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Abstract

That the industrial structure of the Illawarra region is dominated by and heavily dependent on its heavy metallurgy complex hardly requires demonstration. As Robinson (1977) has shown, for example, six major enterprises, Australian Iron and Steel (A.I.S.I, Lysaghts, Tube Makers, Commonwealth Steel, Electrolytic Refining and Smelting (E.R. & S.) and Metal Manufacturers (M .M.), employ between them more than 75% of the region's manufacturing workforce and more than one third of the region 's total (male and female) employed workforce in 1976-77. As can be seen from Table 1, however, the range of industrial activity carried out in the region's factories and workshops is very much wider than basic metallurgy. At the level of the individual plant, for instance, a quite bewildering array of products is manufactured, ranging from foundation garments to fibreglass pools and surfboards, from plastic bags to pelmets and pyjamas, from low loaders to lemonade, from hats to home cleansing preparations and horsecovers and from textiles to railway waggons. Nor are all these other activities necessarily small in scale nor oriented simply to meeting the needs of a local market though many, of course, are both.

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THE INDUSTRIAL STRUCTURE OF THE URBAN ILLAWARRA - M.G.A. Wilson

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That the industrial structure of the Illawarra region is dominated by and heavily dependent on its heavy metallurgy complex hardly requires demonstration. As Robinson (1977) has shown, for example, six major enterprises, Australian Iron and Steel (A.I.S.), Lysaghts, Tube Makers, Commonwealth Steel, Electrolytic Refining and Smelting (E.R. & S.) and Metal Manufacturers (M.M.), employ between them more than 75% of the region's manufacturing workforce and more than one third of the region's total (male and female) employed workforce in 1976-77. As can be seen from Table 1, however, the range of industrial activity carried out in the region's factories and workshops is very much wider than basic metallurgy. At the level of the individual plant, for instance, a quite bewildering array of products is manufactured, ranging from foundation garments to fibreglass pools and surfboards, from plastic bags to pelmets and pyjamas, from low loaders to lemonade, from hats to home cleansing preparations and horsecovers and from textiles to railway waggons. Nor are all these other activities necessarily small in scale nor oriented simply to meeting the needs of a local market though many, of course, are both.

Robinson's "background" paper referred to above briefly discusses the location and the location factors of establishments falling into each of eight industrial classification categories, using information derived from a survey of plants conducted during the early 1970's. Such a segmented, category-by-category approach has much to recommend it, particularly when attention is directed at factors responsible for location decision at the intra-urban level. A casualty of that approach, however, is the comprehensive overview of the interrelationships between industrial categories, that is, of the structure and functioning of the regional industrial system. This study aims to fill that gap by:

- i) identifying and describing the characteristics of the major constellations of manufacturing activity in the Wollongong-Shellharbour urbanised area and its vicinity.
- ii) examining the linkages within and between these clusters and, as well, their links on both supply (market) and demand (raw material) sides with other more distant regions.

Finally, the regional complex of manufacturing activity will be considered in the broader context of urban and regional development theory.

THE STRUCTURE OF THE INDUSTRIAL 'SYSTEM'

In 1977 the Illawarra Regional Advisory Council prepared and published a **Register of Manufacturing Industry** for the Illawarra Region in which the activity, raw material sources, product markets and employment totals were listed for each individually listed firm. While some obvious inaccuracies/omissions have since been identified, the Register provides at once the most comprehensive and informative data source on the region's manufacturing activity. From these data it is possible to view the region's industrial structure as comprising essentially two internally diverse constellations of manufacturing activity and a third largely independent, single plant element, namely:

- a) those firms engaged in basic metallurgy or in the pressing and fabrication of metallurgical products;
- b) that cluster of manufacturing plants oriented towards local markets and labour supplies; and
- c) the fertiliser industry (See diagram overleaf).

Though widely diverse in terms of produce orientation and plant size, for example, each element/cluster draws heavily on external sources of raw materials, often overseas; each serves, to a greater or lesser extent, markets beyond the region; each is linked with the other only weakly, that is, between-cluster flows of product or

TABLE 1: BROAD CATEGORIES OF MANUFACTURING ACTIVITY IN URBAN ILLAWARRA, 1977*

Category.	No. of Plants	No. of Employees	Average No. Employees
1. Heavy metallurgy (ferrous and non-ferrous)	7	25,100	3,600
2. Clothing	18	3,500	203
3. Engineering	16	975	61
4. Food products	19	900	47
5. Refractories, bricks, tiles, etc.	8	600	75
6. Chemicals	6	515	86
7. Steel fabricating	30	475	16
8. Cement products	14	313	22
9. Timber products	8	250	31
10. Household furnishings, etc.	16	160	10
11. Textiles	4	160	40
12. Printing, etc.	3	20	7
13. Miscellaneous	15	380	24

Source: Illawarra Regional Advisory Council (1977) **A Register of Manufacturing Industry**, Wollongong.

* Categories employed here are not directly comparable to those of the Standard Industries Classification as used in statistical publications of the A.B.S.

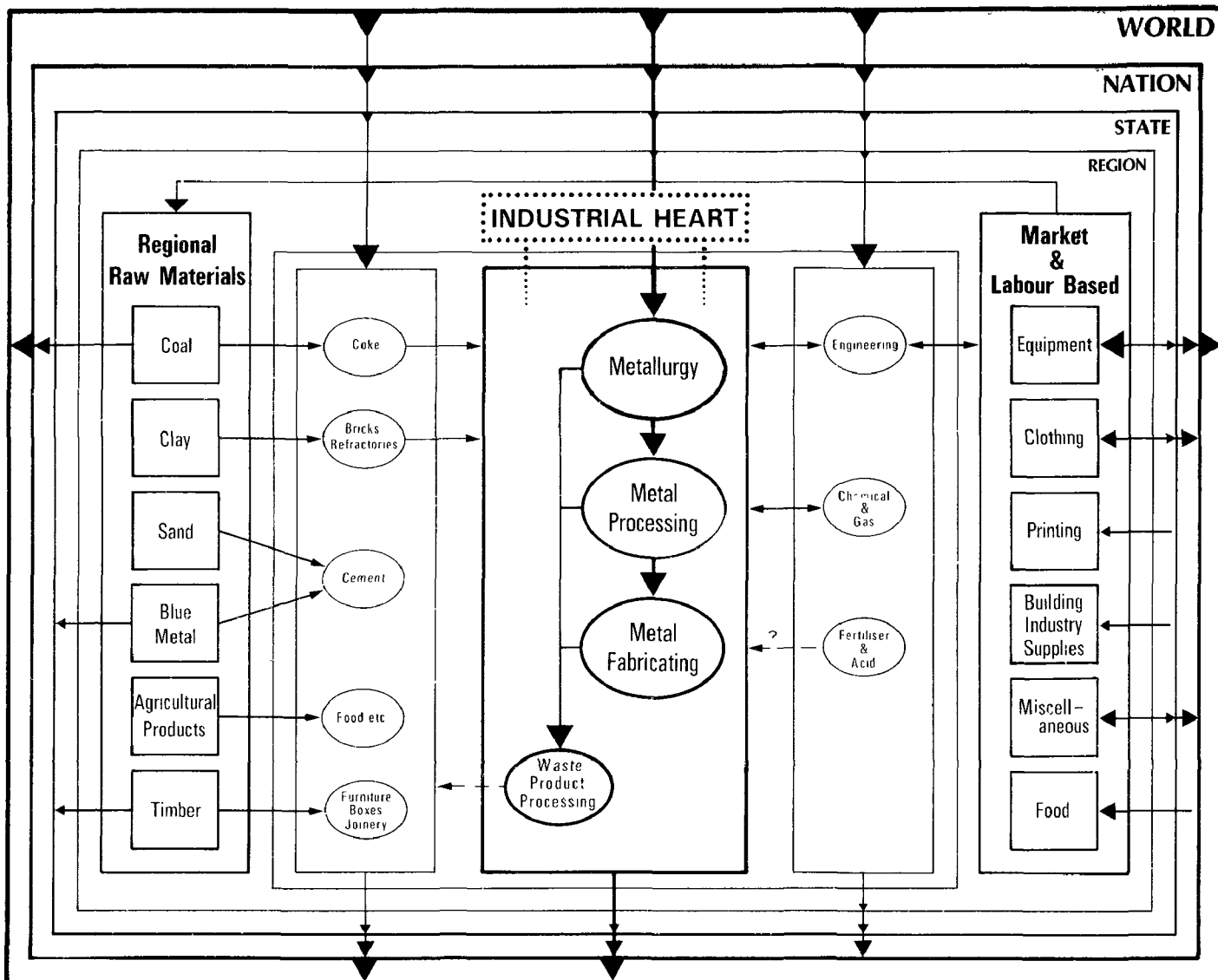
service are not well developed; and, as Robinson has demonstrated, dissimilar location patterns have evolved which tend to reflect these differences.

As the diagram suggests, the metallurgical "cluster", extending as it does **backwards** to the processing of local raw materials such as coal, clay or air and **forwards** beyond basic smelting, refining and first shaping of ferrous and non-ferrous metals to include a variety of fabricating and engineering activities, is quite the most important of these clusters, in terms both of employment and contribution to the overall character of the regional system. It is also that sub-system within which the linkages **between** components are best developed and provide clear evidence of the importances of "localisation economies" in the explanation of industrial location patterns.

By contrast, the fertiliser "industry" comprises virtually a single plant, with only the weakest of links between it and others in the region and having virtually no local market for its main product - superphosphate. The third cluster of activities, comprises industries such as clothing or textile manufacturing, for which the availability of cheap female labour has conventionally been an attractive force, or others such as printing, joinery, cement products, soft furnishings, small goods and soft drinks manufacturing, which tend to be attracted towards any significant population concentration. To the extent that this is the case, therefore, that is, to the extent that this third cluster of industries has evolved essentially to meet the requirements of or to use the female labour from a population principally concerned to produce iron, steel, and non-ferrous metals, then of course, it can be argued that the key to the whole is the region's specialisation in ferrous and non-ferrous metallurgy.

THE METALLURGICAL 'LINE'

Central to this component of the regional industrial system are the basic smelting, refining and "shaping" plants of the A.I. & S. and E.R. & S., which between them employ some 20,650 workers. In the years since initial establishment (the 1920's and 1900's, respectively), however, forward and backward linkages of some considerable magnitude have evolved. Locally mined coal, highly suited to the production of metallurgical coke and, of course, one of the prime reasons for the establishment and development of these activities in the region, is consumed in large quantities by the steel-works coke ovens but also by specialist coke making plants at



Corrimal and Coalcliff. While much of this product is consumed by foundries elsewhere in N.S.W. (especially Sydney and Newcastle) or is exported interstate, some portion is also consumed by local foundries and by the E.R. & S. Local clay deposits, occurring in association with the coal seams, has also proved extremely suitable for the manufacturing of firebricks and other refractory products used extensively for lining furnaces in the smelting, refining and shaping industries. Refractory production, still heavily dependent on local industrial demand and local raw materials, has also developed its own extra-regional links, both backwards (on the raw material side) and forwards (on the marketing side), however, and now draws raw materials from interstate and overseas while supplying markets throughout Australia and the Pacific Basin. In all, more than 500 were employed in this form of manufacturing at the time of the survey.

The introduction of bulk oxygen steel manufacturing technologies in the 1960's created a demand for large volumes of oxygen for injection into the B.O.S. furnaces, over and above the ordinary need for industrial gasses (nitrogen, argon, etc.) for welding, cutting and otherwise working metals in the region's factories and engineering shops. These requirements, as well as those generated elsewhere in the region, are met from the C.I.G. (Commonwealth Industrial Gases) plant, adjacent to and linked by pipeline to the steelworks.

Forward of the smelting and refining processes in both the ferrous and non-ferrous sections of this "line" lies a very considerable and diverse array of manufacturing establishments. On the ferrous side iron and steel is further processed (alloyed, rolled, tinned, cast, extruded, etc.) in plants partly or wholly owned by the B.H.P., the parent company of A.I. & S. In addition, however, some 40-odd other plants, employing nearly 1,200 workers, are engaged in various forms of steel fabrication or engineering for which sheet, round, and structural shapes, tube or other steel products are the fundamental raw material and in which metallurgical coke and industrial gas are widely required. On the market

side most of these plants are local oriented, not uncommonly being involved in meeting the needs of the steelworks complex itself, but several of the largest, for example, Garnock Engineering, Transfield Pty. Ltd., Titan, B. & W. Steel Pty. Ltd. (concerned respectively with the production of steel wire equipment, cranes, pressure vessels, ship repairing and the like, structural steel rail waggons, roof supports and mining hardware, and gas mains, gantry cranes and general engineering housing), all have inter-state, national and/or overseas markets. At the other end of the spectrum, however, are to be found small "jobbing" fabricators and foundrymen making gates, wrought iron, roof trusses and the like, usually for a local market.

As can be seen from Table 2 there is a direction relationship between plant size and the extent of the market served. Similarly, larger firms tend also to depend less upon local raw materials. In only one case is a plant apparently involved in the fabricating of steel products not dependent largely or entirely upon raw material of local origin.

On the non-ferrous side neither backward nor forward linkages are so well developed or diverse. As in the steel industry the smelting of copper ores and concentrates mined elsewhere in N.S.W. (Cobar), Victoria (Woodlawn) and Tasmania uses locally manufactured coke. The resulting "blister" copper is refined, alloyed, cast into ingots, billets/bars (E.R. & S.) and extruded as rod, wire, strip, tube, etc. along with other non-ferrous metals, at the plant of Metal Manufacturers Ltd.

By contrast with the ferrous side, however, the great bulk of these products leave the region without further transformation, contributing little to the region's industrial structure by way of later-phase fabricating and engineering. Nor are the linkages between ferrous and non-ferrous lines significant, being essentially confined to the production of anode tin (M. & T. Chemicals) for use in the tin plating of steel strip (Lysaghts).

TABLE 2: ENGINEERING AND STEEL FABRICATING INDUSTRIES - EMPLOYMENT AND PLANT SIZE BY RAW MATERIAL AND MARKET LOCATIONS, 1977

Market Area	Raw Material Source	No Local Raw Materials	Part Local Raw Materials	Wholly Local Raw Materials	Total
Local					
	*Employees		173	186	359
	*Plants		10	18	28
	Average Empl.		17.3	10.3	12.8
N.S.W.					
	*Employees	40	55	71	166
	*Plants	1	3	4	8
	Average Empl.	40	18.3	17.7	20.7
Australia					
	*Employees		170	167	337
	*Plants		2	2	4
	Average Empl.		85	83	82.2
Overseas					
	*Employees		281	82	327
	*Plants		3	1	4
	Average Empl.		93.7	82	90.8
Total					
	*Employees	40	679	506	1189
	*Plants	1	18	25	44
	Average Empl.	40	37.7	20.2	27.8

Source: Illawarra Regional Advisory Council (1977) *A Register of Manufacturing Industry*, Wollongong.

The extensive development of ferrous and to a lesser extent non-ferrous fabricative industries in the region, drawing, for example, on locally produced steel or copper shapes, has resulted over the years in the development of a significant pool of skilled, experienced metal workers capable of attracting related industries into the region, even where raw material and product markets are extra-local. The fabrication of cool-rooms, aluminium truck bodies and boats, air conditioning ducting and other perhaps more logically market-located activities serving largely statewide markets would seem explicable in these terms.

In sum, the metallurgical industrial complex in the northern Illawarra comprises a series of product and service linked industries ranging from those providing inputs (coke, refractories, industrial gas) into the basic smelting and refining activities and drawing directly upon the region's extensive industries to those involved with shaping and fabricating the outputs of those smelting and refining activities. At all stages, however, whether backward from or forward of these central processes, suppliers or consumers external to the region and often even to the nation are involved. The vital significance of the portside location and the importance by volume of throughput of Port Kembla in the Australian port system (see Robinson, 1977) are thereby underscored.

THE FERTILISER ELEMENT

Australian Fertilisers Ltd. wharf-side plant at Port Kembla is classically located at a "break of bulk" point to convert imported bulk rock phosphate and sulphur into superphosphate for distribution throughout agricultural and pastoral N.S.W. Its links with either the "metallurgical" or the market/labour oriented clusters of industries are therefore almost non-existent, except in so far as it supplies sulphuric acid to local industry. Nevertheless, its "noxious" nature and its need for easy access to ocean shipping and rail facilities provide strong parallels with the metallurgical base.

THE 'URBANIZATION' CLUSTER

For many industries proximity to market is a prime locational consideration, particularly when commodity perishability, direct customer contact and/or low value: bulk ratios are characteristic. For these reasons all major urban areas, whatever their functional role and whether or not they possess other significant industrial activities, are likely to contain plants engaged in the manufacture of foodstuffs (bread, cakes, pies, small goods), soft drinks and cordials, curtains and soft furnishings, joinery, clay and cement products (bricks, tiles, pipes, etc.), printing, and the like. For similar reasons industries dependent upon large supplies of lower

cost female labour, such as the textile and clothing industries, are also common in such centres, despite their often heavy, even total, reliance upon imported raw materials and markets external to the city. The urban region of the Illawarra is no exception to these generalisations and the great bulk of the remainder of its industrial establishments belong to this broad category of manufacturing activity (Table 3).

In employment terms quite the most important form of manufacturing are the female labour orientated textile and clothing industries which, in 1977, provided gainful employment for nearly 3,000 workers, less than 10% of whom were males. At the time of the survey individual establishments ranged in size from nearly 800 employees (shirts, underwear, baby wear, sheets, towels) down to five or six (hats, shirt-sleeves) but the great majority (14 of 20) employed more than 50 workers each. Since that time, of course, both textile and clothing industries have experienced considerable difficulty. As a result, substantial "lay-offs" and even factory closure have exacerbated an already difficult regional female employment situation. In all cases raw materials, whether in the form of yarn/fibre or woven cloth, is supplied from outside the region, generally from Sydney but in 40% of cases from other parts of Australia or overseas. Similarly, only two plants (concerned with the production of uniforms and school shirts, etc. and employing between them less than 4% of the workforce in this area), admit to a local rather than a nation-wide market. Quite clearly, then, the ready availability of female workers in this area of otherwise male dominated employment (mining, heavy metallurgy) is the dominant locational factor. Other industries of this type would seem to include the manufacture of "home products" (bleach, polishes, toothpaste, etc.) in which some 200 workers (c.150 females) were employed.

As can be seen from Table 3 the great majority of other industrial establishments in the region largely or exclusively serve the local market and depend largely on non-local sources for at least a substantial portion of their raw material needs (cement in the concrete products area, for example, livestock for the abattoirs/meat processing industry, concentrates/syrups for soft drink making, etc.). The principal exceptions to this generalisation are a small number of concerns processing local primary products for an extra-regional market, for example, the Jamberoo dairy factory supplying butter, milk powder and condensed milk to the metropolitan area, a local abattoir drawing stock from intra- as well as interstate sources for the local, metropolitan and export markets and one or two small plants (producing, for example, fibre-glass swimming pools) whose location would appear more likely to reflect local entrepreneurial initiative, given their dependence on metropolitan raw materials, their national markets and their small labour requirements.

TABLE 3: MANUFACTURING ACTIVITIES ATTRACTED BY LABOUR AND MARKET

Type	No. of Plants	Total Empl.	Plants with mainly external raw materials	Plants serving mainly or entirely local market
1. Labour				
Textiles	4	160	4	1
Clothing	18	3400	18	2
2. Market				
Household supplies	10	130	9	10
Joinery	4	43	2	4
Construction related	8	63	8	7
Concrete/Cement prod.	14	204	14	14
Bricks (non refractory)	2	113	0	2
Printing	6	37	5	5
Business Supplies	3	126	3	2
Food & Drink	20	23	15	17
Timber Prod.	5	197	1	4
Chemicals	4	226	3	3
Plastic, Fibre Glass, Rubber Goods	5	74	5	3

As might be expected the direct linkages between these forms of local consumption orientated manufacturing and the metallurgical complex are relatively undeveloped except in so far as activities such as printing, brick/concrete products and wooden pallets, etc. may be consumed by these industries. In future years the use of crushed slag - a waste product of the steel industry - as a replacement for sand in the concrete products industry - may provide one quite important link in the reverse direction.

AGGLOMERATION ECONOMIES AND INDUSTRIAL LINKAGES

For many individual factories and workshops in the region it would seem likely that the potential for achieving "agglomeration economies" has been a locational attraction. The steel industry certainly enjoys economies of scale deriving from the region's ability to support continued expansion of productive capacity e.g. by the addition of more and larger blast-furnaces, further and technologically more advanced steel making capacity, further basic shaping facilities, etc. on the one site. It is also arguable that transfer economies (i.e. cost savings due to reduced freight charges on raw materials and finished products) have been realised from the growth of the major vertically - linked, steel using plants (engaged in rolling, plating, shaping, etc.) on sites immediately adjacent to the steel works. Equally, transfer economies and localisation economies (savings accruing from the local availability of a pool of (skilled) labour and specialist services such as tool makers, maintenance workers, sub-contractors, etc.) are undoubtedly advantageous to and underpin the presence of that cluster of small engineering and metal fabricating establishments which figure so large in the regional complex. For much of remainder, however, that is, for those industries serving the needs of the local community, urbanization economies may be claimed, that is, the cost advantages flowing from a diversified and flexible labour force, local demand, and the presence of many ancillary services ranging from transportation through financial, legal and public utilities.

A MODEL OF URBAN-INDUSTRIAL GROWTH

The cumulative significance of these linkages and their consequential cost-efficiency advantages to the evolution of an industrial region has been highlighted by Wilbur Thompson in his multi-stage model of the process of urban growth (Thompson, 1965; 12-18). Because the relevance of this model to the Illawarra is considerable and because, in particular, it offers some insight into the growth potential and problems of this region it provides an appropriate tail-piece to this study.

In Thompson's view the first stage of urban growth in a region might occur as the result of the rise of some industry based probably on local raw materials and largely dependent upon markets external to the region. This stage he identified as the **Stage of Export Specialisation**, in which the local economy is "the lengthened shadow of a single dominant industry or even a single firm".

In time the addition of vertically linked industries i.e. additional stages of production and/or local suppliers to or consumer of products from these activities leads ultimately to the emergence of an export-oriented industrial complex, the **Stage of the Export Complex**. Further expansion of the industrial base, resulting from the replace-

ment of imported products by local production, leads to the **Stage of Economic Maturation**, characterised by the filling out of the local economy in range and quality of business and consumer services. When neighbouring cities become interlined with and dominated by the centre and the export of its services become a major economic function, then, Thompson suggests, the **Stage of Regional Metropolis** has been reached. Should our centre achieve national eminence in some specialised skill or economic function, whether before or after the Stage of Regional Metropolis, then, as in the case of Detroit for its automobile industry, the **Stage of Technical-Professional Virtuosity** may be reached.

As Thompson himself noted, such a sequence of events is strongly suggestive of the inevitability of the process, that is, "once aboard the elevator the sky's the limit". Such is certainly not the case, however, as many once prosperous but now depressed, technologically obsolete industrial centres have found. What enables one rather than another centre to maintain early momentum to rise clear of its rivals is not always easy to determine; in some cases it may be little more than the momentum of an early start, in others, a capacity to take advantage of a faster rate of technological innovation in one industry rather than another. And when one gets a head start, it is unlikely that another, nearby, will also rise to the level of Regional Metropolis.

How then does this scheme apply to the Illawarra? Since the region's first major industrial (as distinct from mining) development involved the establishment and growth of those same coal-based smelting and refining industries which remain pre-eminent in today's industrial structure and since external markets were even more dominant then than now, **export specialisation** is clearly appropriately descriptive of the urban region in the pre-war years. Massive post-war development and expansion led, however, to the emergence of a far more complex range of industries, backward and forward linked to these key activities. At this time, therefore, the urban region may reasonably be viewed as having evolved into the stage of **export complex**. In the last decade or two, continued diversification of the industrial base, the growing scope and diversity of the business and consumer services and the importance of strongly articulated internal industrial linkage suggest, however, that the stage of **economic maturation** has been reached.

Further than this it is difficult to proceed for, while it is arguable that the region's national eminence, even pre-eminence, in steel-making entitles it to the status of **technical and professional virtuosity**, it is absolutely clear that **regional and metropolis** status has neither been gained nor is even likely to be achieved, gives the ever increasing strength of the links with Sydney and the physically very restricted extent of the service hinterland.

Whether in years to come, the combined effects of technological and structural change in manufacturing, foreign competition and changing patterns of location for resource processing industries will not so dampen the momentum of industrial growth as to result in regional stagnation or worse decline, as it would seem, is a far more important question.

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