Deriving an Empirical Development Taxonomy for Manufacturing SMEs Using Data from Australia's Business Longitudinal Survey

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ABSTRACT. This novel methodological paper describes the first stage of an on-going research effort to derive, characterise and employ an empirically-based development taxonomy for small and medium-sized enterprises (SMEs) in the manufacturing sector using panel data recently made available from Australia's Business Longitudinal Survey. Exploratory cluster analysis is used with key enterprise age, size and growth variables to discover if there appear to be any stable development pathways evident in the data. Each of four annual data collections is separately examined, and then comparisons are made of the resulting cluster analysis outcomes over time. Descriptive statistics for various enterprise characteristics facilitate interpretation of the cluster analysis solutions. Using the clusters as markers or signposts over time, three relatively stable SME development pathways are discernible in the longitudinal panel results. The first is a low growth pathway apparently leading to the traditional or life-style SME configuration (around 70 per cent of the panel). The second is a moderate growth pathway possibly leading to the capped growth SME configuration (around 25 per cent of the panel). And the third is a high growth pathway seemingly leading to the entrepreneurial SME configuration (around 5 per cent of the panel). These findings are clearly in accord with the observed rarity of substantial growth amongst SMEs worldwide.

Introduction

Over many decades it has been very common amongst researchers to view small and medium-sized enterprise (SME) growth as a series of phases or stages of development through which the business may pass in an enterprise life-cycle. Having its origins in the literature of economics (Marshall, 1890; Penrose, 1952, 1959; Rostow, 1960), reliance on this paradigm in the SME literature is most frequently claimed to date back to Steinmetz (1969). In an often cited book of readings on the organisational life-cycle, Kimberly and Miles (1980, p. ix) draw attention to:

> . . . the cyclical quality of organizational existence. Organizations are born, grow, and decline. Sometimes they reawaken, and sometimes they disappear.

This quotation invokes a biological metaphor for business organisations which has been the source of much controversy in the literatures of economics, business and sociology (Penrose, 1952; Kimberly and Miles, 1980).

Before presenting the findings of their own empirical research, Hanks et al. (1993) critically review virtually all significant prior writing and research on the enterprise life-cycle construct. Commenting on wide differences in the specifics of prior stages of growth models (particularly inclusion of from 3 to 10 stages), Hanks et al. (1993, pp. 11–12) observe that:

> In recent years, a few empirical studies of the organization life cycle have emerged, providing important contributions to life-cycle theory (Kazanjian, 1988; Kazanjian and Drazin, 1990; Miller and Friesen, 1984; Smith et al., 1985). However, most of these studies have defined growth stages *a priori*, using existing conceptualizations. The lack of specificity and empirical rigour in these typologies may account for unexpected intrastage variance found in some analyses. . . . It may be possible to address some of these difficulties by deriving taxonomic rather than typological models . . .

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Hanks et al. (1993) see the strength of a taxonomic approach to identifying and specifying stages in an enterprise life-cycle model as deriving from use of multivariate statistical analysis of empirical data to reveal common patterns and relationships in the data. They acknowledge only Smith et al. (1985) as having previously employed a taxonomic approach to developing an enterprise life-cycle model, but note that that research had a very small sample size and various other weaknesses. Developed using exploratory cluster analysis, the taxonomic stages of growth model subsequently described by Hanks et al. (1993) is represented in Figure 1.

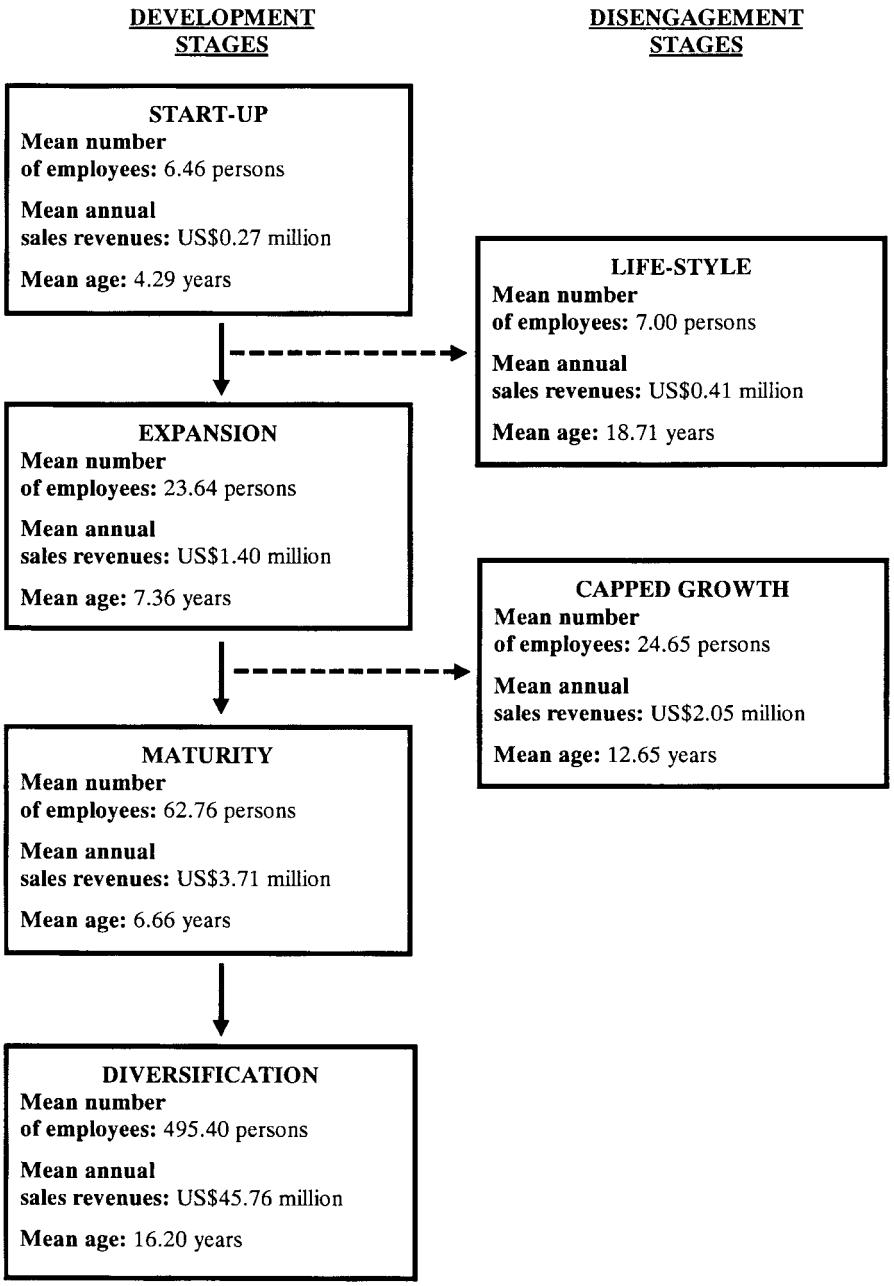

Figure 1. Hanks et al. (1993) enterprise life-cycle model.

After conducting his own critical appraisal of recent research in the field, the present author (McMahon, 1998) believes that some reliance can be placed on both the broad approach and the general features of the Hanks et al. (1993) model. As well as overcoming concerns that such models are frequently not empirically based, it can also be claimed to at least partially answer the most prevalent objections to this type of model that have appeared in the relevant literature (O'Farrell and Hitchens, 1988). Importantly, this model incorporates two disengagement (or arrested development) configurations that are frequently observed amongst SMEs – the life-style business and the business electing for capped growth. Furthermore, while predominantly focused upon stages of growth, the model is sympathetic to, or at least not inconsistent with, an alternative *gestalts* of growth perspective that has received some support in the literature (Kazanjian and Drazin, 1989).

This novel methodological paper reports on the first stage of an on-going research effort to derive, characterise and employ an empirically-based development taxonomy for SMEs in the manufacturing sector using panel data recently made available from Australia's Business Longitudinal Survey (BLS). The research does not aspire to directly testing the validity of the Hanks et al. (1993) model with new data. Rather, it responds to a suggestion for further research made at the close of the Hanks et al. (1993, p. 24) paper:

> . . . longitudinal studies of the organization life cycle that trace changing organizational configurations over time are needed. Although the cross-sectional approach taken in this study is suggestive of life-cycle stages, it is impossible to differentiate between configurations representative of life-cycle stages and those suggestive of firms simply choosing to do business in different ways. Both historical and repeated measures designs would provide important insights into patterns of organization growth.

Where attempts have been made to empirically validate SME life-cycle models, this has hitherto been done with relatively small and narrowly defined samples, and with cross-sectional data. The need for larger and more representative samples in SME research is difficult to dispute (McMahon, 1999). Furthermore, a strong argument can be made that longitudinal data are inherently appropriate to representing growth and development of SMEs over time (McMahon, 1999). The availability of panel data from Australia's Business Longitudinal Survey now provides an opportunity to meet such research demands.

In prior cross-sectional research in this field, efforts have inevitably been made to attach particular meaning to emerging clusters of SMEs by characterising them as certain phases or stages of development through which businesses may pass in an enterprise life-cycle. In the present research using longitudinal data, clusters of SMEs are more appropriately viewed as markers or signposts for apparent development pathways over time. Rather than the persistence of specific life-cycle stages, the primary concern is with the stability of discernible SME development pathways. No attempt is made to attribute significance to clusters other than to construe which development pathways they appear to mark. The overall objective is to discover, empirically, possibly stable pathways for manufacturing SMEs that, to some helpful degree, reflect their achievement of business growth and development.

Research method

Longitudinal survey

The panel data used in this research are drawn from the Business Longitudinal Survey (BLS) conducted by the Australian Bureau of Statistics (ABS) on behalf of the federal government over the financial years 1994–95, 1995–96, 1996–97 and 1997–98. Costing in excess of $4 million, the BLS was designed to provide information on the growth and performance of Australian employing businesses, and to identify selected economic and structural characteristics of these businesses.

The ABS Business Register was used as the population frame for the survey, with approximately 13,000 business units being selected for inclusion in the 1994–95 mailing of questionnaires. For the 1995–96 survey, a sub-sample of the original selections for 1994–95 was chosen, and this was supplemented with a sample of new business units added to the Business Register during 1995–96. The sample for the 1996–97 survey was again in two parts. The first formed the longitudinal or continuing part of the sample,

comprising all those remaining live businesses from the 1995–96 survey. The second part comprised a sample of new business units added to the Business Register during 1996–97. A similar procedure was followed for the 1997–98 survey. Approximately 6,400 business units were surveyed in each of 1995–96, 1996–97 and 1997–98.

The BLS did not employ completely random samples. The original population (for 1994–95) was stratified by industry and business size, with equal probability sampling methods being employed within strata. Further stratification by innovation status, exporting status and growth status took place for the 1995–96 survey. Data collection in the BLS was achieved through self-administered, structured questionnaires containing essentially closed questions. Copies of the questionnaires used in each of the four annual collections can be obtained from the ABS. The questionnaires were piloted prior to their first use, and were then progressively refined after each collection in the light of experience. As well as on-going questions, each questionnaire also included once-off questions dealing with certain matters of policy interest to the federal government at the time of the collections. Various imputation techniques, including matching with other data files available to the ABS, were employed to deal with any missing data. Because information collected in the BLS was sought under the authority of the *Census and Statistics Act 1905*, and thus provision of appropriate responses to the mailed questionnaires could be legally enforced by the Australian Statistician, response rates were very high by conventional research standards – typically exceeding 90 per cent.

Data employed

The specific BLS data used in this study are included in a Confidentialised Unit Record File (CURF) released by the ABS on CD-ROM in December, 1999. This CURF contains data on 9,731 business units employing fewer than 200 persons – broadly representing SMEs in the Australian context. Restricted industrial classification detail, no geographical indicators, presentation of enterprise age in ranges, and omission of certain data items obtained in the BLS all help to maintain the confidentiality of unit records. Furthermore, all financial variables have been subject to perturbation – a process in which values are slightly varied to provide further confidentiality protection.

This research is concerned only with the manufacturing sector of the BLS CURF. There are two reasons for this. First, over the last few decades, the performance of the Australian manufacturing sector has been a major preoccupation of policy-makers and government departments dealing with industry and trade. The sector has been characterised as non-competitive by international standards, and it is considered to have failed in countering Australia's growing trade imbalance with the rest of the world (Pappas et al., 1990). Over 99 per cent of all businesses in the Australian manufacturing sector are SMEs according to generally accepted definitions (Australian Bureau of Statistics, 1996). The second reason for considering only the manufacturing sector is that is highly probable that cross-industry differences in the nature of business activities, typical employment per business, capital intensity, etc. could confound findings relating to SME development patterns, and to SME growth and performance more generally. Such influences are, to a reasonable extent, controlled for by examining a single (albeit broadly defined) industry. There are 3,411 manufacturing SMEs in the BLS CURF, representing approximately 35 per cent of businesses in the file.

Additional focus is provided to this research by considering only manufacturing SMEs legally organised as proprietary companies. There are two main reasons for this further narrowing of the unit of analysis. First, as Freedman and Godwin (1994, p. 234) indicate, a particular concern with proprietary companies is not uncommon amongst SME researchers world-wide:

> It would appear that, in so far as the issue is considered at all, the limited liability company is of more interest to the small business research community than are unincorporated firms; . . . limited liability companies and entrepreneurship have become equated, or at least associated.

Second, the primary concern in this research is with SME growth and development, and it is more likely that these will be evident in businesses legally organised as proprietary companies (Freedman and Godwin, 1994; Hakim, 1989; Gray, 1992; Hughes and Storey, 1994; Yellow Pages

Australia, 1995). There are 2,413 manufacturing SMEs legally organised as proprietary companies in the BLS CURF, representing approximately 71 per cent of manufacturing SMEs in the file.

Analytical technique employed

The principal analytical procedure used in this research is exploratory cluster analysis (as employed by Hanks et al. (1993)). This is a multivariate statistical technique for developing meaningful clusters or groupings of cases. The aim is to objectively classify cases into a small number of mutually exclusive groups on the basis of similarities amongst values for certain clustering variables selected by the researcher. The groups should exhibit high internal (within-cluster) homogeneity and high external (between-cluster) heterogeneity. The groups are not predefined, but are derived from the "natural" structure of the data. Subsequent profiling using characteristic or demographic variables facilitates interpretation of the nature of the groups.

As Hair et al. (1995, p. 435) point out, "Cluster analysis is not a statistical technique where parameters for a sample are assessed as possibly representative of a population". Rather, cluster analysis is typically an exploratory technique that requires minimal distributional assumptions regarding clustering variables. Nevertheless, issues such as the representativeness of the sample, differences in scale amongst clustering variables, the undue influence of outliers, and multicollinearity amongst clustering variables are important considerations.

Because of the heavy computational and storage demands on personal computer memory, agglomerative hierarchical cluster analysis (that is, the CLUSTER procedure in SPSS for Windows) is not recommended for use with samples containing 200 or more cases (Hair et al., 1995; Norusis and SPSS Inc., 1992). Since all samples employed in this study include 871 cases, the alternative *k*-means cluster analysis was primarily used (that is, the QUICK CLUSTER procedure in SPSS for Windows). This non-hierarchical procedure is based on nearest centroid sorting with squared Euclidean distance being the similarity measure.

Research findings

Identifying SME development pathways

On the basis of prior research in the area, particularly that of Hanks et al. (1993), the following key clustering variables were selected for use from the BLS CURF:

- Enterprise age – as measured by an ordinal variable reflecting enterprise age in 2-yearly intervals up to 30 years, with a single category for concerns older than 30 years. Cluster analysis normally requires clustering variables to be measured on at least an interval scale. However, for reasons of confidentiality, such an age measure is not available in the BLS CURF. Nevertheless, the available measure is considered to acceptably approximate an interval variable.
- Enterprise size – as measured by interval variables reflecting total employment and annual sales. To avoid problems of multicollinearity amongst clustering variables, total assets was not used as a size measure during cluster analysis. However, it was used in *ex post* characterisation of clusters.
- Enterprise growth rate – as measured by interval variables reflecting annual employment growth and annual sales growth. It was not possible to estimate annual growth rate in total assets for the first collection (1994–95), and so this variable was not used in the cluster analyses.

To ensure that all SMEs included in the study were truly active or operational, any concerns with no employees and/or no sales and/or no assets were excluded. In order to deal with differences in scale amongst the clustering variables, and with the undue influence of outliers, all the variables listed above were standardised and then observations 4 or more standard deviations from the mean value were removed (Hair et al., 1995).

The analysis began by examining data from the 1994–95 BLS collection including only businesses operating in all 4 collections (that is, the first collection for businesses constituting the on-going longitudinal panel; $n = 871$). Sub-samples were subjected to agglomerative hierarchical cluster analysis to get a feel for the likely number of clusters needed to represent the data. For the

reason given earlier, this procedure was extremely slow; but eventually solutions with up to 9 clusters seemed to be indicated. The full sample was then subjected to *k*-means cluster analysis using randomly selected seed points, with 9 clusters being pre-specified. Since Hanks et al. (1993) had arrived at a 6 cluster solution, further solutions with 6, 7 and 8 clusters were also examined. A 7 cluster solution was ultimately chosen as potentially being the most useful and most amenable to interpretation. This solution is represented in Figure 2 (while an effort has been made to use enterprise size and enterprise age as axes, because of space limitations the figure is not drawn strictly to scale). Descriptors for possible development pathways between the clusters are suggested in the figure. The ANOVA significance figures in the first panel of Table I suggest that all clustering variables do differ between clusters in the solution. In the first panel of Table II, the results of Kruskal-Wallis one-way analysis of variance tests lead to rejection of null hypotheses that median values for all characterisation variables (enterprise age, total employment, annual sales, total assets, annual employment growth, and annual sales growth) do not differ between clusters in the solution.

Similar analyses were then undertaken examining data from the 1995–96, 1996–97 and 1997–98 BLS collections including only businesses operating in all 4 collections (that is, the second, third and fourth collections for businesses constituting the on-going longitudinal panel; n = 871 for all three). For these collections, agglomerative hierarchical cluster analysis seemed to indicate solutions with up to 7 clusters. Ultimately, 6 cluster solutions were chosen as potentially being the most useful and most amenable to interpretation. These solutions are represented in Figures 3, 4 and 5 (as for Figure 2, the figures are not drawn strictly to scale). The ANOVA significance figures in the second, third and fourth panels of Table I suggest that, for all three collections, all clustering variables do differ between clusters in the solutions. In the second, third and fourth panels of Table II, the results of Kruskal-Wallis one-way analysis of variance tests lead to rejection, for all three collections, of null hypotheses that median values for all characterisation variables do not differ between clusters in the solutions.

Bearing in mind the exploratory nature of this study and the acknowledged limitations of the research method used, the following conclusions might nevertheless be reached at this point:

- While not corresponding in all respects, it would appear that certain features of the 1994–95 BLS panel model (n = 871) match those of the Hanks et al. (1993) model reasonably well. These include similar development pathways (see discussion of traditional vs. capped growth vs. entrepreneurial SMEs later in the paper) and the pace of SME development (viewed over 20 or so years). Not unexpectedly, the enterprise age and size benchmarks for clusters vary somewhat. In judging these models against each other, it should be borne in mind that the BLS model is derived from a much larger and broadly more representative manufacturing SME sample.
- Support for the existence of stable SME development pathways is gained by comparing the first BLS panel model (for 1994–95; n = 871) with subsequent panel models for 1995–96 (n = 871), 1996–97 (n = 871) and 1997–98 (n = 871) which are derived for exactly the same businesses. As time elapses, the identified development pathways – low, moderate and high growth – seem to persist. Clusters at the left of Figures 2, 3 and 4 tend to disappear and there appears to be a rightward drift in the models towards roughly the same range of SME configurations.

In the following sub-section of the paper, attempts are made to characterise, and to distinguish between, the apparent SME development pathways identified above. Descriptive statistics for various enterprise characteristics are used for this purpose. The resulting depiction facilitates interpretation of the nature and significance of the development pathways.

Characterising SME development pathways

The first step in characterisation of the three apparent SME development pathways in the panel data was to construe the clusters for each collection as markers or signposts for the pathways, as follows (using Figures 2, 3, 4 and 5):

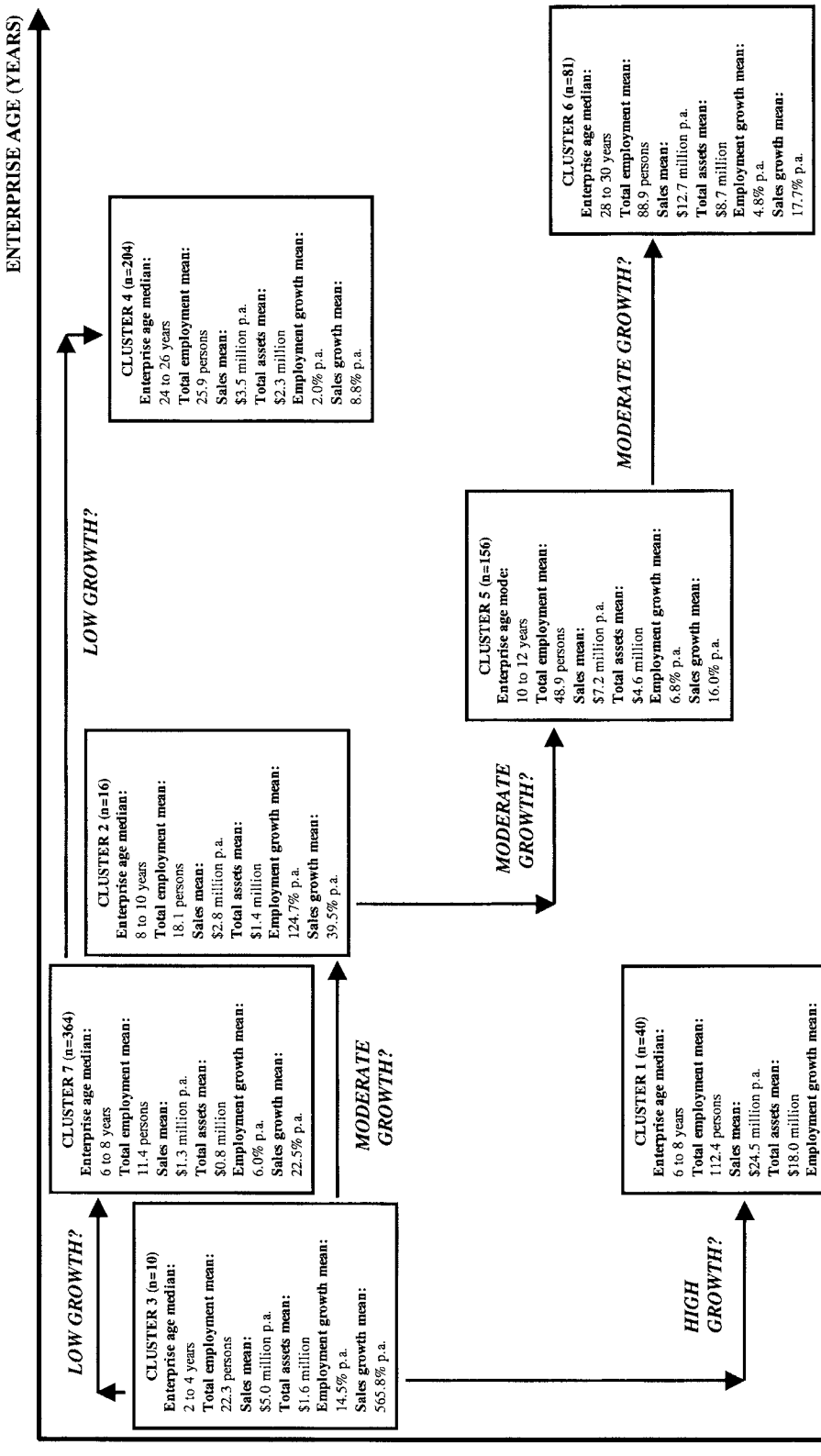

Figure 2. Business longitudinal survey 1994–95 enterprise life-cycle model (n = 871).

TABLE I
K-means cluster analysis ANOVAs

Annual collection	Standardised variable	Cluster		Error			
		Mean square	df	Mean square	df	Univariate *F* ratio	Significance
1994–95 (*n* = 871)	*Z* score Enterprise age	110.431	6	0.233	864	473.535	0.000
	Z Score Total employment	94.499	6	0.178	864	529.682	0.000
	Z Score Annual sales	33.406	6	0.126	864	264.591	0.000
	Z Score Annual employment growth	11.471	6	0.116	864	98.849	0.000
	Z Score Annual sales growth	9.435	6	0.033	864	289.259	0.000
1995–96 (*n* = 871)	*Z* Score Enterprise age	124.609	5	0.276	865	451.750	0.000
	Z Score Total employment	95.210	5	0.258	865	368.800	0.000
	Z Score Annual sales	40.017	5	0.176	865	227.906	0.000
	Z Score Annual employment growth	37.048	5	0.293	865	126.369	0.000
	Z Score Annual sales growth	58.940	5	0.395	865	149.373	0.000
1996–97 (*n* = 871)	*Z* Score Enterprise age	126.638	5	0.263	865	480.725	0.000
	Z Score Total employment	107.443	5	0.191	865	562.539	0.000
	Z Score Annual sales	52.375	5	0.129	865	405.053	0.000
	Z Score Annual employment growth	51.346	5	0.352	865	146.036	0.000
	Z Score Annual sales growth	2.677	5	0.248	865	10.792	0.000
1997-98 (*n* = 871)	*Z* Score Enterprise age	125.431	5	0.269	865	467.078	0.000
	Z Score Total employment	118.732	5	0.166	865	713.703	0.000
	Z Score Annual sales	51.218	5	0.150	865	341.691	0.000
	Z Score Annual employment growth	4.282	5	0.236	865	18.123	0.000
	Z Score Annual sales growth	42.069	5	0.408	865	103.109	0.000

TABLE II
Kruskal-Wallis tests for cluster characterisation variables

Annual collection	Test details	Enterprise age	Total employment	Annual sales	Total assets	Annual employment growth	Annual sales growth
1994–95 (n = 871)	Kruskal-Wallis statistic	590.702	607.234	537.221	493.634	62.733	65.594
	df	6	6	6	6	6	6
	Significance	0.000	0.000	0.000	0.000	0.000	0.000
1995–96 (n = 871)	Kruskal-Wallis statistic	567.429	396.264	342.781	316.240	269.031	255.945
	df	5	5	5	5	5	5
	Significance	0.000	0.000	0.000	0.000	0.000	0.000
1996–97 (n = 871)	Kruskal-Wallis statistic	557.679	515.476	470.551	430.941	301.177	49.904
	df	5	5	5	5	5	5
	Significance	0.000	0.000	0.000	0.000	0.000	0.000
1997–98 (n = 871)	Kruskal-Wallis statistic	561.021	553.359	487.205	442.274	80.407	360.007
	df	5	5	5	5	5	5
	Significance	0.000	0.000	0.000	0.000	0.000	0.000

- For 1994–95 (n = 871) – Cluster 7 (n = 364) and Cluster 4 (n = 204) mark the low growth pathway; Cluster 2 (n = 16), Cluster 5 (n = 156) and Cluster 6 (n = 81) mark the moderate growth pathway; and Cluster 1 (n = 40) marks the high growth pathway.
- For 1995–96 (n = 871) – Cluster 2 (n = 358) and Cluster 4 (n = 206) mark the low growth pathway; Cluster 6 (n = 83), Cluster 5 (n = 72) and Cluster 3 (n = 91) mark the moderate growth pathway; and Cluster 1 (n = 61) marks the high growth pathway.
- For 1996–97 (n = 871) – Cluster 1 (n = 338) and Cluster 5 (n = 207) mark the low growth pathway; Cluster 4 (n = 105), Cluster 6 (n = 109) and Cluster 3 (n = 74) mark the moderate growth pathway; and Cluster 2 (n = 38) marks the high growth pathway.
- For 1997–98 (n = 871) – Cluster 6 (n = 265), Cluster 5 (n = 159) and Cluster 4 (n = 198) mark the low growth pathway; Cluster 3 (n = 121) and Cluster 1 (n = 81) mark the moderate growth pathway; and Cluster 2 (n = 47) marks the high growth pathway.

The only cluster not so far assigned to a development pathway is Cluster 3 (n = 10) in the data for 1994–95. The difficulty here is that, in 1994–95, all three pathways appear to commence in Cluster 3. The approach taken was to retrospectively assign businesses in Cluster 3 to pathways in 1994–95 according to which pathway they appeared to lie on in 1995–96. Ultimately then, for each year of the panel data, each business is seen as being on one only of the three SME development pathways identified. Relative frequency distributions for each pathway in each year are presented in Table III.

The second step in characterisation of the three apparent SME development pathways in the panel data was to construe a single dominant pathway for each business over the four years of data, as follows:

- Businesses lying on the same pathway in all four years were simply assigned to the pathway concerned. These businesses account for 52.4 per cent (n = 456) of the panel sample (n = 871).
- Businesses lying on the same pathway in three of the four years (that is, only changed pathways once) were assigned to the dominant pathway. These businesses, together with those that did not change pathways at all, account for 88.6 per cent (n = 772) of the panel sample (n = 871).
- Businesses that changed pathways twice in the four years were assigned to a dominant pathway using researcher judgement. These businesses account for just 11.4 per cent (n = 99) of the panel sample (n = 871). Details of the assignment rules applied consistently to these busi-

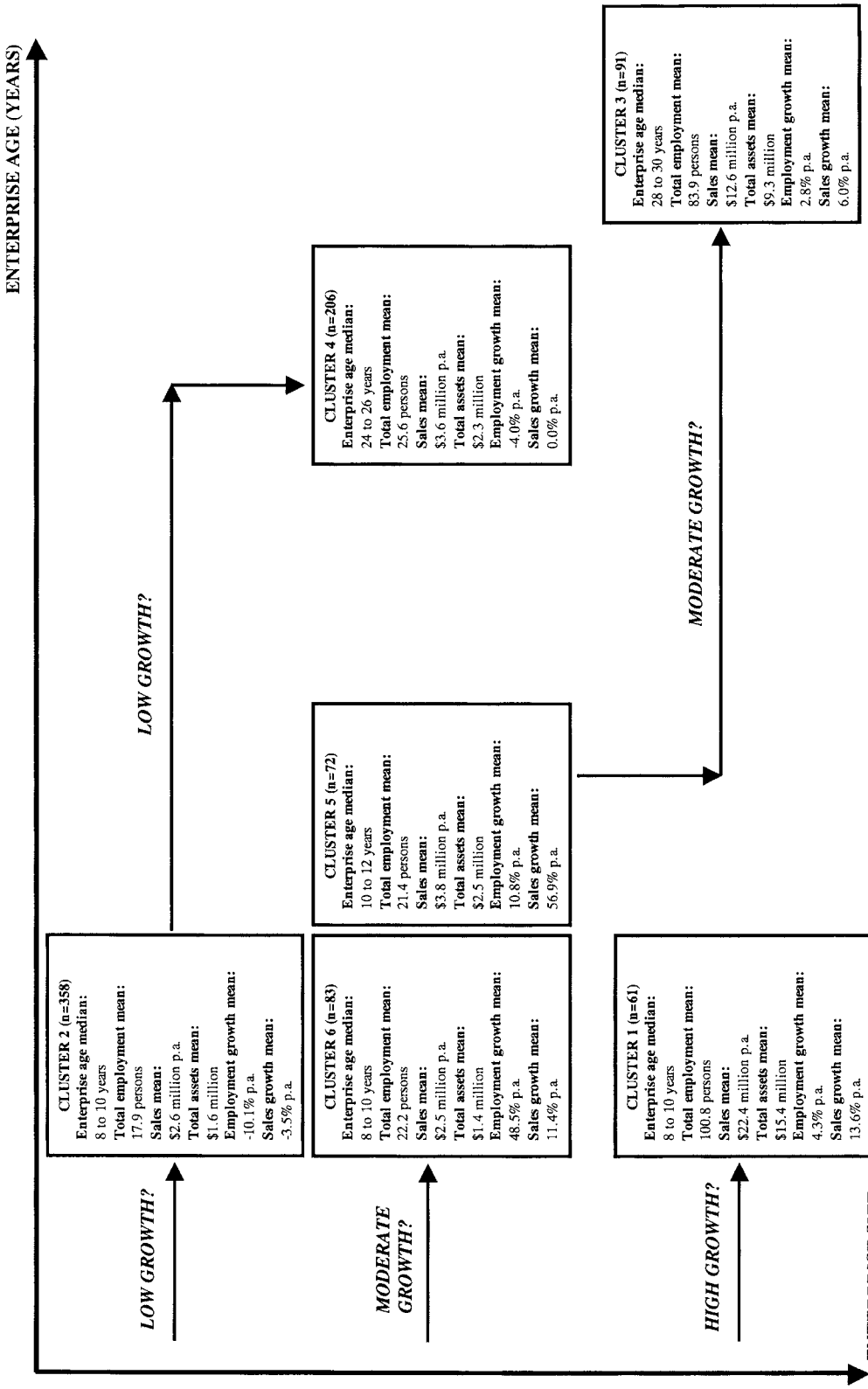

Figure 3. Business longitudinal survey 1995–96 enterprise life-cycle model (n = 871).

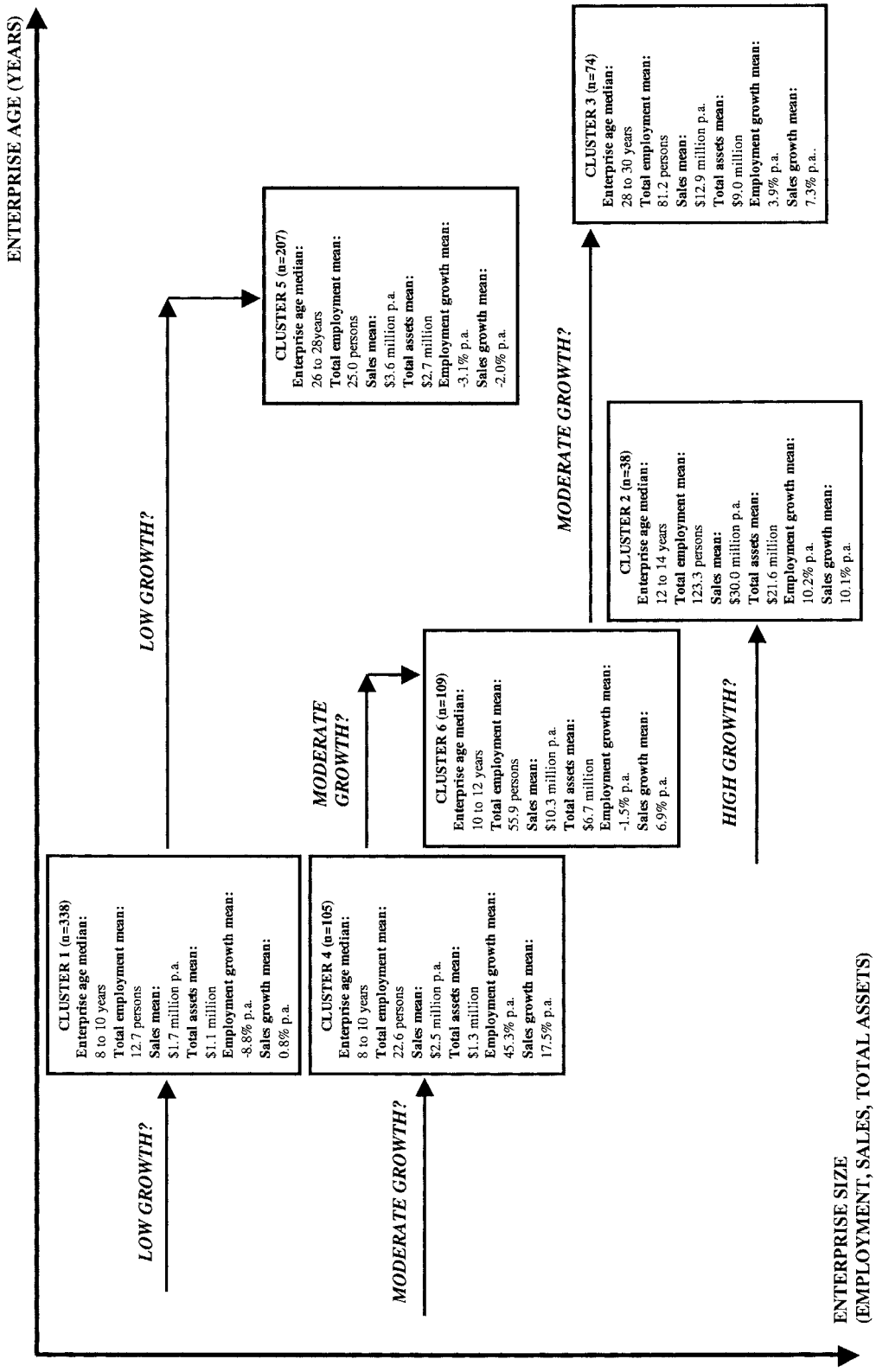

Figure 4. Business longitudinal survey 1996–97 enterprise life-cycle model (n = 871).

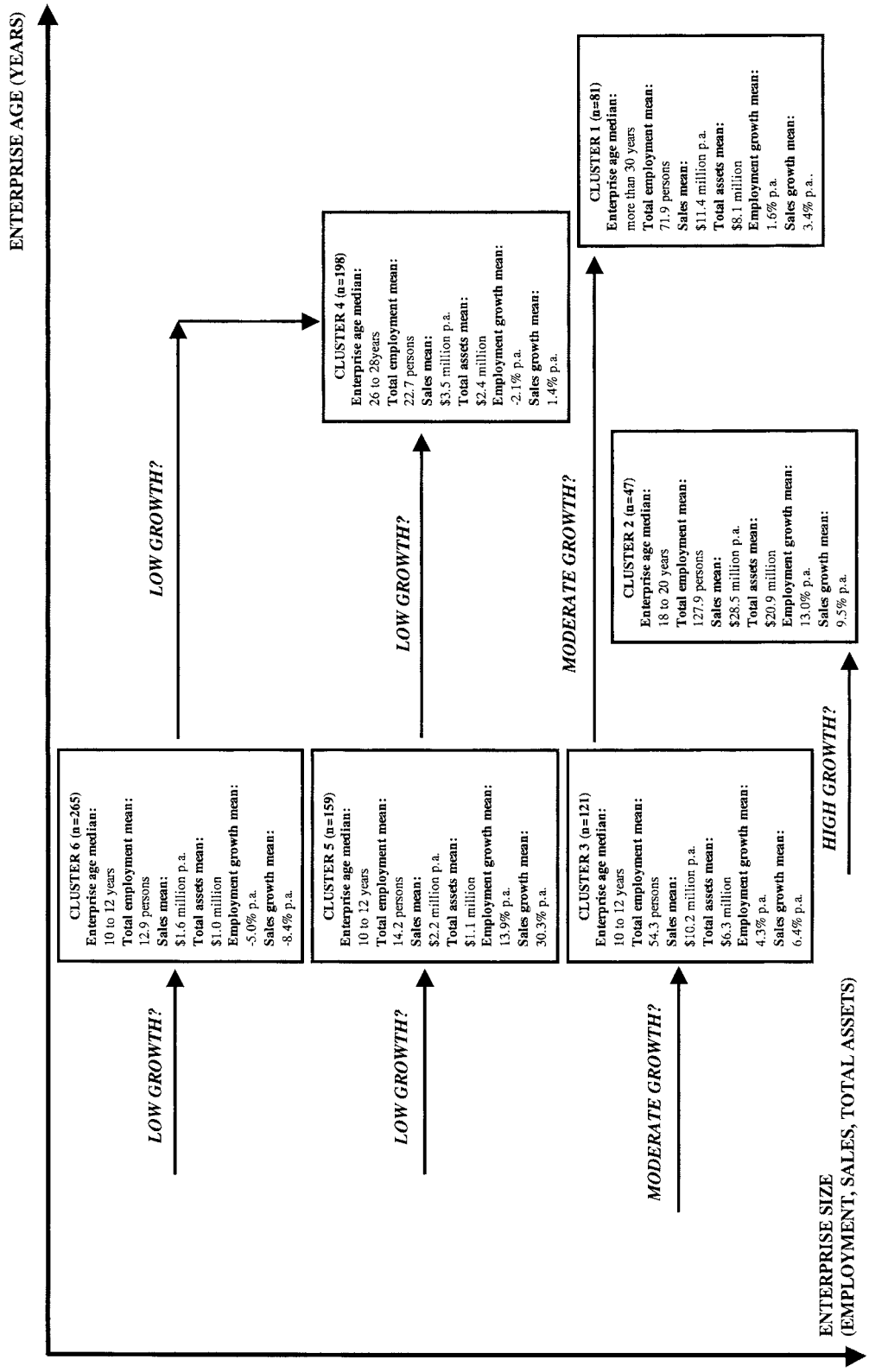

Figure 5. Business longitudinal survey 1997–98 enterprise life-cycle model (n = 871).

TABLE III
Relative frequency distributions for SME development pathways

Annual collection	Frequency measure	Low growth pathway	Moderate growth pathway	High growth pathway	Total
1994–95	Frequency	576	255	40	871
	Per cent	66.1	29.3	4.6	100.0
	Cumulative per cent	64.6	95.4	100.0	
1995–96	Frequency	564	246	61	871
	Per cent	64.8	28.2	7.0	100.0
	Cumulative per cent	64.8	93.0	100.0	
1996–97	Frequency	545	288	38	871
	Per cent	62.6	33.1	4.4	100.0
	Cumulative per cent	62.6	95.6	100.0	
1997–98	Frequency	622	202	47	871
	Per cent	71.4	23.2	5.4	100.0
	Cumulative per cent	71.4	94.6	100.0	
1994–98	Frequency	629	203	39	871
	Per cent	72.2	23.3	4.5	100.0
	Cumulative per cent	72.2	95.5	100.0	

nesses are available from the author. By way of example, a business on the same pathway in the last two years of the panel data was assigned to that pathway regardless of its position in the first two years. It is acknowledged that such rules could be seen as somewhat arbitrary. However, given the small proportion of businesses for which researcher judgement had to be exercised in this manner, it is believed that the overall findings of the research have not been unduly compromised.

Note that, since there are only three development pathways identified in the research, there could be no businesses in the panel data that lay on different pathways in all four years. The relative frequency distribution for each dominant pathway over all four years in the panel data is presented at the bottom of Table III. The low growth development pathway appears to account for around 70 per cent of SMEs in the panel. The moderate growth pathway seems to be followed by around 25 per cent of the panel. And around 5 per cent of the panel look to lie on the high growth pathway, which is in accord with the observed rarity of substantial growth amongst SMEs world-wide (McMahon et al., 1993).

Median or mean values for certain characterisation variables (enterprise age, total employment, annual sales, total assets, compound annual employment growth, and compound annual sales growth) for the three identified SME development pathways are presented in Table IV. All values shown are entirely consistent with the existence of low, moderate and high growth development pathways amongst SMEs in the panel. When assessing the implications of these values, it should be recalled that the BLS CURF is restricted to business units employing fewer than 200 persons. Thus, enterprise size is constrained at the larger end of the scale. At the smaller end, being manufacturing SMEs, they could be expected to have more employees than concerns in other industrial sectors such as service or trading. In Table V, the results of Kruskal-Wallis one-way analysis of variance tests lead to rejection of null hypotheses that median values for all characterisation variables do not differ between development pathways. Differences between the identified SME development pathways in terms of enterprise age, size and growth variables are highly significant in a statistical sense.

TABLE IV
Characterisation variables for SME development pathways

Characterisation variable pathway	Low growth pathway	Moderate growth pathway	High growth
Enterprise age median for 1997–98 (years)	12 to 14	16 to 18	12 to 14
Total employment mean for 1997–98 (persons)	16.9	64.7	123.5
Sales mean for 1997–98 ($ million per annum)	2.5	11.0	30.5
Total assets mean for 1997–98 ($ million)	1.6	7.2	22.9
Compound employment growth for 1994–95 to 1997–98 (% per annum)	–0.2	2.4	6.6
Compound sales growth for 1994–95 to 1997–98 (% per annum)	5.3	9.3	10.4

TABLE V
Kruskal-Wallis tests for SME development pathway characterisation variables

Test details	Enterprise age	Total employment	Annual sales	Total assets	Compound annual employment growth	Compound annual sales growth
Kruskal-Wallis statistic	15.634	475.407	418.986	357.454	21.121	17.746
df	2	2	2	2	2	2
Significance	0.000	0.000	0.000	0.000	0.000	0.000

Conclusions and recommendations

Further scholarly inquiry certainly seems to be encouraged by this multivariate statistical analysis of data from Australia's Business Longitudinal Survey to derive an empirically-based development taxonomy for manufacturing SMEs. Three relatively stable development pathways are discernible in the longitudinal panel results – low, moderate and high growth. Highly significant differences between the identified SME development pathways in terms of key enterprise age, size and growth variables underpin confidence in this development taxonomy. Furthermore, it would appear that the development pathways and the pace of SME development in the present research match reasonably well with those in earlier research of a similar nature undertaken by Hanks et al. (1993). Both development models seem to lead towards the same range of SME configurations that are widely recognised in the relevant research literature (McMahon et al., 1993):

- Traditional or life-style SMEs – following the low growth development pathway, these concerns generally have few, if any, growth aspirations. They principally exist to provide their owner-managers with a source of employment and income. Furthermore, they are frequently operated in a manner consistent with the life-style aspirations of their owner-managers. The present research suggests that after approximately 15 years such SMEs would have fewer than 20 employees, sales less than $3 million per annum, total assets below $2 million, little or no employment growth, and sales growth up to 5 per cent per annum.
- Capped growth SMEs – following the moderate growth development pathway, these concerns generally have modest growth aspirations. Bounds to growth could be externally imposed by the nature of their competitive environment; or may be intrinsic given the nature of their operations. Frequently though, growth is deliberately capped by owner-managers to a rate that limits dependence upon external financing – thus minimising surrender of control and accountability obligations this support would normally bring. The present research suggests that after approximately 15 years such SMEs would have fewer than 100

employees, sales around $10 million per annum, total assets less than $10 million, employment growth up to 3 per cent per annum, and sales growth as much as 10 per cent per annum. At the current stage of this research, it is not possible to discern whether the restricted growth of these SMEs is externally imposed, intrinsic to their operations, or elective on the part of their owner-mangers.

- Entrepreneurial SMEs – following the high growth development pathway, these concerns generally have ambitious growth aspirations. They are most often associated with entrepreneurial aptitude, technical and commercial innovation, international outlook, and other business qualities that could see them eventually become large enterprises. The present research suggests that after approximately 15 years such SMEs would have over 100 employees, sales around $30 million per annum, total assets more than $20 million, employment growth exceeding 5 per cent per annum, and sales growth greater than 10 per cent per annum.

The fact that these common SME configurations are recognised in this research lends further plausibility to the empirically-based development taxonomy described.

The following recommendations are made to shape the direction and specifics of further research effort to characterise and employ the empirically-based development taxonomy for Australian manufacturing SMEs presented in this paper:

- Take advantage of the numerous opportunities that now exist for comparing and contrasting manufacturing SMEs on different development pathways in terms of their demographic characteristics, ownership structures, business aspirations, management practices, industrial arrangements, training commitment, international orientation, innovation potential, networking activities, etc., etc. A major focus here would be identification of correlates with SME success in growth and performance terms.
- Using the SME development taxonomy data now available for learning purposes, employ polytomous logistic regression to construct a model that would allow manufacturing SMEs to be reliably classified as to their most likely future development pathway on the basis of measured values for key enterprise age, size and growth variables. Other characteristic variables included in the BLS CURF could also be added to such a model to enhance its reliability.
- Using the excellent financial data provided in the BLS CURF, produce financial profiles for manufacturing SMEs on different development pathways employing conventional measures (such as financial ratios) reflecting financial position and performance. A major focus here would be linkages between growth and performance in manufacturing SMEs. It should also be possible to examine connections between growth and experience of certain financial problems such as overtrading, liquidity crises and inappropriate financing.

Clearly, it is also possible to extend the methods employed in this research to SMEs in other industrial sectors, such as service and trading, so that a range of industry-specific development taxonomies become available for use. The potential benefits of this and the other lines of inquiry identified above to SME scholarship, policy-making, support and management are readily apparent.

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