCHES
Tel: 03 88 97 54 89 **Fax:** 03 88 47 32 55 **Turnover:** £2 - £5M
Product Groups: 262J
Employees: 51-100
Directors:

Vibracim
Vibracim, 25 Rue Emile Vandamme, 59350 ST ANDRE LEZ LILLE
Tel: 03 20 51 62 75 **Fax:** 03 20 40 98 78 **Turnover:** £0.500 - £1M
Product Groups: 262L
Employees: 11-20

Villeroy et Boch
Villeroy et Boch, Route de Couloumier, 77320 LA FERTE GAUCHER
Tel: 01 64 75 64 75 **Fax:** 01 64 75 64 47 **Turnover:** N/A
Directors:
Product Groups: 263Z
Employees:

Villeroy et Boch SA
Villeroy et Boch SA, 68 Rue d'Hauteville, 75010 PARIS
Tel: 01 48 01 90 01 **Fax:** 01 40 22 01 52 **Turnover:** £75 - £125M
Directors: Marchalant, Y.
Product Groups: 263Z
Employees: Over 1501

Virebent Henri et Cie
Virebent Henri et Cie, 46700 PUY L EVEQUE
Tel: 05 65 21 30 03 **Fax:** 05 65 21 39 39 **Turnover:** Up to £0.250
Directors:
Product Groups: 262A
Employees: 1-10

APPENDIX C : GLOSSARY OF TERMS

Ball Clay A sedimentary kaolinitic clay that fires to a white colour and which, because of its very fine particle size, is highly plastic. The name is derived from the original method of winning in which the clay was cut into balls, each weighing 30-35lb.

Biscuit Pottery that has been fired but not yet glazed.

Biscuit Firing The process of kiln firing potteryware before it has beeb glazed. Earthenware is biscuit-fired at 1100-1150°C; bone china is biscuit-fired at 1200-1250°C.

Blunger A machine for mixing clay and/or other materials to form a slip; it usually consists of a large hexagonal vat with a slowly rotating vertical central shaft on which are mounted paddles. The process of producing a slip in such a machine is known as **blunging**.

BOD Biochemical Oxygen Demand.

Body A blend of raw materials awaiting shaping into pottery or refractory products.

Bone china Vitreous, translucent pottery made from a body of the following approximate composition: calcined bone, 45-50%; china clay, 20-25%, china stone, 25-30%. BS 5416 'china tableware' now specifies that bone china shall contain 'at least 35% by mass of the fired body of tricalcium phosphate'.

China Within the UK pottery industry this term refers to Bone China an essential feature of which is translucency. BS 5416 specifies this to be pottery with water obsorption 0.2% and translucency 0.75%.

China clay Kaolin - A white-firing clay consisting essentially of kaolinite. Major deposits are found in Devon & Cornwall. About 20% of total china clay output is used by the ceramics industry. Typical composition (%) = SiO2, 47%; Al_2O_3, 38%; Fe_2O_3, 1%; Alkalis, 2%; loss-on-ignition, 12%.

China stone Partly decomposed granite, consisting of feldspathic minerals and quartz, it is used as a flux in pottery bodies.

COD Chemical Oxygen Demand.

Decal From the USA word *decalcomania*, a particular type of transfer printing, aka lithography.

Dobbin	A type of dryer used in the tableware section of the pottery industry; the ware, while still in the plaster mould, is placed on horizontal turntables within the drying cabinet; the turntables can be rotated about a vertical axis so that the ware moves from the working opening into the interior of the dryer where moisture is removed from the mould and the ware by means of hot air.
Dry Pressing	The shaping of ceramic ware under high pressure (up to 14 000 p.s.i.), the moisture addition being kept to a minimum (5-6%) or, with some materials, eliminated by the use of a plasticizer, e.g. a stearate.
Faïence	Originally the French name for the earthenware made at Faenza, Italy, in the 16th century.
Fletton	An English building brick originally made at Fletton, now a suburb of Peterborough; centres of Fletton brickmaking also include Bedford and Bletchley. The bricks are made by the semi-dry process from Oxford Clay; this clay is shaly and contains much organic matters, which assists in the firing process.
Glost	This word, meaning "glazed", is used in compound terms such as "Glost ware" and " Glost placer".
Green	Ceramic ware in the condition after it has been shaped but before it has been dried and fired.
Jolleying	Terms applied to the shaping of hollow-ware in the same sense as Jigger and Jiggering are applied to the shaping of flat-ware.
Kiln	A kiln in which the full firing temperature is maintained continuously in one or other zone of the kiln.
Once-fired Ware	Ceramic whiteware to which a glaze is applied before the ware is fired, the biscuit firing and glost firing then being combined in a single operation. Sanitaryware is the principal type of ware made in this way.
Pitchers	Pottery that has been broken in the course of manufacture. Biscuit pitchers are crushed, ground and re-used, either in the same factory or elsewhere; the crushed material is also used in other industries as an inert filler. Because of the adhering glaze, glost pitchers find less use.
Porcelain	One type of vitreous ceramic whiteware and containing 40-50% kaolin, 15-25% quartz, and 20-30% feldspar.
Pug Mill	A shaft mixer with a closed barrel instead of an open trough.
Roller-hearth Kiln	A tunnel kiln through which the ware, placed on bats, is carried on rollers. Such kilns are rare in the ceramic industry.

Shraff	N. Staffordshire word for the waste from a pottery.
Sintering	The process of heating a compacted powder to a temperature lower than that necessary to produce a liquid phase but sufficiently high for solid-state reaction or intercrystallisation to take place so that the fired body acquires strength.
Slip	A suspension in water of clay and/or other ceramic materials; normally a deflocculant is added to disperse the particles and to prevent their settling out.
Spray drying	The process of dewatering a suspension, e.g. clay slip, by spraying the suspension into a heated chamber, the dried powder being removed from the bottom of the chamber.
Stoneware	Dense, impermeable and hard enough to resist scratching by a teel point, differs from porcelain because it is more opaque, and normally only partially vitrified.
Tunnel Kiln	A continuous kiln of the type in which ware passes through a stationary firing zone near the centre of the kiln. In the most common type of tunnel kiln the ware is placed on the refractory-lined deck of a car, a continuous series of loaded cars being slowly pushed through a long, straight, tunnel.
Vitrification	The progressive partial fusion of a clay, or of a body, as a result of a firing process or, in the case of a refractory material, of a conditions of use in a furnace lining.
Vitrified Hotelware	This can be regarded as feldspathic earthenware with little or no apparent porosity.
Whiteware	A general term for all those varieties of pottery that usually have a white body, e.g. tableware, sanitaryware and wall tiles.

APPENDIX D : TELEPHONE QUESTIONNAIRE

a. English questionnaire

GENERAL (ID: «ID»)

Director's contact name: **«Directors»**

If not the same person or N/A, name of the new contact?

....

Q1. Could You tell me your level of responsibility in the company?

1 = Senior management **2** = Line/operational management **3** = Technical

Q2. What is your prime role within the company?

Environmental Policy or Action 1

Energy Policy or Action 2

Technical/Production/Processes...3

Research & Development 4

Health & Safety 5

Sales & Marketing 6

General Management/Finance 7

Other 8

If N°1 (Env. Policy or Action) is not pointed out, ask for someone who has financial signing powers for environmental spending or is involved in environmental decisions.

Q3. Do you have any financial responsability i.e. able to give the go-ahead for expenditure?

1 = Yes **2** = No **3** = No answer

CURRENT OVERALL ISSUES FACING THE CERAMICS INDUSTRY

Q4. What are the three most important issues affecting the profitability of your company today:

Interest rates 1
UK competition 2
Overseas competition 3
Meeting statutory requirements/legislation 4
Raw material costs 5
General economic climate 6
Lack of consumer demand 7
Lack of government support 8
Exports 9
Lack of investment 10
Productivity 11
Quality of management 12
Environmental issues 13
Other 14
Don't know 15

DRIVERS AND BARRIERS FOR IMPROVING ENVIRONMENTAL PERFORMANCE

I would like to have your point of view in a number of statements and ranked each of them from 1 to 6:

1 = Strongly agree **2** = Tend to agree **3** = Neither agree nor disagree
4 = Tend to disagree **5** = Strongly disagree **6**= No opinion

Q5. My company does not have an environmental impact

1 2 3 4 5 6

Q6. Having an environmental policy does not currently benefit my company

1 2 3 4 5 6

Q7. Improving environmental performance usually improves production efficiency

1 2 3 4 5 6

Q8. We only take environmental action to meet legislation

1 2 3 4 5 6

Q9. It is not always clear how environmental legislation affect us

1	**2**	**3**	**4**	**5**	**6**

Q10.Financial constraints restrict us doing more to improve our environmental perf.

1	**2**	**3**	**4**	**5**	**6**

Q11. It would make it easier for us if better advice was available

1	**2**	**3**	**4**	**5**	**6**

Q12. Business environmental initiatives are of little benefit to my company

1	**2**	**3**	**4**	**5**	**6**

Q13. Reducing our environmental impact can have significant cost benefits

1	**2**	**3**	**4**	**5**	**6**

Q14. What is the main benefit to your Co. in improving environmental performance?

None 1
Waste minimisation 2
Increased efficiencies 3
Cost reductions to company 4
A safer working environment 5
Cleaner working environment 6
Improved local environment 7
Recycling 8
Reduced emissions 9
Helps company sell products 10
Better image among customers 11
Better image in local community 12
Better image among employees 13
Keep inspectors at bay 14
Complying with legislation 15
Reduction cost of waste disposal 16
Reduced labour costs 17
Noise reduction 18
Other 19
....
Don't know 20

Q15. How well do you think you are aware of the options and technology available to meet environmental legislation?

Very well informed..............................1 Fairly well informed......................2
Not very well informed........................3 Not at all informed........................4
Don't have an opinion 5

Q16. What are the key environmental impacts your company has on the environment?

Disposal of toxic and hazardous wastes 1
Disposal of non-toxic wastes 2
Disposal of packaging wastes 3
Indoor dust 4
Outdoor dust 5
Consumption of energy 6
VOC (Volatile Organic Compounds) emissions 7
Odour 8
Gaseous emissions (non specific) 9
Liquid effluent discharged to sewer 10
Inputs of water 11
Noise 12
Traffic and transport to & from the production site(s) 13
Health & safety 14
Land contamination 15
Other 16
....
....
None 17
Don't know 18

COMPANY ACTION TO IMPROVE ENVIRONMENTAL PERFORMANCE

Q17. Does your organisation have a formal corporate environmental policy, or are you considering one?

1 = **Yes**, have a policy **2** = **Yes**, considering **3** = **No**, no need

Q18. Are the levels of waste or emissions produced at your site monitored in any way?

1 = Yes **2** = No **3** = Don't know

Q19. Are reduction targets for emissions and waste set?

1 = Yes **2** = No **3** = Don't know

Q20. Is your company accredited, or will your company seek to be accredited under an environmental management system?

Already Accredited .... 1 Seek to be Accredited 2

Not Accredited or seeking to be................ 3 Don't know.............................4

Q21. **IF 1 or 2 to Q20**, Which one?

1 = BS7750 (for environmental management systems)

2 = EMAS(Eco management & Audit Scheme) **3** = ISO 14000

Other ....

....

How effective it is in encouraging business to improve their environmental perf.?

1 = Very effective **2** = Fairly effective **3** = Not very effective

4 = Not at all effective **5** = Don't know

Q22. *EMAS(Eco management & Audit Scheme)*............	1	2	3	4	5
Q23. BS7750	1	2	3	4	5
Q24.ISO 14000	1	2	3	4	5

Q25.Over the last 2 years, has your company introduced any change to improve environmental performance in its:

Managerial approach	**1** = Yes	**2** = No
Process procedures	**1** = Yes	**2** = No
Installed new piece of equipment	**1** = Yes	**2** = No

Q26.If **YES** what influenced you to change?

To meet legislation 1
To reduce costs 2
Increase cost of waste disposal 3
Need to renew equipment 4
To reduce waste 5
To improve image among customers 6
To improve image among employees 7
To improve image among local community 8
To improve image among financial stockholders 9
At suggestion of employee 10
External advice 11
New management 12
Recommended by audit/consultants 13
Other 14
....
Don't know 15

Q27. Would it be possible to describe very briefly one of these projects?

....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
....

Q28. Have you realised any benefits in adopting this procedure or equipment?

None 1

Complied with current legislation 2

Will comply with future legislation 3

Saved money 4

Sold products 5

Better relationship with customers 6

Better image in local community 7

Better image among employees 8

Better image among financial stockholders/shareholders 9

Has helped defend us against media criticism 10

Company have more prestige 11

Improved relationship with the regulating authority 12

Increased efficiency 13

Waste reduction 14

Other 15

....

....

Don't know 16

Q29.Have you noticed any disadvantages in adopting this procedure or equipment

None 1

Too expensive/costly (general) 2

Capital costs 3

Not cost-effective use of resources 4

Emphasis on short-term gains/profits 5

Management does not champion the idea 6

Staff training/re-training costs 7

Don't know enough about it/need more information 8

Too much work 9

It didn't meet legislative limits 10

Other 11

....

....

Don't know 12

How would you rate the importance of the following factors in encouraging improved environmental performance of your company?

1 = Very important **2** = Fairly important **3** = Not very important
4 = Not at all Important **5** = Don't know

Q30. Long term financial benefits	1	2	3	4	5
Q31. Short term financial benefits	1	2	3	4	5
Q32. Compliance with relevant legislation	1	2	3	4	5
Q33. Customer pressure	1	2	3	4	5
Q34. Shareholder's/supporter's views	1	2	3	4	5
Q35. Public opinion generally in Britain	1	2	3	4	5
Q36. The views of the local community	1	2	3	4	5
Q37. Environmental impact alone	1	2	3	4	5
Q38. Market position and market share	1	2	3	4	5
Q39. Your employees' views	1	2	3	4	5

Q40. Are you a member of a Local Waste Minimisation Club or do you want to be?
1 = Yes, I am a member **2** = No, but I would like to be a member
3 = No, I do not want to be a member
If **3** Why: ....

Q41. Are you aware of a local Waste Minimisation club?
1 = Yes **2** = No **3** = No answer

SEEKING INFORMATION ON ENVIRONMENTAL ISSUES

Q42. Where do you, or are likely to, get business and specialist environmental information from?

National daily newspapers 1
Regional/local newspapers 2
Trade journals 3
Environmental journals or magazines 4
Environmental exhibitions & conferences 5
Trade exhibitions & conferences 6
Trade/industry associations 7
Academic institutions/Universities/etc. 8
Industrial research organisations 9
Professional advisors (lawyers, accountants) 10
Environmental Consultants 11
Suppliers of plant & equipment 12
Department of the Environment (DoE) 13
Department of Trade & Industry (DTI) 14
Her Majesty's Inspectorate of Pollution (HMIP) 15
Regional Government Office 16
Local authority 17
National River Authority 18
TEC/Training and Enterprise Council 19
CBI 20
Local Chamber of commerce 21
Other ....
.... 22
None 23
Don't know 24

COMPANY DETAILS

Could you tell me if the following details are correct:

Company name: «Name»
....
Holding Company: «Holding_Company»
....
Address: «Address»
....
....
Tel: «Tel» ....
Fax: «Fax» ....
Directors: «Directors» ....

Q43: How many sites in the UK does your company operate?

.... **1** = Don't know

Q44: Could you please indicate the annual turnover?

Turnover : «Turnover» Site = ... **1** = Don't know **2** = N/A

(N/A = Not Applicable) Company = ... **1** = Don't know **2** = N/A

Q45: How many staff does the company employ in the UK?

Employees: «Employees» .... **5** = Don't Know

1 = Micro (1-50) **2** = Small (51-99) **3** = Medium (100-250) **4** = Large (251 +)

Q46: In which ceramics sub-sector do you operate?

Nature of Business: «Nature_of_Business»

1 = Brick **2** = Industrial & Refractory **3** = Sanitaryware & Tiles **4** = Tableware *b. French Questionnaire*

INFORMATION GENERALE (ID: «ID»)

Nom du directeur à contacter: **«Directors»**
Dans le cas ou l'interlocuteur est diffèrent ou N/D, nom du nouveau contact?

....

Q1. Quelle est votre position au sein de l'entreprise?

1 = Directeur **2** = Cadre **3** = Technicien

Q2. Quel est votre rôle principal au sein de l'entreprise :

Responsable de la politique ou activités liées à l'environnement 1
Responsable de la politique ou activités liées à l'énergie 2
Production/Fabrication 3
Recherche & Développement 4
Hygiène & Sécurité/ Prévention 5
Vente & Marketing 6
Gestion/Finances 7
Autre 8

Si Q2/1 (pol. ou activités liées à l'environnement) n'a pas été désigné, demander à parler à la personne responsable des dépenses ou décisions environnementales.

Q3. Etes-vous en mesure de donner le feu vert (financièrement) pour entreprendre un nouveau projet?

1 = Oui **2** = Non **3** = Pas de réponse

FACTEURS INFLUANT ACTUELLEMENT SUR L'INDUSTRIE DE LA CERAMIQUE

Q4. Actuellement, quels sont les trois principaux facteurs influant sur la rentabilité de votre entreprise:

Taux d'intérêt 1
Concurrence Française 2
Concurrence étrangère 3
Conformité aux règlements/décrets/législation 4
Prix des matières premières 5
Climat économique ambiant 6
Demande insuffisante 7
Insuffisance des aides gouvernementales 8
Exportation 9
Manque d'investissement 10
Productivité 11
Problème de gestion 12
Problème environnementaux 13
Autre 14
Ne sais Pas 15

AMELIORATION DES PERFORMANCES ENVIRONNEMENTALES : ATOUTS ET CONTRAINTES

Pourriez-vous classer les affirmations suivantes de 1 à 6 :

1 = Totalement d'accord	**2** = Assez d'accord	**3** = indifferent
4 = Plutôt pas d'accord	**5** = Pas du tout d'accord	**6** = Sans opinion

Q5. Mon entreprise n'a pas d'impact sur l'environnement

1 **2** **3** **4** **5** **6**

Q6. Une politique environnementale n'apporte actuellement aucun avantage à l'entreprise

1 **2** **3** **4** **5** **6**

Q7. Améliorer les performances environnementales permet en général d'accroître la production

1 **2** **3** **4** **5** **6**

Q8. Nous prenons des décisions environnementales uniquement pour se conformer à la réglementation en vigueur

1 **2** **3** **4** **5** **6**

Q9. Généralement, il n'est pas facile de quantifier l'impact de la réglementation environnementale sur l'entreprise

1 **2** **3** **4** **5** **6**

Q10.Les contraintes financières nous empêchent de faire plus pour améliorer les performances environnementales

1	**2**	**3**	**4**	**5**	**6**

Q11. Il nous serait plus facile de gérer les problèmes lies à l'environnement si de meilleurs conseils étaient disponibles

1	**2**	**3**	**4**	**5**	**6**

Q12. Les décisions liées à l'environnement, prises par l'entreprise, ne lui sont que très peu profitables

1	**2**	**3**	**4**	**5**	**6**

Q13. Diminuer l'impact environnemental peut être très profitable

1	**2**	**3**	**4**	**5**	**6**

Q14. Quels avantages votre entreprise retire-t-elle de l'amelioration des performances environnementales?

Aucun 1
Réduction des déchets 2
Augmentation de la productivité 3
Diminution des coûts pour l'entreprise 4
Un environnement de travail plus sûr 5
Un environnement de travail plus propre 6
Améliorer l'image de la région 7
Recyclage 8
Diminuer les rejets polluants dans l'atmosphère 9
Moyen de promouvoir la vente des produits 10
Meilleure image auprès des clients 11
Meilleure image de l'entreprise au sein de la collectivité locale 12
Meilleure image auprès des employés 13
Etre en bon terme avec les autorités compétentes 14
Conformité à la législation en vigueur 15
Permet de réduire le coût du traitement des déchets 16
Permet de réduire le coût du travail 17
Permet de réduire le bruit...18
Autre 19
Ne sais pas 20

Q15. Etes-vous informés sur les différentes technologies disponibles permettant de se conformer à la réglementation?

Très bien informé 1
Très peu informe 2
Pas très bien informé 3
Pas du tout informé 4
Sans opinion 5

Q16.Quelles sont les principales nuisances provoquées par votre entreprise sur l'environnement?

Production de déchets toxiques et dangereux 1
Production de déchets non-toxiques 2
Emballages usagés 3
Poussière générée à l'intérieur du bâtiment 4
Poussière générée à l'extérieur du bâtiment 5
Consommation d'énergie 6
Emission de COV (Composé Organique Volatile) 7
Odeur.. 8
Emission de gaz (non spécifié) 9
Effluents liquides déversés dans les égouts 10
Quantité d'eau utilisée 11
Bruit 12
Transport de et jusqu'au lieu(x) de production 13
Hygiène & Sécurité 14
Contamination du sol 15
Autre 16

....

....

Aucun 17
Ne sais pas 18

MESURES MISES EN OEUVRE AFIN D'AMELIORER LES PERFORMANCES ENVIRONNEMENTALES

Q17. Avez-vous établi une politique environnementale, ou êtes vous en train d'en envisager une?

1 = **Oui**, avons une politique | **2** = **Oui**, envisageons | **3** = **Non**, pas besoin

Q18. La quantité de déchets et/ou de rejets polluants dans l'atmosphère est-elle contrôlée?

1 = Oui | **2** = Non | **3** = Ne sais pas

Q19. Un niveau de réduction des déchets et/ou des rejets polluants dans l'atmosphère a-t-il été fixé?

1 = Oui | **2** = Non | **3** = Ne sais pas

Q20. Votre entreprise a-t-elle reçu une certification pour un système de gestion environnementale ou souhaite t-elle être certifiée?

Déjà certifiée.. 1 | Souhaite être certifiée 2

Pas certifiée et pas envisagée actuellement .... 3 | Ne sais pas 4

Q21. **Si 1 ou 2 à la Q20**, certification pour quelle norme?

1 = Afnor X 30-200

2 = SMEA ou EMAS (Système d'Eco-management & d'audit) | **3** = ISO 14000/9000

Autre ....

....

Ces normes permettent-elles d'encourager les entreprises à améliorer leurs performances environnementales?

1 = beaucoup | **2** = Assez | **3** = Pas vraiment

4 = Pas du tout | **5** = Ne sais pas

Q22. EMAS(Système d'Eco-management&d'audit) 1 2 3 4 5

Q23. Afnor X 30-200 ....1 2 3 4 5

Q24. ISO 14000/9000 ....1 2 3 4 5

Q25. Au cours des 2 dernières années, votre entreprise a-t-elle introduit des nouvelles mesures pour améliorer les performances environnementales, au niveau:

de la gestion de l'entreprise	**1** = Oui	**2** = Non
des procédés de fabrication	**1** = Oui	**2** = Non
d'installation de nouvelles machines	**1** = Oui	**2** = Non

Q26. Si **OUI** quelles ont été les déterminants de ces changements?

Conformité à la réglementation 1
Diminuer les coûts 2
Augmentation des prix du traitement des déchets 3
Besoin de renouveler le matériel 4
Diminuer la quantité de déchets 5
Améliorer l'image auprès des clients 6
Améliorer l'image auprès des employés.. 7
Améliorer l'image auprès de la collectivité locale 8
Améliorer l'image auprès des actionnaires 9
Suite à des suggestions d'employés 10
Avis externe.. 11
Nouvelle direction 12
Suite à un audit/cabinet conseil.. 13
Autre 14
....
Ne sais pas 15

Q27. Pouvez-vous décrire brièvement un des projets que vous avez mené à bien?

....
....
....
....
....
....
....
....
....
....
....
....

Q28. Suite à l'adoption de ce nouveau mode de gestion ou matériel avez-vous perçu des améliorations?

Aucune 1
Conformité à la réglementation en vigueur 2
Conformité à une réglementation à venir 3
Economie de capitaux 4
Augmentation de la vente des produits 5
Amélioration des rapports avec le client 6
Amélioration de l'image de l'entreprise au sein de la collectivité locale 7
Amélioration de l'image de l'entreprise auprès des employés 8
Amélioration de l'image de l'entreprise auprès des actionnaires 9
Meilleure image auprès des médias 10
L'entreprise a gagné en prestige 11
L'entreprise a améliorer ses rapports avec les autorités compétentes 12
Amélioration de la productivité 13
Réduction des déchets 14
Autre 15
....
Ne sais pas 16

Q29. Suite à l'adoption de nouveau mode de gestion ou matériel avez-vous noté des inconvénients?

Aucun 1
Trop coûteux (en général) 2
Frais financiers trop élevés 3
Rapport coût/efficacité pas atteint 4
Vision plutôt de court terme (faire immédiatement des bénéfices) 5
La direction ne croit pas totalement à la réussite de ce projet 6
Coût de la formation du personnel élevé 7
Information insuffisante 8
A entraîné un surcroît de travail 9
Les limites fixées par la réglementation non pas éte atteintes 10
Autre 11
....
....
Ne sais pas 12

Comment classeriez-vous les facteurs suivants, afin d'améliorer les performances environnementales de votre entreprise?

1 = Très important **2** = Assez important **3** = Pas vraiment important

4 = Pas du tout important **5** = Ne sais pas

Q30. A Long terme amélioration des résultats 1 2 3 4 5

Q31. A court terme amélioration des résultats 1 2 3 4 5

Q32. Conformité à la réglementation 1 2 3 4 5

Q33. Influence de la clientèle 1 2 3 4 5

Q34. Intérêts des actionnaires 1 2 3 4 5

Q35. Opinion publique en générale 1 2 3 4 5

Q36. Intérêts de la collectivité locale 1 2 3 4 5

Q37. Impact sur l'environnement 1 2 3 4 5

Q38. Position sur le marché et parts de marché 1 2 3 4 5

Q39. Intérêts des employés 1 2 3 4 5

Q40. Faites vous parti au niveau local d'une association imp iquée dans le problème des déchets ou souhaitez-vous en faire parti ?

1 = Oui, je suis membre **2** = Non, mais je le souhaiterais

3 = Non, je ne le souhaite pas

Si **3** pourquoi: ....

Q41. Connaissez-vous l'existence d'une telle assoc ation?

1 = Oui **2** = Non **3** = Pas de réponse

SOURCE D'INFORMATION CONCERNANT LES PROBLEMES ENVIRONNEMENTAUX

Q42. Quelle source d'information utilisez-vous pour trouver des renseignements commerciaux et techniques sur l'environnement?

Quotidiens nationaux 1
Quotidiens régionaux 2
Journaux professionnels 3
Journaux ou magazines spécialisés dans le domaine de l'environnement.............................. 4
Conférences/symposiums traitant des thèmes environnementaux 5
Foires/expositions 6
Associations *professionnelles/syndicats* 7
Institut de recherches/universités/etc. 8
Centre de recherches privés.. 9
Conseillés (Avocat, comptable) 10
Cabinets conseil en environnement.. 11
Fournisseurs d'équipement 12
Ministère de l'Environnement 13
Ministère de l'industrie 14
La DRIRE 15
Conseil général 16
Mairie 17
Agence de l'eau 18
GRETA 19
CNPF 20
Chambre de Commerce et d'Industrie 21
Autre ....
.... 22
Aucun 23
Ne sais pas 24

INFORMATION SUR L'ENTREPRISE

Pouvez-vous m'indiquer si les informations suivantes sont correctes:

Nom de l'entreprise : «Name»

....

Nom du groupe : «Holding_Company»

....

Adresse : «Address»

....

....

Tel : «Tel» ....

Fax : «Fax» ....

Directeurs : «Directors» ....

Q43: Combien d'unités de production sont exploitées sur le territoire français?

.... **1** = Ne sais pas

Q44: Pouvez-vous m'indiquer le CA annuel?

CA : «Turnover» Site = ... **1** = Ne sais pas **2** = P/A

(P/A = Pas Applicable) Entreprise = ... **1** = Ne sais pas **2** = P/A

Q45: Combien de personnes sont employées sur le territoire français?

Employés : «Employees» .... **5** = Ne sais pas

1 = 1-50 **2** = 51-99 **3** = 100-250 **4** = 251 +)

Q46: Dans quel sous-secteur de l'industrie céramique opérez-vous?

Information sur l'entreprise : «Nature_of_Business»

1 = Brique **2** = Industriel & Réfractaire **3** = Sanitaire & Carreau **4** = Art de la table

APPENDIX E : DATA TABULATIONS

a. UK by size

By size	Q1 1	Q1 2	Q1 3	Q2 1	Q2 2	Q2 3	Q2 4	Q2 5	Q2 6	Q2 7	Q2 8	Q3 1	Q3 2	Q3 3	Q4 1	Q4 2	Q4 3	Q4 4	Q4 5	Q4 6	Q4 7	Q4 8	Q4 9	Q4 10	Q4 11	Q4 12	Q4 13	Q4 14	Q4 15
Micro (1-50)	17	19	1	37	8	27	3	15	6	15	2	28	7	2	0	2	2	3	0	23	14	1	1	0	0	0	1	7	15
Small (51-99)	9	8	0	15	4	7	1	8	2	8	5	14	2	1	1	1	2	0	0	3	2	0	0	1	0	0	0	0	11
Medium (100-250)	4	12	2	17	7	11	0	4	0	2	3	15	2	1	3	1	1	0	2	1	3	0	0	0	0	0	3	0	13
Large (251+)	5	14	3	21	2	10	2	9	0	2	4	10	11	1	0	2	7	0	2	4	1	0	0	0	0	0	1	2	12
Total	35	53	6	90	21	55	6	36	8	27	14	67	22	5	4	6	12	3	4	31	20	1	1	1	0	0	5	9	51
			94											94															

By size	Q5 1	Q5 2	Q5 3	Q5 4	Q5 5	Q5 6	Q5	Q6 1	Q6 2	Q6 3	Q6 4	Q6 5	Q6 6	Q6	Q7 1	Q7 2	Q7 3	Q7 4	Q7 5	Q7 6	Q7	Q8 1	Q8 2	Q8 3	Q8 4	Q8 5	Q8 6	Q8
Micro (1-50)	4	7	1	18	7	0		7	9	2	11	7	1		1	9	15	6	5	1		11	6	1	11	7	1	
Small (51-99)	1	0	4	6.5	3.5	2		3	5	3	2	1	3		3	3	4	2	1	4		6	1	2	4	3	1	
Medium (100-250)	2	2	0	10	4	0		2	4	0	9	3	0		2	6	4	4	2	0		6	4	0	3	5	0	
Large (251+)	4	4	1	7	5	1		0	3	1	8	8	2		10	5	2	3	1	1		3	7	1	2	9	0	
Total	11	13	6	41.5	19.5	3		12	21	6	30	19	6		16	23	25	15	9	6		26	18	4	20	24	2	
							94							94							94							94

By size	Q9 1	Q9 2	Q9 3	Q9 4	Q9 5	Q9 6	Q9	Q10 1	Q10 2	Q10 3	Q10 4	Q10 5	Q10 6	Q10	Q11 1	Q11 2	Q11 3	Q11 4	Q11 5	Q11 6	Q11
Micro (1-50)	16	11	4	3	1	2		11	6	2	9	2	7		14	11	5	5	0	2	
Small (51-99)	9	5	0	2	0	1		4	6	0	2	2	3		7	4	2	0	0	4	
Medium (100-250)	6	7	0	4	1	0		6	8	1	2	0	1		6	4	4	4	0	0	
Large (251+)	5	10	3	2	1	1		6	7	4	4	1	0		7	7	3	4	0	1	
Total	36	33	7	11	3	4		27	27	7	17	5	11		34	26	14	13	0	7	
							94							94							94

By size	Q12 1	Q12 2	Q12 3	Q12 4	Q12 5	Q12 6	Q12	Q13 1	Q13 2	Q13 3	Q13 4	Q13 5	Q13 6	Q13
Micro (1-50)	3	9	7	8	4	6		2	6	8	8	4	9	
Small (51-99)	3	3	2	4	0	5		2	2	3	2	3	5	
Medium (100-250)	3	2	3	6	1	3		1	5	3	4	3	2	
Large (251+)	1	2	2	9	2	6		5	6	7	2	0	2	
Total	10	16	14	27	7	20		10	19	21	16	10	18	
							94							94

By size	Q14 1	Q14 2	Q14 3	Q14 4	Q14 5	Q14 6	Q14 7	Q14 8	Q14 9	Q14 10	Q14 11	Q14 12	Q14 13	Q14 14	Q14 15	Q14 16	Q14 17	Q14 18	Q14 19	Q14 20	Q15 1	Q15 2	Q15 3	Q15 4	Q15 5	Q15
Micro (1-50)	19	7	1	10	6	11	2	4	3	2	6	11	3	7	6	0	0	0	3	1	2	21	8	2	4	
Small (51-99)	5	2	0	3	0	3	2	0	0	3	4	8	6	2	0	0	0	0	5	2	2	12	2	1	0	
Medium (100-250)	2	3	5	7	1	1	1	1	1	0	1	2	0	2	3	1	0	0	0	0	4	12	2	0	0	
Large (251+)	0	5	1	11	2	4	3	1	5	3	5	6	6	5	1	0	0	0	6	2	6	11	4	0	1	
Total	26	17	7	31	9	19	8	6	9	8	16	27	15	16	10	1	0	0	14	5	14	56	16	3	5	
																										94

By size	Q16 1	Q16 2	Q16 3	Q16 4	Q16 5	Q16 6	Q16 7	Q16 8	Q16 9	Q16 10	Q16 11	Q16 12	Q16 13	Q16 14	Q16 15	Q16 16	Q16 17	Q16 18	Q17 1	Q17 2	Q17 3
Micro (1-50)	2	11	3	7	6	0	0	2	11	2	0	1	3	1	1	3	9	1	4	4	29
Small (51-99)	1	2	1	4	2	0	0	1	7	1	1	3	1	0	0	3	3	1	2	4	11
Medium (100-250)	3	4	1	5	7	0	0	0	13	5	3	1	1	1	1	5	0	0	6	8	4
Large (251+)	6	9	3	2	4	0	1	2	14	8	5	5	0	0	3	4	2	2	12	3	7
Total	12	26	8	18	19	0	1	5	45	16	9	10	5	2	5	15	14	4	24	19	51
																					94

By size	Q18 1	Q18 2	Q18 3	Q19 1	Q19 2	Q19 3	Q20 1	Q20 2	Q20 3	Q20 4	Q21 1	Q21 2	Q21 3	Q21 4	Q22 1	Q22 2	Q22 3	Q22 4	Q22 5	Q23 1	Q23 2	Q23 3	Q23 4	Q23 5
Micro (1-50)	15	20	2	6	30	1	0	4	25	8	2	2	0	0	2	0	0	0	0	1	1	0	0	0
Small (51-99)	13	3	1	4	13	0	1	1	9	6	1	0	0	1	0	0	0	0	0	0	1	0	0	0
Medium (100-250)	13	5	0	9	8	1	1	4	6	7	1	3	0	1	0	2	0	0	1	1	0	0	0	0
Large (251+)	19	2	1	9	12	1	0	5	5	12	1	4	0	0	1	2	0	0	1	1	0	0	0	0
Total	60	30	4	28	63	3	2	14	45	33	5	9	0	2	3	4	0	0	2	3	2	0	0	0
			94			94				94				16					9					5

By size	Q25 1	Q25 2	Q25 1	Q25 2	Q25 1	Q25 2	Q25	Q25 NO to Q	Q26 1	Q26 2	Q26 3	Q26 4	Q26 5	Q26 6	Q26 7	Q26 8	Q26 9	Q26 10	Q26 11	Q26 12	Q26 13	Q26 14	Q26 15
Micro (1-50)	4	33	4	33	13	24		19	5	1	0	5	1	0	3	1	0	0	2	2	0	4	2
Small (51-99)	3	14	6	11	9	8		6	4	2	0	3	0	0	3	2	0	0	2	1	0	4	0
Medium (100-250)	5	13	6	12	13	5		2	11	2	0	1	0	1	1	0	1	0	1	1	0	5	0
Large (251+)	11	11	15	7	14	8		1	13	6	1	1	2	4	2	3	1	0	0	2	0	6	0
Total	23	71	31	63	49	45		28	33	11	1	10	3	5	9	6	2	0	5	6	0	19	2
		94		94		94																	

By size	Q28 1	Q28 2	Q28 3	Q28 4	Q28 5	Q28 6	Q28 7	Q28 8	Q28 9	Q28 10	Q28 11	Q28 12	Q28 13	Q28 14	Q28 15	Q28 16
Micro (1-50)	3	1	0	1	1	0	1	6	0	0	0	3	2	2	0	2
Small (51-99)	1	0	0	2	0	0	2	3	0	0	0	1	1	0	0	0
Medium (100-250)	3	0	2	4	1	0	2	2	0	0	1	0	4	1	2	1
Large (251+)	2	3	1	8	4	1	3	6	1	0	1	1	3	3	7	0
Total	9	4	3	15	6	1	8	17	1	0	2	5	10	6	9	3

By size	Q29 1	Q29 2	Q29 3	Q29 4	Q29 5	Q29 6	Q29 7	Q29 8	Q29 9	Q29 10	Q29 11	Q29 12	Q30 1	Q30 2	Q30 3	Q30 4	Q30 5	Q31 1	Q31 2	Q31 3	Q31 4	Q31 5
Micro (1-50)	14	1	2	0	0	0	0	0	0	0	0	1	12	11	6	3	5	11	13	5	3	5
Small (51-99)	6	1	3	0	0	0	0	0	0	0	1	1	11	2	1	1	2	10	4	1	0	2
Medium (100-250)	8	4	6	0	0	0	0	0	1	0	0	0	5	10	0	0	3	4	11	0	0	3
Large (251+)	10	3	4	1	0	1	1	0	2	0	1	0	5	3	7	0	7	5	3	6	1	7
Total	38	9	15	1	0	1	1	0	3	0	2	2	33	26	14	4	17	30	31	12	4	17
																	94					*94*

By size	Q32 1	Q32 2	Q32 3	Q32 4	Q32 5	Q33 1	Q33 2	Q33 3	Q33 4	Q33 5	Q34 1	Q34 2	Q34 3	Q34 4	Q34 5	Q35 1	Q35 2	Q35 3	Q35 4	Q35 5
Micro (1-50)	24	9	1	0	3	5.5	4.5	4	20	3	0	2	0	1	34	5	7	8	10	7
Small (51-99)	12	3	0	0	2	1	4	1	9	2	1	1	0	5	10	2	5	2	3	5
Medium (100-250)	12	2	0	0	4	3	1	4	6	4	0	3	0	2	13	3	8	1	0	6
Large (251+)	14	3	0	0	5	1	5	2	9	5	5	2	3	0	12	1	4	5	5	7
Total	62	17	1	0	14	10.5	14.5	11	44	14	6	8	3	8	69	11	24	16	18	25
					94					94					94					94

By size	Q36 1	Q36 2	Q36 3	Q36 4	Q36 5	Q37 1	Q37 2	Q37 3	Q37 4	Q37 5	Q38 1	Q38 2	Q38 3	Q38 4	Q38 5	Q39 1	Q39 2	Q39 3	Q39 4	Q39 5	Q40 1	Q40 2	Q40 3
Micro (1-50)	10	10	5	7	5	7	8	1	10	11	0	4	2	23	8	7	18	6	2	4	0	12	25
Small (51-99)	9	2	2	1	3	7	2	1	0	7	0	3	1	9	4	5	7	1	1	3	0	11	6
Medium (100-250)	5	6	1	0	6	3	6	0	0	9	0	1	2	8	7	3	6	1	2	6	0	8	10
Large (251+)	11	1	3	2	5	9	3	0	2	8	2	3	2	9	6	3	7	7	0	5	7	13	2
Total	35	19	11	10	19	26	19	2	12	35	2	11	7	49	25	18	38	15	5	18	7	44	43
					94					94					94					94			94

By size	Q41 1	Q41 2	Q41 3	Q42 1	Q42 2	Q42 3	Q42 4	Q42 5	Q42 6	Q42 7	Q42 8	Q42 9	Q42 10	Q42 11	Q42 12	Q42 13	Q42 14	Q42 15	Q42 16	Q42 17	Q42 18	Q42 19	Q42 20	Q42 21	Q42 22	Q42 23	Q42 24
Micro (1-50)	0	30	7	0	0	0	1	0	1	16	1	11	0	4	3	0	3	1	0	6	0	0	0	2	13	0	3
Small (51-99)	0	13	4	0	0	0	3	0	0	6	0	5	0	1	1	1	2	0	1	6	1	0	0	2	2	0	2
Medium (100-250)	2	10	6	0	0	1	3	0	0	9	0	8	0	2	1	0	2	1	0	10	1	0	0	3	3	0	0
Large (251+)	8	12	2	0	0	2	9	0	0	13	0	11	1	3	4	0	0	4	0	6	2	0	0	0	8	0	0
Total	10	65	19	0	0	3	16	0	1	44	1	35	1	10	9	1	7	6	1	28	4	0	0	7	26	0	5
			94																								

b. France by size

By size	Q1 1	Q1 2	Q1 3	Q2 1	Q2 2	Q2 3	Q2 4	Q2 5	Q2 6	Q2 7	Q2 8	Q3 1	Q3 2	Q3 3	Q4 1	Q4 2	Q4 3	Q4 4	Q4 5	Q4 6	Q4 7	Q4 8	Q4 9	Q4 10	Q4 11	Q4 12	Q4 13	Q4 14	Q4 15
Micro (1-50)	24	14	2	39	12	21	8	14	13	21	5	32	6	2	0	7	4	2	1	13	9	5	1	1	0	0	2	3	17
Small (51-99)	7	7	1	14	4	7	3	4	3	2	2	11	1	3	1	2	3	1	0	6	2	0	0	2	0	1	0	0	5
Medium (100-250)	5	12	4	19	8	10	1	11	1	5	5	14	5	2	2	1	5	1	0	2	3	2	0	1	0	1	3	0	10
Large (251+)	3	6	6	12	2	9	3	8	1	2	1	7	5	3	0	2	4	0	1	2	1	0	0	0	0	0	1	0	8
Total	39	39	13	84	26	47	15	37	18	30	13	64	17	10	3	12	16	4	2	23	15	7	1	4	0	2	6	3	40
			91											91															

By size	Q5 1	Q5 2	Q5 3	Q5 4	Q5 5	Q5 6	Q5	Q6 1	Q6 2	Q6 3	Q6 4	Q6 5	Q6 6	Q6	Q7 1	Q7 2	Q7 3	Q7 4	Q7 5	Q7 6	Q7	Q8 1	Q8 2	Q8 3	Q8 4	Q8 5	Q8 6	Q8
Micro (1-50)	9	7	2	15.5	6.5	0		6	9	1	11	9	4		3	7	11	12	3	4		11	12	0	9	8	0	
Small (51-99)	2	4	1	7	1	0		1	6	3	3	0	2		2	3	5	2	0	3		4	1	3	5	2	0	
Medium (100-250)	5	2	3	7	4	0		3	1	3	7	6	1		5	7	2	5	2	0		3	7	4	3	4	0	
Large (251+)	1	1	2	6	4	1		0	3	1	4	3	4		3	3	4	3	1	1		1	6	3	1	4	0	
Total	17	14	8	35.5	15.5	1		10	19	8	25	18	11		13	20	22	22	6	8		19	26	10	18	18	0	
							91							91							91							91

By size	Q9 1	Q9 2	Q9 3	Q9 4	Q9 5	Q9 6	Q9	Q10 1	Q10 2	Q10 3	Q10 4	Q10 5	Q10 6	Q10	Q11 1	Q11 2	Q11 3	Q11 4	Q11 5	Q11 6	Q11
Micro (1-50)	18	9	5	6	0	2		17	8	3	7	1	4		16	11	5	4	0	4	
Small (51-99)	8	4	0	3	0	0		6	2	2	2	2	1		7	2	2	1	0	3	
Medium (100-250)	8	10	0	3	0	0		6	8	1	3	0	3		6	6	2	1	0	6	
Large (251+)	5	4	1	3	1	1		1	4	3	4	1	2		3	4	2	2	0	4	
Total	39	27	6	15	1	3		30	22	9	16	4	10		32	23	11	8	0	17	
							91							91							91

By size	Q12 1	Q12 2	Q12 3	Q12 4	Q12 5	Q12 6	Q12	Q13 1	Q13 2	Q13 3	Q13 4	Q13 5	Q13 6	Q13
Micro (1-50)	2	8	2	14	6	8		4	6	7	5	7	11	
Small (51-99)	0	3	1	4	2	5		1	4	3	3	0	4	
Medium (100-250)	1	2	4	7	2	5		3	4	5	4	1	4	
Large (251+)	1	0	2	6	3	3		3	2	5	3	0	2	
Total	4	13	9	31	13	21		11	16	20	15	8	21	
							91							91

By size	Q14 1	Q14 2	Q14 3	Q14 4	Q14 5	Q14 6	Q14 7	Q14 8	Q14 9	Q14 10	Q14 11	Q14 12	Q14 13	Q14 14	Q14 15	Q14 16	Q14 17	Q14 18	Q14 19	Q14 20	Q15 1	Q15 2	Q15 3	Q15 4	Q15 5	Q15
Micro (1-50)	15	2	2	4	3	9	3	2	3	0	2	10	0	3	4	1	0	0	1	1	2	21	9	6	2	
Small (51-99)	1	2	5	5	1	1	0	1	3	2	4	1	1	2	0	0	0	0	1	0	3	9	3	0	0	
Medium (100-250)	1	4	3	6	0	1	3	0	2	2	1	2	1	3	5	1	0	0	0	0	2	16	3	0	0	
Large (251+)	2	2	1	5	2	2	3	0	1	2	4	4	3	2	2	1	0	0	1	1	5	6	3	1	0	
Total	19	10	11	20	6	13	9	3	9	6	11	17	5	10	11	3	0	0	3	2	12	52	18	7	2	
																										91

By size	Q16 1	Q16 2	Q16 3	Q16 4	Q16 5	Q16 6	Q16 7	Q16 8	Q16 9	Q16 10	Q16 11	Q16 12	Q16 13	Q16 14	Q16 15	Q16 16	Q16 17	Q16 18	Q17 1	Q17 2	Q17 3
Micro (1-50)	1	6	5	8	6	0	0	0	11	10	1	1	4	1	3	5	11	1	8	4	28
Small (51-99)	0	5	2	4	3	1	1	0	8	1	0	0	0	0	0	2	3	0	0	7	8
Medium (100-250)	3	10	5	4	6	1	0	1	10	8	3	0	3	1	1	6	1	0	10	5	6
Large (251+)	4	11	5	2	2	1	0	3	9	7	5	4	1	0	1	4	1	1	9	5	1
Total	8	32	17	18	17	3	1	4	38	26	9	5	8	2	5	17	16	2	27	21	43
																					91

By size	Q18 1	Q18 2	Q18 3	Q19 1	Q19 2	Q19 3	Q20 1	Q20 2	Q20 3	Q20 4	Q21 1	Q21 2	Q21 3	Q21 4	Q22 1	Q22 2	Q22 3	Q22 4	Q22 5	Q23 1	Q23 2	Q23 3	Q23 4	Q23 5
Micro (1-50)	10	27	3	3	34	3	0	0	25	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small (51-99)	7	8	0	2	13	0	1	0	8	6	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Medium (100-250)	12	8	1	9	11	1	1	5	4	11	3	3	0	0	0	3	0	0	0	1	2	0	0	0
Large (251+)	15	0	0	6	8	1	1	4	4	6	2	3	0	0	3	0	0	0	0	1	1	0	0	0
Total	44	43	4	20	66	5	3	9	41	38	5	7	0	0	3	4	0	0	0	2	3	0	0	0
			91			91				91				12					7					5

By size	Q25 1	Q25 2	Q25 1	Q25 2	Q25 1	Q25 2	Q25 No to Q	Q25	Q26 1	Q26 2	Q26 3	Q26 4	Q26 5	Q26 6	Q26 7	Q26 8	Q26 9	Q26 10	Q26 11	Q26 12	Q26 13	Q26 14	Q26 15
Micro (1-50)	8	32	3	37	16	24		18	13	5	0	4	1	0	2	2	0	0	0	3	0	4	0
Small (51-99)	3	12	2	13	5	10		7	6	4	0	1	0	3	2	2	0	0	0	1	0	1	0
Medium (100-250)	6	15	6	15	11	10		5	10	5	0	2	1	1	1	2	1	0	2	3	0	7	1
Large (251+)	8	7	10	5	9	6		2	7	5	0	2	0	0	0	1	0	0	1	2	1	5	1
Total	25	66	21	70	41	50		32	36	19	0	9	2	4	5	7	1	0	3	9	1	17	2
		91		91		91																	

By size	Q28 1	Q28 2	Q28 3	Q28 4	Q28 5	Q28 6	Q28 7	Q28 8	Q28 9	Q28 10	Q28 11	Q28 12	Q28 13	Q28 14	Q28 15	Q28 16
Micro (1-50)	5	3	0	4	0	0	3	6	0	0	0	0	4	2	2	0
Small (51-99)	0	3	1	4	1	1	1	0	0	0	0	1	2	1	2	0
Medium (100-250)	2	2	2	5	1	0	1	2	0	0	0	0	3	2	5	2
Large (251+)	0	3	3	4	1	1	2	3	1	0	3	1	4	4	5	1
Total	7	11	6	17	3	2	7	11	1	0	3	2	13	9	14	3

By size	Q29 1	Q29 2	Q29 3	Q29 4	Q29 5	Q29 6	Q29 7	Q29 8	Q29 9	Q29 10	Q29 11	Q29 12	Q30 1	Q30 2	Q30 3	Q30 4	Q30 5	Q31 1	Q31 2	Q31 3	Q31 4	Q31 5
Micro (1-50)	13	2	5	1	0	0	0	0	1	0	1	0	12	14	5	1	8	11	13	7	1	8
Small (51-99)	7	0	1	0	0	0	0	0	0	0	0	0	4	4	4	0	3	4	4	4	0	3
Medium (100-250)	7	3	4	0	0	0	1	0	2	0	1	0	7	8	0	0	6	6	9	0	0	6
Large (251+)	5	2	4	1	0	1	1	0	1	0	0	0	5	3	5	0	2	3	4	5	1	2
Total	32	7	14	2	0	1	2	0	4	0	2	0	28	29	14	1	19	24	30	16	2	19
																	91					91

By size	Q32 1	Q32 2	Q32 3	Q32 4	Q32 5	Q33 1	Q33 2	Q33 3	Q33 4	Q33 5	Q34 1	Q34 2	Q34 3	Q34 4	Q34 5	Q35 1	Q35 2	Q35 3	Q35 4	Q35 5
Micro (1-50)	22	9	1	0	8	1	3	12	13	11	2	3	1	1	33	8	8	6	4	14
Small (51-99)	8	4	0	0	3	1	3	3	5	3	0	1	1	0	13	4	1	3	2	5
Medium (100-250)	15	1	0	0	5	2	4	4	6	5	1	6	0	1	13	6	5	3	0	7
Large (251+)	11	3	0	0	1	0	3	4	6	2	4	1	3	0	7	4	4	2	2	3
Total	56	17	1	0	17	4	13	23	30	21	7	11	5	2	66	22	18	14	8	29
					91					91					91					91

By size	Q36 1	Q36 2	Q36 3	Q36 4	Q36 5	Q37 1	Q37 2	Q37 3	Q37 4	Q37 5	Q38 1	Q38 2	Q38 3	Q38 4	Q38 5	Q39 1	Q39 2	Q39 3	Q39 4	Q39 5	Q40 1	Q40 2	Q40 3
Micro (1-50)	16	7	4	3	10	9	5	7	5	14	1	3	4	16	16	12	12	4	0	12	0	12	28
Small (51-99)	4	4	2	1	4	5	3	1	1	5	0	3	1	7	4	6	3	2	0	4	1	5	9
Medium (100-250)	8	2	5	0	6	7	6	0	0	8	1	3	2	8	7	5	4	4	2	6	2	13	6
Large (251+)	8	3	1	2	1	8	3	2	0	2	2	2	2	7	2	2	6	6	0	1	3	9	3
Total	36	16	12	6	21	29	17	10	6	29	4	11	9	38	29	25	25	16	2	23	6	39	46
					91					91					91					91			91

By size	Q41 1	Q41 2	Q41 3	Q42 1	Q42 2	Q42 3	Q42 4	Q42 5	Q42 6	Q42 7	Q42 8	Q42 9	Q42 10	Q42 11	Q42 12	Q42 13	Q42 14	Q42 15	Q42 16	Q42 17	Q42 18	Q42 19	Q42 20	Q42 21	Q42 22	Q42 23	Q42 24
Micro (1-50)	1	35	4	0	0	6	3	0	5	17	1	5	0	3	3	1	7	2	0	10	0	2	0	6	7	0	0
Small (51-99)	1	11	3	0	0	4	2	0	2	6	0	3	0	3	1	0	0	0	0	4	0	0	0	2	3	0	0
Medium (100-250)	4	14	3	0	0	4	5	0	2	10	0	10	0	6	3	3	4	0	0	6	1	0	1	5	3	0	0
Large (251+)	5	9	1	0	0	6	8	0	2	8	0	6	0	3	7	1	0	1	0	6	2	0	0	1	3	0	0
Total	11	69	11	0	0	20	18	0	11	41	1	24	0	15	14	5	11	3	0	26	3	2	1	14	16	0	0
			91																								

c. *UK by sector*

By sector	Q1 1	Q1 2	Q1 3	Q2 1	Q2 2	Q2 3	Q2 4	Q2 5	Q2 6	Q2 7	Q2 8	Q3 1	Q3 2	Q3 3	Q4 1	Q4 2	Q4 3	Q4 4	Q4 5	Q4 6	Q4 7	Q4 8	Q4 9	Q4 10	Q4 11	Q4 12	Q4 13	Q4 14	Q4 15
Brick	9	9	1	19	6	10	0	5	2	10	2	15	3	1	3	1	1	2	0	17	13	1	0	0	0	0	3	5	4
Industrial & Refractory	7	21	2	30	1	19	1	13	0	4	6	21	6	3	0	0	3	1	0	7	6	0	1	0	0	0	1	0	19
Sanitaryware & Tiles	3	6	2	9	3	9	2	3	0	2	1	6	4	1	1	1	0	0	2	0	0	0	0	1	0	0	0	0	7
Tableware	16	17	1	32	11	17	3	15	6	11	5	25	9	0	0	4	8	0	2	7	1	0	0	0	0	0	1	4	21
Total	35	53	6	90	21	55	6	36	8	27	14	67	22	5	4	6	12	3	4	31	20	1	1	1	0	0	5	9	51
			94											94															

By sector	Q5 1	Q5 2	Q5 3	Q5 4	Q5 5	Q5 6	Q5	Q6 1	Q6 2	Q6 3	Q6 4	Q6 5	Q6 6	Q6	Q7 1	Q7 2	Q7 3	Q7 4	Q7 5	Q7 6	Q7	Q8 1	Q8 2	Q8 3	Q8 4	Q8 5	Q8 6	Q8
Brick	2	1	1	9	5	1		3	3	2	7	3	1		3	4	6	2	1	3		5	3	1	3	7	0	
Industrial & Refractory	3	7	2	11	7	0		3	10	0	8	8	1		6	5	7	6	5	1		9	3	1	9	7	1	
Sanitaryware & Tiles	1	1	0	4	3	2		1	1	2	0	4	3		2	5	3	0	0	1		2	2	0	1	5	1	
Tableware	5	4	3	17.5	4.5	0		5	7	2	15	4	1		5	9	9	7	3	1		10	10	2	7	5	0	
Total	11	13	6	41.5	19.5	3		12	21	6	30	19	6		16	23	25	15	9	6		26	18	4	20	24	2	
							94							94							94							94

By sector	Q9 1	Q9 2	Q9 3	Q9 4	Q9 5	Q9 6	Q9	Q10 1	Q10 2	Q10 3	Q10 4	Q10 5	Q10 6	Q10	Q11 1	Q11 2	Q11 3	Q11 4	Q11 5	Q11 6	Q11
Brick	7	7	3	1	1	0		6	3	3	3	2	2		6	5	4	3	0	1	
Industrial & Refractory	12	14	0	4	0	0		6	11	1	9	1	2		15	4	5	5	0	1	
Sanitaryware & Tiles	2	3	2	2	1	1		2	5	2	0	0	2		2	2	2	3	0	2	
Tableware	15	9	2	4	1	3		13	8	1	5	2	5		11	15	3	2	0	3	
Total	36	33	7	11	3	4		27	27	7	17	5	11		34	26	14	13	0	7	
							94							94							94

By sector	Q12 1	Q12 2	Q12 3	Q12 4	Q12 5	Q12 6	Q12	Q13 1	Q13 2	Q13 3	Q13 4	Q13 5	Q13 6	Q13
Brick	2	4	3	7	1	2		0	4	5	5	0	5	
Industrial & Refractory	4	7	6	6	2	5		4	6	5	5	5	5	
Sanitaryware & Tiles	0	0	3	4	0	4		1	3	3	0	1	3	
Tableware	4	5	2	10	4	9		5	6	8	6	4	5	
Total	10	16	14	27	7	20		10	19	21	16	10	18	
							94							94

By sector	Q14 1	Q14 2	Q14 3	Q14 4	Q14 5	Q14 6	Q14 7	Q14 8	Q14 9	Q14 10	Q14 11	Q14 12	Q14 13	Q14 14	Q14 15	Q14 16	Q14 17	Q14 18	Q14 19	Q14 20	Q15 1	Q15 2	Q15 3	Q15 4	Q15 5	Q15
Brick	7	6	2	8	0	4	1	2	5	3	3	4	2	2	4	0	0	0	5	1	2	12	3	0	2	
Industrial & Refractory	9	6	3	7	3	7	3	3	3	2	6	11	5	8	3	0	0	0	6	0	2	18	7	1	2	
Sanitaryware & Tiles	1	0	0	1	3	4	0	0	0	1	0	2	1	0	2	0	0	0	1	0	3	8	0	0	0	
Tableware	9	5	2	15	3	4	4	1	1	2	7	10	7	6	1	1	0	0	2	4	7	18	6	2	1	
Total	26	17	7	31	9	19	8	6	9	8	16	27	15	16	10	1	0	0	14	5	14	56	16	3	5	
																										94

By sector	Q16 1	Q16 2	Q16 3	Q16 4	Q16 5	Q16 6	Q16 7	Q16 8	Q16 9	Q16 10	Q16 11	Q16 12	Q16 13	Q16 14	Q16 15	Q16 16	Q16 17	Q16 18	Q17 1	Q17 2	Q17 3
Brick	1	3	1	2	7	0	0	2	11	0	3	3	3	0	4	4	3	1	6	2	11
Industrial & Refractory	4	9	4	9	5	0	1	1	11	4	1	2	0	0	1	3	3	0	10	6	14
Sanitaryware & Tiles	1	2	1	2	2	0	0	0	8	4	3	2	0	0	0	2	1	2	3	5	3
Tableware	6	12	2	5	5	0	0	2	15	8	2	3	2	2	0	6	7	1	5	6	23
Total	12	26	8	18	19	0	1	5	45	16	9	10	5	2	5	15	14	4	24	19	51
																					94

By sector	Q18 1	Q18 2	Q18 3	Q19 1	Q19 2	Q19 3	Q20 1	Q20 2	Q20 3	Q20 4	Q21 1	Q21 2	Q21 3	Q21 4	Q22 1	Q22 2	Q22 3	Q22 4	Q22 5	Q23 1	Q23 2	Q23 3	Q23 4	Q23 5
Brick	15	4	0	7	12	0	1	2	13	3	0	3	0	0	1	2	0	0	0	0	0	0	0	0
Industrial & Refractory	13	14	3	11	16	3	0	7	13	10	2	4	0	1	2	1	0	0	1	2	0	0	0	0
Sanitaryware & Tiles	10	1	0	6	5	0	1	4	1	5	3	2	0	0	0	1	0	0	0	1	2	0	0	0
Tableware	22	11	1	4	30	0	0	1	18	15	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Total	60	30	4	28	63	3	2	14	45	33	5	9	0	2	3	4	0	0	2	3	2	0	0	0
			94			94				94				16					9					5

By sector	Q25 1	Q25 2	Q25 1	Q25 2	Q25 1	Q25 2	Q25 NO to Q	Q26 1	Q26 2	Q26 3	Q26 4	Q26 5	Q26 6	Q26 7	Q26 8	Q26 9	Q26 10	Q26 11	Q26 12	Q26 13	Q26 14	Q26 15
Brick	7	12	6	13	10	9	4	6	3	0	4	1	0	2	1	0	0	0	2	0	4	1
Industrial & Refractory	5	25	9	21	17	13	10	10	0	0	1	0	1	4	2	0	0	3	3	0	7	0
Sanitaryware & Tiles	3	8	6	5	9	2	2	4	3	1	0	1	1	0	1	0	0	1	0	0	3	1
Tableware	8	26	10	24	13	21	12	13	5	0	5	1	3	3	2	2	0	1	1	0	5	0
Total	23	71	31	63	49	45	28	33	11	1	10	3	5	9	6	2	0	5	6	0	19	2
		94		94		94																

By sector	Q28 1	Q28 2	Q28 3	Q28 4	Q28 5	Q28 6	Q28 7	Q28 8	Q28 9	Q28 10	Q28 11	Q28 12	Q28 13	Q28 14	Q28 15	Q28 16
Brick	2	1	0	3	3	0	0	5	0	0	0	1	3	1	1	1
Industrial & Refractory	5	1	2	1	0	0	4	5	1	0	0	2	1	0	5	1
Sanitaryware & Tiles	1	1	1	2	1	0	3	1	0	0	2	0	1	1	1	1
Tableware	1	1	0	9	2	1	1	6	0	0	0	2	5	4	2	0
Total	9	4	3	15	6	1	8	17	1	0	2	5	10	6	9	3

By sector	Q29 1	Q29 2	Q29 3	Q29 4	Q29 5	Q29 6	Q29 7	Q29 8	Q29 9	Q29 10	Q29 11	Q29 12	Q30 1	Q30 2	Q30 3	Q30 4	Q30 5	Q31 1	Q31 2	Q31 3	Q31 4	Q31 5
Brick	10	2	2	0	0	0	0	0	1	0	0	0	10	3	1	2	3	7	7	1	1	3
Industrial & Refractory	11	4	7	0	0	0	0	0	1	0	0	0	5	13	4	1	7	5	14	3	1	7
Sanitaryware & Tiles	4	0	2	0	0	1	0	0	1	0	0	2	6	3	1	0	1	6	3	1	0	1
Tableware	13	3	4	1	0	0	1	0	0	0	2	0	12	7	8	1	6	12	7	7	2	6
Total	38	9	15	1	0	1	1	0	3	0	2	2	33	26	14	4	17	30	31	12	4	17
																	94					94

By sector	Q32 1	Q32 2	Q32 3	Q32 4	Q32 5	Q33 1	Q33 2	Q33 3	Q33 4	Q33 5	Q34 1	Q34 2	Q34 3	Q34 4	Q34 5	Q35 1	Q35 2	Q35 3	Q35 4	Q35 5
Brick	12	4	1	0	2	2	3	3	9	2	0	0	1	5	13	2	3	5	6	3
Industrial & Refractory	24	2	0	0	4	4.5	4.5	3	14	4	2	5	0	0	23	1	11	5	5	8
Sanitaryware & Tiles	8	1	0	0	2	0	3	0	6	2	2	0	1	2	6	0	2	1	3	5
Tableware	18	10	0	0	6	4	4	5	15	6	2	3	1	1	27	8	8	5	4	9
Total	62	17	1	0	14	11	15	11	44	14	6	8	3	8	69	11	24	16	18	25
					94					94					94					94

By sector	Q36 1	Q36 2	Q36 3	Q36 4	Q36 5	Q37 1	Q37 2	Q37 3	Q37 4	Q37 5	Q38 1	Q38 2	Q38 3	Q38 4	Q38 5	Q39 1	Q39 2	Q39 3	Q39 4	Q39 5	Q40 1	Q40 2	Q40 3
Brick	11	1	3	1	3	4	5	0	2	8	1	2	2	10	4	5	8	3	1	2	1	7	11
Industrial & Refractory	6	10	3	5	6	5	11	0	6	8	0	2	2	19	7	3	16	4	3	4	2	10	18
Sanitaryware & Tiles	4	1	1	2	3	5	0	0	3	3	1	2	0	6	2	0	4	5	0	2	2	4	5
Tableware	14	7	4	2	7	12	3	2	1	16	0	5	3	14	12	10	10	3	1	10	2	23	9
Total	35	19	11	10	19	26	19	2	12	35	2	11	7	49	25	18	38	15	5	18	7	44	43
					94					94					94					94			94

By sector	Q41 1	Q41 2	Q41 3	Q42 1	Q42 2	Q42 3	Q42 4	Q42 5	Q42 6	Q42 7	Q42 8	Q42 9	Q42 10	Q42 11	Q42 12	Q42 13	Q42 14	Q42 15	Q42 16	Q42 17	Q42 18	Q42 19	Q42 20	Q42 21	Q42 22	Q42 23	Q42 24
Brick	2	12	5	0	0	1	3	0	1	13	1	9	1	0	1	0	0	0	0	5	1	0	0	0	5	0	1
Industrial & Refractory	3	22	5	0	0	0	5	0	0	9	0	7	0	6	2	0	4	4	0	9	2	0	0	4	7	0	1
Sanitaryware & Tiles	3	6	2	0	0	1	4	0	0	6	0	4	0	1	1	0	0	1	0	3	0	0	0	1	6	0	1
Tableware	2	25	7	0	0	1	4	0	0	16	0	15	0	3	5	1	3	1	1	11	1	0	0	2	8	0	2
Total	10	65	19	0	0	3	16	0	1	44	1	35	1	10	9	1	7	6	1	28	4	0	0	7	26	0	5
			94																								

d. France by sector

By sector	Q1	Q1	Q1	Q2	Q2	Q2	Q2	Q2	Q2	Q2	Q2	Q3	Q3	Q3	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q4
	1	2	3	1	2	3	4	5	6	7	8	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Brick	12	3	1	16	5	8	2	6	4	6	1	15	1	0	1	4	0	1	0	5	6	1	0	0	0	0	2	2	7
Industrial & Refractory	8	16	5	28	9	17	2	16	6	11	5	20	6	3	0	3	2	1	0	9	6	3	0	1	0	0	3	0	12
Sanitaryware & Tiles	0	7	1	6	2	3	4	4	1	3	2	1	2	5	0	2	0	0	1	2	0	0	0	1	0	0	0	0	4
Tableware	19	13	6	34	10	19	7	11	7	10	5	28	8	2	2	3	14	2	1	7	3	3	1	2	0	2	1	1	17
Total	39	39	13	84	26	47	15	37	18	30	13	64	17	10	3	12	16	4	2	23	15	7	1	4	0	2	6	3	40
			91											91															

By sector	Q5	Q5	Q5	Q5	Q5	Q5	Q5	Q6	Q6	Q6	Q6	Q6	Q6	Q6	Q7	Q7	Q7	Q7	Q7	Q7	Q7	Q8	Q8	Q8	Q8	Q8	Q8	Q8
	1	2	3	4	5	6		1	2	3	4	5	6		1	2	3	4	5	6		1	2	3	4	5	6	
Brick	2	3	4	4.5	2.5	0		0	4	1	6	4	1		2	3	5	2	1	3		2	4	2	3	5	0	
Industrial & Refractory	7	3	1	11	7	0		6	6	2	5	10	0		4	8	7	7	1	2		7	6	4	6	6	0	
Sanitaryware & Tiles	1	1	2	1	2	1		0	1	2	1	1	3		1	3	2	1	0	1		1	4	1	1	1	0	
Tableware	7	7	1	19	4	0		4	8	3	13	3	7		6	6	8	12	4	2		9	12	3	8	6	0	
Total	17	14	8	35.5	15.5	1		10	19	8	25	18	11		13	20	22	22	6	8		19	26	10	18	18	0	
							91							91							91							91

By sector	Q9	Q9	Q9	Q9	Q9	Q9	Q9	Q10	Q10	Q10	Q10	Q10	Q10	Q10	Q11	Q11	Q11	Q11	Q11	Q11	Q11
	1	2	3	4	5	6		1	2	3	4	5	6		1	2	3	4	5	6	
Brick	8	4	2	2	0	0		6	5	1	2	0	2		5	4	4	0	0	3	
Industrial & Refractory	14	9	1	5	0	0		9	6	4	5	2	3		12	5	3	5	0	4	
Sanitaryware & Tiles	3	3	1	1	0	0		1	3	2	2	0	0		2	2	0	0	0	4	
Tableware	14	11	2	7	1	3		14	8	2	7	2	5		13	12	4	3	0	6	
Total	39	27	6	15	1	3		30	22	9	16	4	10		32	23	11	8	0	17	
							91							91							91

By sector	Q12 1	Q12 2	Q12 3	Q12 4	Q12 5	Q12 6	Q12	Q13 1	Q13 2	Q13 3	Q13 4	Q13 5	Q13 6	Q13
Brick	0	3	1	8	2	2		1	4	4	4	0	3	
Industrial & Refractory	3	3	5	9	4	5		3	6	3	6	5	6	
Sanitaryware & Tiles	0	0	1	4	1	2		2	1	2	1	0	2	
Tableware	1	7	2	10	6	12		5	5	11	4	3	10	
Total	4	13	9	31	13	21		11	16	20	15	8	21	
							91							91

By sector	Q14 1	Q14 2	Q14 3	Q14 4	Q14 5	Q14 6	Q14 7	Q14 8	Q14 9	Q14 10	Q14 11	Q14 12	Q14 13	Q14 14	Q14 15	Q14 16	Q14 17	Q14 18	Q14 19	Q14 20	Q15 1	Q15 2	Q15 3	Q15 4	Q15 5	Q15
Brick	3	2	2	2	2	4	2	2	4	1	1	5	0	1	2	2	0	0	0	0	2	11	2	0	1	
Industrial & Refractory	8	5	3	8	2	5	4	1	1	2	1	4	1	4	2	0	0	0	1	0	4	16	5	3	1	
Sanitaryware & Tiles	0	1	1	2	0	1	1	0	0	1	2	1	0	1	2	1	0	0	0	0	3	4	1	0	0	
Tableware	8	2	5	8	2	3	2	0	4	2	7	7	4	4	5	0	0	0	2	2	3	21	10	4	0	
Total	19	10	11	20	6	13	9	3	9	6	11	17	5	10	11	3	0	0	3	2	12	52	18	7	2	
																										91

By sector	Q16 1	Q16 2	Q16 3	Q16 4	Q16 5	Q16 6	Q16 7	Q16 8	Q16 9	Q16 10	Q16 11	Q16 12	Q16 13	Q16 14	Q16 15	Q16 16	Q16 17	Q16 18	Q17 1	Q17 2	Q17 3
Brick	1	6	3	2	4	0	0	0	8	0	2	0	5	0	4	3	2	0	6	2	8
Industrial & Refractory	4	11	3	8	7	0	0	2	9	5	4	2	1	0	1	4	6	0	11	6	12
Sanitaryware & Tiles	1	1	3	2	1	1	0	1	3	5	2	1	1	0	0	3	1	1	4	0	4
Tableware	2	14	8	6	5	2	1	1	18	16	1	2	1	2	0	7	7	1	6	13	19
Total	8	32	17	18	17	3	1	4	38	26	9	5	8	2	5	17	16	2	27	21	43
																					91

By sector	Q18 1	Q18 2	Q18 3	Q19 1	Q19 2	Q19 3	Q20 1	Q20 2	Q20 3	Q20 4	Q21 1	Q21 2	Q21 3	Q21 4	Q22 1	Q22 2	Q22 3	Q22 4	Q22 5	Q23 1	Q23 2	Q23 3	Q23 4	Q23 5
Brick	10	4	2	5	10	1	1	1	7	7	1	1	0	0	0	1	0	0	0	0	1	0	0	0
Industrial & Refractory	15	13	1	9	18	2	0	5	14	10	2	3	0	0	2	1	0	0	0	1	1	0	0	0
Sanitaryware & Tiles	4	4	0	1	6	1	1	1	1	5	1	1	0	0	0	1	0	0	0	0	1	0	0	0
Tableware	15	22	1	5	32	1	1	2	19	16	1	2	0	0	1	1	0	0	0	1	0	0	0	0
Total	44	43	4	20	66	5	3	9	41	38	5	7	0	0	3	4	0	0	0	2	3	0	0	0
			91			91				91				12					7					5

By sector	Q25 1	Q25 2	Q25 1	Q25 2	Q25 1	Q25 2	Q25 NO to Q	Q26 1	Q26 2	Q26 3	Q26 4	Q26 5	Q26 6	Q26 7	Q26 8	Q26 9	Q26 10	Q26 11	Q26 12	Q26 13	Q26 14	Q26 15
Brick	8	8	3	13	7	9	4	7	5	0	2	0	0	0	0	0	0	1	2	0	2	0
Industrial & Refractory	8	21	6	23	16	13	7	17	5	0	1	1	1	2	5	0	0	0	4	1	6	0
Sanitaryware & Tiles	2	6	2	6	3	5	5	0	1	0	0	0	0	0	0	0	0	0	1	0	2	1
Tableware	7	31	10	28	15	23	16	12	8	0	6	1	3	3	2	1	0	2	2	0	7	1
Total	25	66	21	70	41	50	32	36	19	0	9	2	4	5	7	1	0	3	9	1	17	2
		91		91		91																

By sector	Q28 1	Q28 2	Q28 3	Q28 4	Q28 5	Q28 6	Q28 7	Q28 8	Q28 9	Q28 10	Q28 11	Q28 12	Q28 13	Q28 14	Q28 15	Q28 16
Brick	1	3	1	3	0	0	3	1	0	0	1	0	2	1	2	0
Industrial & Refractory	5	3	3	4	1	0	3	4	1	0	0	0	3	1	5	1
Sanitaryware & Tiles	1	1	2	2	0	1	1	1	0	0	2	1	2	2	1	0
Tableware	0	4	0	8	2	1	0	5	0	0	0	1	6	5	6	2
Total	7	11	6	17	3	2	7	11	1	0	3	2	13	9	14	3

By sector	Q29 1	Q29 2	Q29 3	Q29 4	Q29 5	Q29 6	Q29 7	Q29 8	Q29 9	Q29 10	Q29 11	Q29 12	Q30 1	Q30 2	Q30 3	Q30 4	Q30 5	Q31 1	Q31 2	Q31 3	Q31 4	Q31 5
Brick	8	0	1	0	0	1	0	0	1	0	1	0	7	3	1	0	5	5	3	3	0	5
Industrial & Refractory	10	4	7	0	0	0	0	0	2	0	1	0	7	13	6	1	2	5	15	6	1	2
Sanitaryware & Tiles	1	1	2	0	0	0	0	0	0	0	0	0	5	2	0	0	1	6	1	0	0	1
Tableware	13	2	4	2	0	0	2	0	1	0	0	0	9	11	7	0	11	8	11	7	1	11
Total	32	7	14	2	0	1	2	0	4	0	2	0	28	29	14	1	19	24	30	16	2	19
																	91					91

By sector	Q32 1	Q32 2	Q32 3	Q32 4	Q32 5	Q33 1	Q33 2	Q33 3	Q33 4	Q33 5	Q34 1	Q34 2	Q34 3	Q34 4	Q34 5	Q35 1	Q35 2	Q35 3	Q35 4	Q35 5
Brick	11	1	0	0	4	1	2	4	4	5	0	0	0	1	15	3	5	4	0	4
Industrial & Refractory	22	3	1	0	3	2	3	8	12	4	1	4	3	1	20	5	7	2	4	11
Sanitaryware & Tiles	7	1	0	0	0	0	3	1	3	1	2	2	1	0	3	0	2	3	1	2
Tableware	16	12	0	0	10	1	5	10	11	11	4	5	1	0	28	14	4	5	3	12
Total	56	17	1	0	17	4	13	23	30	21	7	11	5	2	66	22	18	14	8	29
					91					91					91					91

By sector	Q36 1	Q36 2	Q36 3	Q36 4	Q36 5	Q37 1	Q37 2	Q37 3	Q37 4	Q37 5	Q38 1	Q38 2	Q38 3	Q38 4	Q38 5	Q39 1	Q39 2	Q39 3	Q39 4	Q39 5	Q40 1	Q40 2	Q40 3
Brick	7	3	2	0	4	3	5	2	1	5	3	3	1	3	6	6	2	4	0	4	0	6	10
Industrial & Refractory	8	6	5	4	6	10	6	5	3	5	0	1	4	19	5	5	9	6	2	7	3	12	14
Sanitaryware & Tiles	3	1	2	1	1	3	2	1	1	1	1	3	0	4	0	1	4	3	0	0	2	3	3
Tableware	18	6	3	1	10	13	4	2	1	18	0	4	4	12	18	13	10	3	0	12	1	18	19
Total	36	16	12	6	21	29	17	10	6	29	4	11	9	38	29	25	25	16	2	23	6	39	46
					91					91					91					91			91

By sector	Q41 1	Q41 2	Q41 3	Q42 1	Q42 2	Q42 3	Q42 4	Q42 5	Q42 6	Q42 7	Q42 8	Q42 9	Q42 10	Q42 11	Q42 12	Q42 13	Q42 14	Q42 15	Q42 16	Q42 17	Q42 18	Q42 19	Q42 20	Q42 21	Q42 22	Q42 23	Q42 24
Brick	2	10	4	0	0	5	1	0	3	11	1	3	0	5	2	0	0	0	0	4	1	1	0	2	3	0	0
Industrial & Refractory	5	24	0	0	0	3	8	0	0	8	0	7	0	5	3	2	6	2	0	12	2	0	0	5	6	0	0
Sanitaryware & Tiles	2	5	1	0	0	2	3	0	2	2	0	1	0	2	3	1	2	0	0	3	0	0	1	2	0	0	0
Tableware	2	30	6	0	0	10	6	0	6	20	0	13	0	3	6	2	3	1	0	7	0	1	0	5	7	0	0
Total	11	69	11	0	0	20	18	0	11	41	1	24	0	15	14	5	11	3	0	26	3	2	1	14	16	0	0
			91																								

e. UK - Cross correlation by sector

By sector	Q5 Yes to 4 or 5	Q17	Q17/Q5	Q19 1	Q19/Q5	Q25 yes to 1 of 3	Q25/Q5	Q18 1	Q18/Q5
Brick	14	6	4	7	5	15	11	15	10
Industrial & Refractory	18	10	8	11	8	20	14	13	11
Sanitaryware & Tiles	7	3	3	6	4	9	6	10	6
Tableware	22	5	4	4	3	22	14	22	16
Total	61	24	19	28	20	66	45	60	43

By sector	Q6 Yes to 4 or 5 1	Q17	Q17/Q6	Q19 1	Q19/Q6	Q25 yes to 1 of 3	Q25/Q6	Q18 1	Q18/Q5
Brick	10	6	6	7	4	15	8	15	9
Industrial & Refractory	16	10	7	11	8	20	13	13	10
Sanitaryware & Tiles	4	3	2	6	2	9	4	10	3
Tableware	19	5	2	4	1	22	14	22	12
Total	49	24	17	28	15	66	39	60	34

By sector	Q10 Yes to 1 or 2	Q13 Yes to 1 or 2	Q10/Q13	Q30 Yes to 1 or 2	Q31 Yes to 1 or 2	Q30&Q31 Yes to Q31 or 32	Q30&31/Q10	Q30&31/Q13
Brick	9	4	3	13	14	14	7	3
Industrial & Refractory	17	10	8	18	19	19	12	7
Sanitaryware & Tiles	7	4	3	9	9	9	5	2
Tableware	21	11	6	19	19	19	10	6
Total	54	29	20	59	61	61	34	18

By sector	Q8 Yes to 1 or 2	Q32 Yes to 1 or 2	Q8/Q32	Q25	Q13	Q25/13	Q30&31	Q25/Q30&31
Brick	8	16	7	4	5	0	3	0
Industrial & Refractory	12	26	10	10	10	4	5	2
Sanitaryware & Tiles	4	9	2	2	1	0	1	0
Tableware	20	28	16	12	10	5	9	2
Total	44	79	35	28	26	9	18	4

f. UK - Cross correlation by size

By size	Q5 Yes to 4 or 5	Q17	Q17/Q5	Q19 1	Q19/Q5	Q25 Yes to 1 of 3	Q25/Q5	Q18 1	Q18/Q5
Micro (1-50)	25	4	4	6	6	18	15	15	13
Small (51-99)	10	2	1	4	2	11	5	13	9
Medium (100-250)	14	6	5	9	7	16	13	13	9
Large (251+)	12	12	9	9	5	21	12	19	12
Total	61	24	19	28	20	66	45	60	43

By size	Q6 Yes to 4 or 5 1	Q17	Q17/Q6	Q19 1	Q19/Q6	Q25 Yes to 1 of 3	Q25/Q6	Q18 1	Q18/Q6
Micro (1-50)	18	4	4	6	2	18	10	15	9
Small (51-99)	3	2	1	4	1	11	3	13	2
Medium (100-250)	12	6	4	9	6	16	11	13	10
Large (251+)	16	12	8	9	6	21	15	19	13
Total	49	24	17	28	15	66	39	60	34

By size	Q10 Yes to 1 or 2	Q13 Yes to 1 or 2	Q10/Q13	Q30 Yes to 1 or 2	Q31 Yes to 1 or 2	Q30&Q31 Yes to 1 or 2	Q30&31/Q10	Q30&31/Q13
Micro (1-50)	17	8	4	23	24	24	12	6
Small (51-99)	10	4	4	13	14	14	8	4
Medium (100-250)	14	6	5	15	15	15	11	5
Large (251+)	13	11	7	8	8	8	3	3
Total	54	29	20	59	61	61	34	18

By size	Q8 Yes to 1 or 2	Q32 Yes to 1 or 2	Q8/Q32	Q25	Q13	Q25/Q13	Q30&31	Q25/Q30&31
Micro (1-50)	17	33	15	19	12	7	9	3
Small (51-99)	7	15	6	6	5	2	2	1
Medium (100-250)	10	14	7	2	7	0	0	0
Large (251+)	10	17	7	1	2	0	7	0
Total	44	79	35	28	26	9	18	4

g. France - Cross correlation by sector

By sector	Q5 Yes to 4 or 5	Q17 1	Q17/Q5	Q19 1	Q19/Q5	Q25 yes to 1 of 3	Q25/Q5	Q18 1	Q18/Q5
Brick	7	6	2	5	1	12	5	10	4
Industrial & Refractory	18	11	9	9	9	22	13	15	13
Sanitaryware & Tiles	3	4	2	1	1	3	2	4	1
Tableware	23	6	4	5	3	22	13	15	9
Total	51	27	17	20	14	59	33	44	27

By sector	Q6 Yes to 4 or 5	Q17 1	Q17/Q6	Q19 1	Q19/Q6	Q25 yes to 1 of 3	Q25/Q6	Q18	Q18/Q6
Brick	10	6	5	5	4	12	9	10	8
Industrial & Refractory	15	11	7	9	6	22	14	15	9
Sanitaryware & Tiles	2	4	1	1	0	3	0	4	0
Tableware	16	6	2	5	3	22	11	15	7
Total	43	27	15	20	13	59	34	44	24

By sector	Q10 Yes to 1 or 2	Q13 Yes to 1 or 2	Q10/Q13	Q30 Yes to 1 or 2	Q31 Yes to 1 or 2	Q30&Q31 Yes to 1 or 2	Q30&31/Q10	Q30&31/Q13
Brick	11	5	3	10	8	10	9	3
Industrial & Refractory	15	9	7	20	20	20	13	8
Sanitaryware & Tiles	4	3	3	7	7	7	4	3
Tableware	22	10	3	20	19	21	13	4
Total	52	27	16	57	54	58	39	18

By sector	Q8 Yes to 1 or 2	Q32 Yes to 1 or 2	Q8/Q32	Q25	Q13 2	Q25/Q13	Q30&31	Q25/Q30&31
Brick	6	12	5	4	4	2	3	1
Industrial & Refractory	13	25	12	7	11	1	7	2
Sanitaryware & Tiles	5	8	5	5	1	1	0	0
Tableware	21	28	16	16	7	3	9	2
Total	45	73	38	32	23	7	19	5

h. France - Cross correlation by size

By size	Q5 Yes to 4 or 5	Q17 1	Q17/Q5	Q19 1	Q19/Q5	Q25 Yes to 1 of 3	Q25/Q5	Q18 1	Q18/Q5
Micro (1-50)	22	8	5	3	3	22	13	10	8
Small (51-99)	8	0	0	2	1	8	4	7	4
Medium (100-250)	11	10	7	9	6	16	8	12	5
Large (251+)	10	9	5	6	4	13	8	15	10
Total	51	27	17	20	14	59	33	44	27

By size	Q6 Yes to 4 or 5	Q17 1	Q17/Q6	Q19 1	Q19/Q6	Q25 Yes to 1 of 3	Q25/Q6	Q18	Q18/Q6
Micro (1-50)	20	8	7	3	2	22	15	10	9
Small (51-99)	3	0	0	2	0	8	2	7	0
Medium (100-250)	13	10	5	9	8	16	11	12	8
Large (251+)	7	9	3	6	3	13	6	15	7
Total	43	27	15	20	13	59	34	44	24

By size	Q10 Yes to 1 or 2	Q13 Yes to 1 or 2	Q10/Q13	Q30 Yes to 1 or 2	Q31 Yes to 1 or 2	Q30&Q31 Yes to 1 or 2	Q30&31/Q10	Q30&31/Q13
Micro (1-50)	25	10	6	26	24	26	21	6
Small (51-99)	8	5	2	8	8	9	6	3
Medium (100-250)	14	7	7	15	15	15	11	7
Large (251+)	5	5	1	8	7	8	1	2
Total	52	27	16	57	54	58	39	18

By size	Q8 Yes to 1 or 2	Q32 Yes to 1 or 2	Q8/Q32	Q25	Q13 4 & 5	Q25/Q13	Q30&31	Q25/Q30&31
Micro (1-50)	23	31	19	18	12	5	8	2
Small (51-99)	5	12	4	7	3	1	5	2
Medium (100-250)	10	16	9	5	5	1	0	0
Large (251+)	7	14	6	2	3	0	6	1
Total	45	73	38	32	23	7	19	5