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Analyses of the data collected from the Maturity Models

Project Year 2, 2004

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Development of the Maturity Models:

The ICT Test Bed project is a cross-institutional and cross-sector project which required an evaluation research design which could assure that both the strengths and weaknesses of the impacts of new technologies were recorded and understood in order to allow lessons learnt from the target institutions to be disseminated to the wider community. The approach taken was 'Maturity Modelling', drawn from organizational research where it has been shown that it is possible to score organizations to reflect the level of maturity at which they operate. Maturity Model (MM) frameworks allow a rich description of an intervention over time, which allows us to ask whether the designated institutions are so resourced and have the appropriate structures to deliver effective educational experiences using ICT. Six models were developed: Technological Maturity, Curriculum Maturity, Leadership/Management Maturity, Workforce Maturity, Inter/Intra Institutional Linkage Maturity and External Linkage Maturity. Within each model, a set of dimensions were created.

How it works:

The models were developed primarily as an analytical tool with some data capture facilities. A wide range of data are used to evidence the models gathered from interviews, questionnaires and other sources which are then triangulated and used to provide a complete assessment of an institution. The models read from left to right horizontally, with a series of five boxes used for each dimension to describe performance on any such dimension. For each one, one box out of the five is highlighted as most accurately reflecting an institutions position. In cases where institutions fall between boxes, they are marked down to the lower position. Box one reflects the lowest levels of maturity, whilst box five represents the highest level. A sixth box is also provided to encourage those institutions who feel that they have surpassed the highest given level to provide evidence of how they have progressed further than the model allows. The models are completed on an annual basis within the ICT Test Bed project as a means of allowing us to track change over time and enable us to develop predictive models based on performance outcomes.

What it can and cannot tell us:

Each of the dimensions within the model may be treated as six point Likert scale with positive scoring; that is an institution that satisfies all the attributes within a given level of a dimension is assigned an appropriate score. The assessed scores for each of the dimensions can then be combined to create an overall model score for the institution and descriptive data obtained that will allow simple cross institutional and within institutional comparisons to be made.

The models can also be used as a predictive and exploratory tool, for example to identify how the features within and across models relate to one another or to seek what predicts (contributes to) educational outcomes, that is to test predictions of causality.

Methodological Notes:

The analyses presented here represent data that was collected at the end of the summer term in 2004 in the form of the institutions self assessments on the maturity models and subsequent interviews and questionnaire data collated between May 2004 and October 2004.

Preparation of the Data Sets:

As with the data from the first year of the project the analyses reported here were conducted using a merged data set collated using each institutions self assessment and an assessment conducted by the evaluation team using a range of data collected in the first year of the project. A final data set was created for each institution by taking the average score of the institutions' and evaluation teams' assessment on each of the dimensions.

Descriptive Statistics:

The overall mean score for the institutions was calculated for each of the six models and the following tables display a comparison of the means from years one and two split by phase of education and by model.

First level analyses of the models demonstrated that institutions in all sectors displayed increasing levels of maturity in year two of the project. This is a very encouraging finding and supports the qualitative evidence collected by the evaluation that each of the institutions had embarked on a steep learning curve at the start of the ICT Test Bed project. The positive trends depicted here by the mean scores for the six models represent a tangible change in maturity across the institutions and we would anticipate given available evidence to date that the upward trend will continue into year three.

Model 1 – Technological Maturity

The first year of the project found that in the main the FE sector was the most advanced sector in terms of their technology provision. This was not an especially surprising finding and was interpreted as being a reflection of the ICT demands of further education provision and the level of ICT support that could be achieved in larger institutions. Also of interest in the first year was the finding that the special school was operating at higher levels of technological maturity in relation to the other sectors, again which was interpreted as being a reflection of the nature of the school and the pedagogical demands it operates within.

Mean scores from the second year indicate the FE sector are still operating at highest level of technical maturity in comparison to the other sectors, although the nursery and primary schools have increased substantially on this model and are now operating at levels that are not dissimilar to institutions in other sectors (see Table 1). This increase in comparability between the sectors in terms of technological maturity is not surprising and we would perhaps expect to see small but similar levels of maturation for all sectors over the next two years of the project.

In summary, the shift that has taken place between years one and two is indicative of the increase in resources since the start of the project, including

the networking of the institutions and the implementation of broadband technologies, and increases in the security of the network and management of ICT resources. The clustering of these institutions around levels three and four is also indicative of the changes that have been made to policy, such as the shift from no policy of resource renewal moving through to now having a timely and detailed policy of replacement with planned new improvements.

Table 1: Displaying mean scores and standard deviations (s.d) for Model 1 split by phase of education and year.

	Nursery	Primary	Secondary	Special	FE
Mean Score Yr 1 (2003)	2.07	2.73 (0.47)	2.83 (0.25)	3.36	3.42 (0.84)
Mean Score Yr 2 (2004)	3.57	3.78 (0.30)	3.5 (0.63)	3.57	4.00 (0.49)

Model 2 – Curriculum Maturity

Interpretation of the data from year one indicated that the primary sector was typically operating at the lower end of the curriculum maturity model in comparison to all sectors bar the nursery school. Analysis of the standard deviations from year one also indicated that the five secondary schools were more varied in maturity of the curriculum than the primary or FE sectors, with the FE institutions being the most cohesive for this model¹.

Data from year 2 indicate that the nursery has made the most progress in this area between year one and year two, shifting from a mean score of 1.43 to a mean of 3.07. This is a very positive finding and one that has been ratified both by the evaluation and other stakeholders (such as OFSTED). The primaries nursery and special school were collectively in year two leading the way in terms of maturity of the curriculum, closely followed by the secondary and FE sectors.

In terms of the collective position of the institutions, the descriptive statistics for year two indicate the move towards the embedding of ICT into the various curricula. There is also growing staff and student autonomy in their choice of learning and teaching styles. Staff are demonstrating greater critical analysis of ICT and ICT based resources in their teaching. Similarly, and as is demonstrated in the regression analyses, the students' developing abilities to demonstrate critical thought is important and is indicative of increasing student awareness and ability with ICT overall.

¹ Care should be taken when interpreting these data given the variations in sample size between the sectors.

Table 2: Displaying mean scores and standard deviations (s.d) for Model 2 split by phase of education and year.

	Nursery	Primary	Secondary	Special	FE
Mean Score Yr 1 (2003)	1.43	2.18 (0.38)	2.28 (0.47)	2.83	2.48 (0.24)
Mean Score Yr 2 (2004)	3.07	3.03 (0.26)	2.81 (0.35)	3.07	2.90 (0.19)

Model 3 – Leadership/Management Maturity

Table 3 again demonstrates the tendency for the FE colleges and the special school to be operating at the higher levels of maturity at the start of the project and this was certainly true for the leadership/management maturity model in year one. The relatively high standard deviations for FE and for the primary schools reflect the varying nature of maturity in this area in the first year and the mean scores for year two reflect the continuing but varied development of all the institutors in terms of leadership and management. The differential between the sectors operating at the higher levels of maturity here and those at the lower levels (in this instance, the nursery school) is perhaps more indicative of the very different philosophies and nature of these institutions and their management structures.

The clustering of scores between 3/4 of the scale illustrates a clearer and more focused vision of the use of ICT across the institutions and is suggestive of a change in the way the institutions are governed and managed with the introduction of new MIS systems and improvements in the way data are collected, recorded and handled. The increase in mean scores between the first and second years is also an indication of a change in the way in which ICT is co-ordinated across the institutions, for example, more proactive rather than reactive management of initiatives involving the use of ICT.

Table 3: Displaying mean scores and standard deviations (s.d) for Model 3 split by phase of education and year.

	Nursery	Primary	Secondary	Special	FE
Mean Score Yr 1 (2003)	1.83	2.61 (0.48)	2.68 (0.25)	3.33	3.08 (0.65)
Mean Score Yr 2 (2004)	2.67	3.49 (0.38)	3.27 (0.54)	3.39	3.57 (0.22)

Model 4 – Workforce Maturity

Table 4 displays the mean scores for the workforce maturity model. Reading this table in year one demonstrates that the school operating at the highest level of maturity was the special school. In this first year, the primary schools were found to display little variation in their maturity, as were the secondary schools indicating that these sectors were following similar agendas in terms of the management of the workforce and the use of ICT.

Analysis of mean scores from the second year reveals that all sectors have necessarily increased in levels of workforce maturity and all were operating at or above the mid point of the scale by year two. The school that made the least gains on this model was the special school, although it should be noted that this institution is, and was, operating at the highest levels of maturity out of any of the sectors. The sector/institution that had made the most progress was the nursery school, although both the primary and secondary sectors have increased in maturity significantly.

Again, the clustering of scores at levels 3/4 indicates an ICT maturing workforce. Scores in year two of the project across all institutions represent the increasing skills base of staff in ICT, with evidence of improvements in training and staff development. The majority of staff within the ICT Test Bed institutions are now classed as ICT competent and new approaches to teaching and learning are being piloted, evaluated and where suitable embedded into institutional practices. Improvements in technical support are also captured in the changes in year two with all institutions now receiving both reactive and proactive technical support. This is symptomatic of an increase in resources which necessarily increases demand for technical support. The development of the roles of support staff is also in evidence, with an increase in autonomy and clearly defined roles for these staff members increasingly apparent.

Table 4: Displaying mean scores and standard deviations (s.d) for Model 4 split by phase of education and year.

	Nursery	Primary	Secondary	Special	FE
Mean Score Yr 1 (2003)	1.8	2.59 (0.37)	2.78 (0.40)	3.56	3.05 (0.40)
Mean Score Yr 2 (2004)	3.5	3.78 (0.31)	3.65 (0.63)	4.00	3.63 (0.45)

Model 5 – Linkage Maturity 1: Intra/Inter Institutional

Table 5 depicts a greater but generally lower range of scores across the sectors than for the previous four models for year one on the model assessing internal linkage. The primary and secondary sectors demonstrated the greatest range of scores on this model with standard deviations of 0.50 and 0.57 respectively in the first year. One of the explanations advocated for the generally low rates of maturity in this area in year one was that at the start of the project planning for linkage was still in its infancy and rollout across the institutions was inconsistent, with greater emphases being placed on procurement etc. Given the themes of the project, it was anticipated that we would find a much greater shift in developmental progression in this area as the project progressed and this is certainly reflected in the scores from year two.

It is not surprising that the FE colleges are now leading in terms of maturity on this model since as the project has developed they are providing a large

percentage of training and resources for use by parents and schools respectively.

The collective position of these institutions now also stands at the midpoint of the maturity model scale. This is representative of the achievements that many institutions have made in increasing links within and between themselves. In real terms this suggests that staff now have easier access to information and data, that there have been increases in the use of electronic methods of communicating with LEAs/LSCs, and the formal sharing of best practice and expertise within and between ICT Test Bed clusters.

Table 5: Displaying mean scores and standard deviations (s.d) for Model 5 split by phase of education and year.

	Nursery	Primary	Secondary	Special	FE
Mean Score Yr 1 (2003)	1.33	2.16 (0.50)	2.03 (0.57)	3.08	2.56 (0.37)
Mean Score Yr 2 (2004)	3.00	3.13 (0.40)	2.95 (0.18)	3.25	3.31 (0.51)

Model 6 – Linkage Maturity 2: External Communication

Table 6 again demonstrates the finding that overall institutions from each sector, both in year one and year two, were still working towards developing external links to other institutions and the wider community. The primary and secondary data from year one indicate that collectively these institutions were operating at fairly similar stages of maturity. The three FE colleges were found in year one to be operating around the midpoint of the scale, which with slightly higher scores generally on this model than the other sectors, was not an especially surprising finding given the past tendency of these institutions to regularly provide resources for use by the wider community as part of the nature of their provision.

Mean scores from year two, as shown in table 6, whilst showing signs of increasing maturity are still lower generally than for the other models. The FE sector are still represented as being the most mature in terms of external linkage, with the other sectors clustering around similar means score and therefore presumable operating at similar levels to one another.

As a whole the descriptive data indicate that whilst improvements had been made, external communications were still limited. For example, parental and community access to resources within the institutions is in its infancy, although in some institutions access was being granted according to a planned timetable. Institutional websites were not in place as yet for some schools, whilst others had fully functioning websites that were being used to advertise the institutions activities. The use of electronic communication between the home and school/college was emerging rather than standard practice. The limited activity here was not always driven by the technology, a number of heads expressed concerns about the protocol of online communication. Communication in the form of a VLE was an aspirational goal

for most institutions. Only a small minority of institutions had a working VLE at the time of this census.

Table 6: Displaying mean scores and standard deviations (s.d) for Model 6 split by phase of education and year.

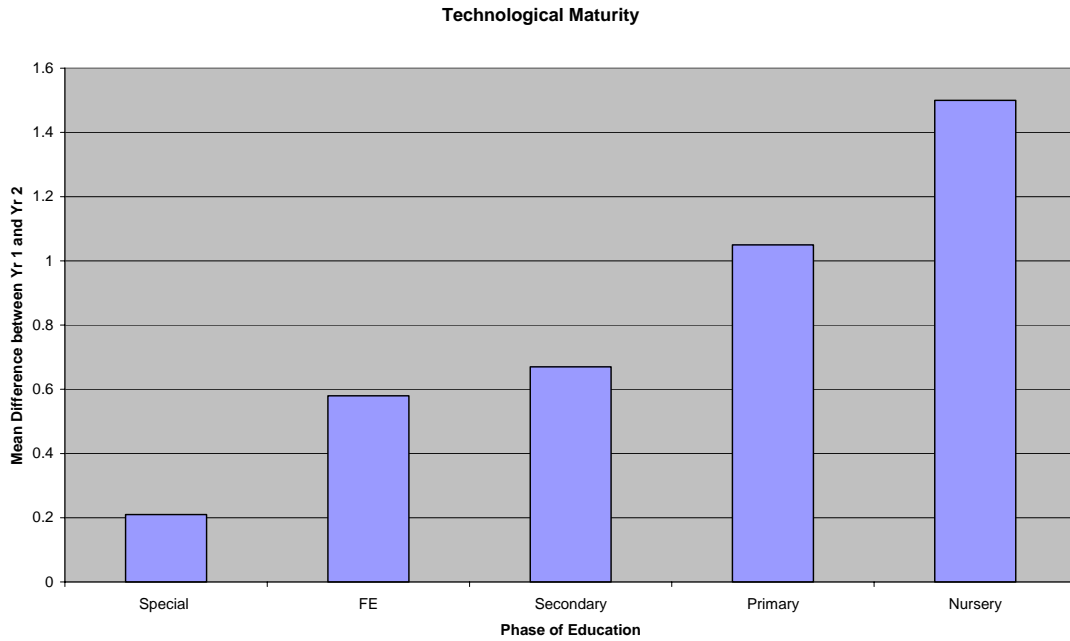
	Nursery	Primary	Secondary	Special	FE
Mean Score Yr 1 (2003)	1.28	1.74 (0.40)	2.02 (0.69)	1.11	2.59 (0.25)
Mean Score Yr 2 (2004)	2.78	2.52 (0.54)	2.76 (0.80)	2.61	3.31 (0.28)

Measures of Change:

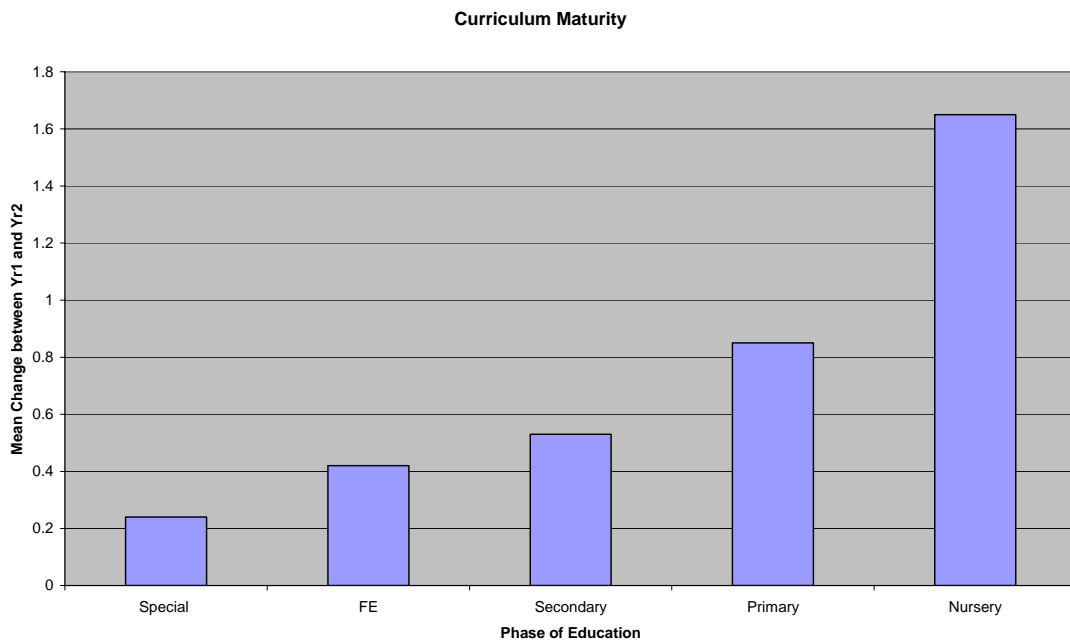
For each of the models a measure of ‘maturity’ or change from year one to year two of the project was calculated. This measure of change was derived by subtracting the mean score for each model from year one from the mean scores for each model from year two. The following series of graphs display the change over time by phase and are presented for each model in turn.

Each of the graphs, for all models with the exception of model 6 which provides a measure of external linkage, depicts the same pattern of results. The biggest developments in maturity have generally been made by the nursery school, followed by the primary schools, secondary schools, FE and then the special school, with the exception of Model 3 where the largest gains have been made by the primary schools. It is with some caution that these graphs should be interpreted however. The differential in sample size between the sectors means that the individual results for those institutions which are greater in number are ‘hidden’ within the collective findings for that sector. In the case of the nursery and the special school, in which they are both the single representative, findings may be inflated or skewed and this should be taken into account when interpreting the findings. Furthermore, given the very different natures of the educational sectors represented here, comparisons across sectors should be done with care.

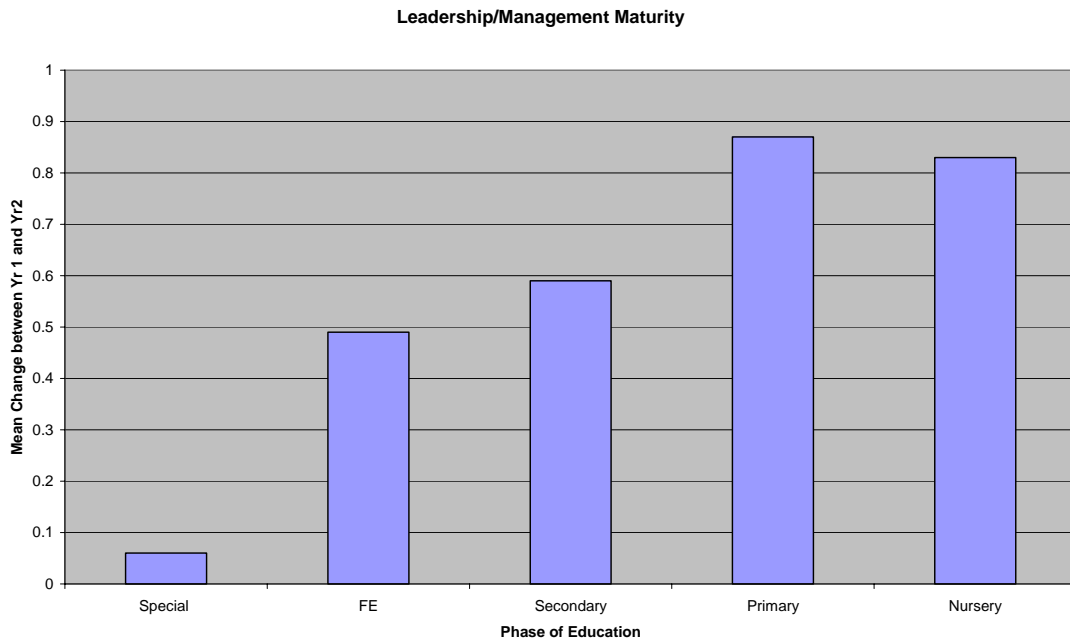
Graph 1: Displaying the mean difference in maturity between year one and year two for Model 1 (Technological Maturity)



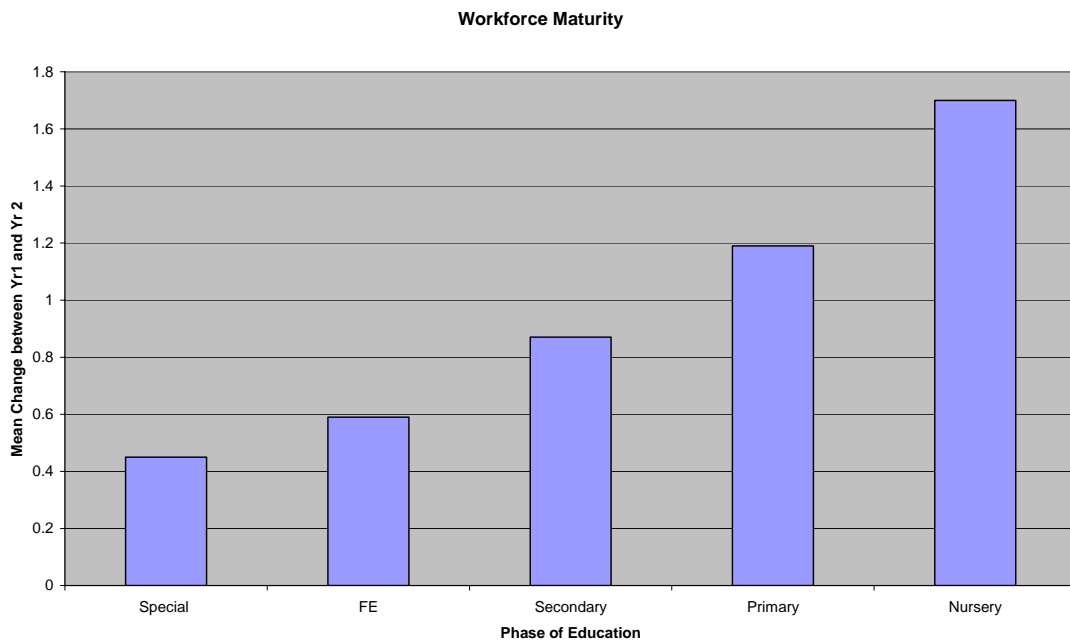
Graph 2: Displaying the mean difference in maturity between year one and year two for Model 2 (Curriculum Maturity)



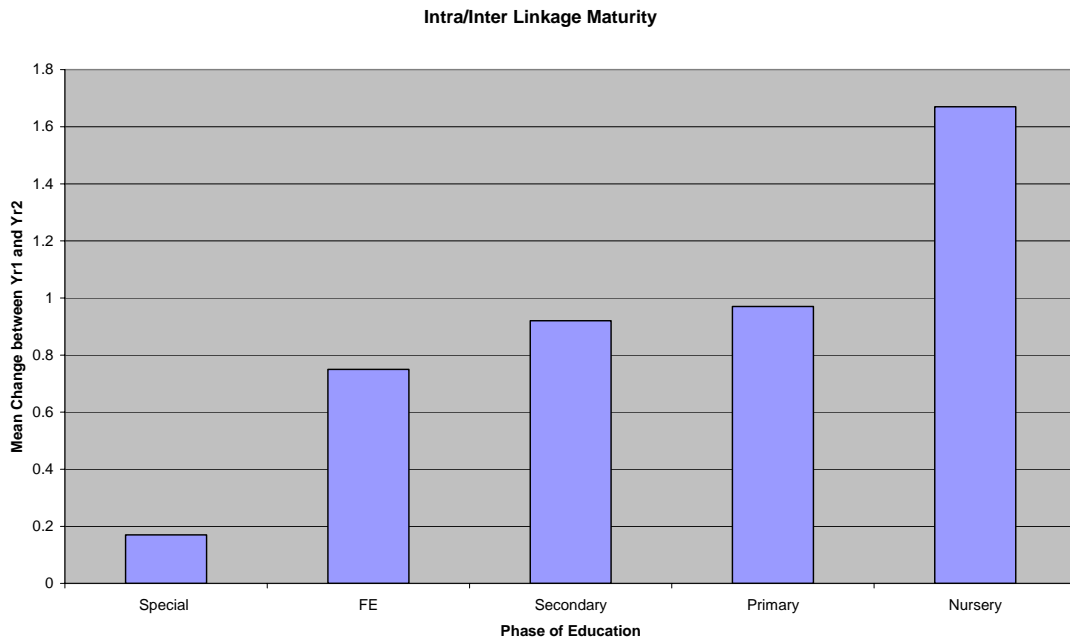
Graph 3: Displaying the mean difference in maturity between year one and year two for Model 3 (Leadership/Management Maturity)



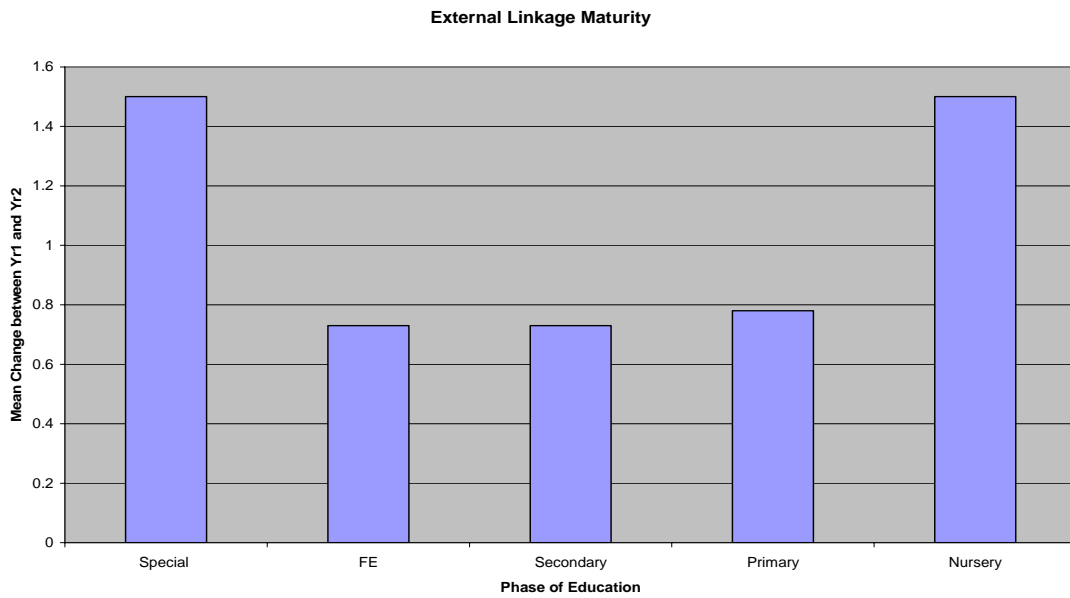
Graph 4: Displaying the mean difference in maturity between year one and year two for Model 4 (Workforce Maturity)



Graph 5: Displaying the mean difference in maturity between year one and year two for Model 5 (Intra/Inter Institution Linkage Maturity)



Graph 6: Displaying the mean difference in maturity between year one and year two for Model 6 (External Linkage Maturity)



Regression Analyses

Preparation of the Data Set:

As with the analyses from the first year of the project, all analyses reported here were conducted using a merged data set collated using each institutions self assessment and an assessment conducted by the evaluation team using data collected during the second year of the project. A final data set was created for each institution by taking an average score of the institutions' and evaluation teams' assessment on each of the dimensions.

A series of regression analyses were conducted on this final data set for each institution which enables us to establish which, if any, of the dimensions within each of the models predicts performance outcomes. These analyses also enable us to compare the models globally and ask which of the six models is able to best predict performance outcomes from the second year of the project.

The Performance Data:

School Data:

The performance data used for schools was the same as that used in the process of benchmarking the schools reported previously in January 2004 and January 2005. The average point score for each institution calculated by the DfES from the national test results was the starting point for the schools data.

At present (June 2005) the college performance data has not been released for use in the public domain. It is anticipated that these data will be entered into the analyses as soon as they become available.

Running the Analyses:

Three levels of analysis were conducted on these data. The three levels represent the level at which the data were broken down and can be defined as follows:

1. **Macro Level Analyses:** The macro level analyses were performed as global analyses in order to establish the predictive power of scores on each of the six maturity models overall on performance outcome. In order to conduct these analyses, both the mean and total scores of each institution were calculated for each model, resulting in the generation of six data points for each institution.
2. **Meso Level Analyses:** The meso level analyses were performed on each independent model in turn, resulting in one analysis per model. For each model the number of independent variables was equal to the total number of dimensions contained within that particular model. For example, Model 1: Technological Maturity has seven dimensions following the removal of one dimension at the preliminary analysis stage, resulting in seven independent variables being entered into this analysis.
3. **Micro Level Analyses:** The micro level analyses were performed on those models that contained subsections, namely Models 2, 3 and 4, each of which is made up of three sub-sections. The micro analyses

were conducted such that each sub-section constituted its own analysis, resulting in either three or four analyses being run per overall model. For example, Model 2: Curriculum Maturity is made up of the subsections 'Institutional', 'Teacher' and 'Pupil/Learner', resulting in one analysis being conducted for each of the 'Institutional', 'Teacher' and 'Pupil/Learner' levels.

Findings from Year One:

The analyses performed in year one at the macro and meso levels were all found to be non significant. At the micro level, however, one model was found to predict performance outcomes. It was found that section four of Maturity Model 4, titled 'Developing Workforce Roles' was a significant predictor of measures of an institutions performance, with this model accounting for 22% of total variance ($F = 3.66$, d.f. $_{2,26}$ $p < 0.05$).

Findings from Year Two:

Macro Level Analyses

Preparation of the Data Set:

In order to be able to run the analyses with all institutions entered simultaneously², it was necessary to standardise the performance data to be used as the dependent variable. It was necessary to create a single score for each institution to be used in the analyses and this was achieved by calculating the mean of the available test data for each institution. Thus, for those primary schools for which Key Stage 1 and Key Stage 2 data were available, the mean score of the two average point scores for both tests was calculated and used in the analyses. In the case of the secondary schools, the mean score of the Key Stage 3, GCSE and where applicable, GCE average point scores were calculated. The resulting single score for each institution was then converted to a z score in order to standardise the data and make the data directly comparable for each sector.

Significant Models:

With the total score on each of the six models as the independent variables and a measure of improvement in performance between the 2003 and 2004 KS1, KS2, KS3, GCSE and A level test scores as each of the dependent variables, two models were found to be significant.

The two regression models that were significant were those with the improvement measure between year one and year two of the project as the dependent variable on the KS2 tests and the A level tests. These analyses found that the total scores achieved on each of the six maturity models significantly predicted the improvement score for the KS2 tests with this model accounting for 45% of the total variance ($F = 3.29$, d.f. $_{6,30}$, $p < 0.01$), with the total score on model 2 ($t = -2.86$, $p < 0.01$) and the total score on Model 6 ($t = 3.11$, $p < 0.01$) being significant predictors. It was also found that the total scores from the six models predicted the A level improvement score,

² Since the performance data for the Special School and the Nursery were limited or non-existent, these institutions were not included in the regression analyses.

accounting for 40% of the total variance ($F = 2.62$, $d.f_{6,30}$, $p < 0.05$) with the total score on Model 2 being the only significant predictor ($t = 2.18$, $p < 0.05$).

Meso Level Analyses

At the meso level the 'A' level improvement measure was found to be predicted by both the technological maturity model scores, accounting for 52% of the total variance ($F = 3.62$, $d.f_{7,30}$, $p < 0.01$) with dimension one (overall policy) as the only significant predictor ($t = 2.74$, $p < 0.01$) and the curriculum maturity model scores ($F = 3.63$, $d.f_{2,30}$, $p < 0.05$).

The KS2 improvement measure was found to be predicted by Model 3, the Leadership/Management Model ($F = 2.50$, $d.f_{9,30}$, $p < 0.05$) with dimension 5 (management systems) and dimension 9 (co-ordination of ICT) being the two significant predictors of improvement ($t = 2.72$, $p < 0.01$ and $t = -2.77$, $p < 0.01$ respectively).

Micro Level Analyses

The results of the regression analyses conducted on each of the sub models within Maturity Models 2, 3 and 4 highlighted several significant regression models and thus that several of the sub models are significant predictors of performance on national tests.

The management systems section of Model 3 (Leadership/Management Maturity) was found to be a significant predictor of the KS2 improvement measure, accounting for 41% of the variance ($F = 3.94$, $d.f_{3,20}$, $p < 0.05$), with dimension 5 (management systems) as the only significant predictor ($t = 2.52$, $p < 0.02$). Similarly, the pupil/learner section of Model 2 (Curriculum Maturity) was found to predict the KS2 improvement scores, accounting for 70% of variance ($F = 5.14$, $d.f_{5,16}$, $p < 0.01$), with dimension 18 (critical thought appropriate to the relevant key stage) ($t = -4.04$, $p < 0.02$) being the only significant predictor within this sub section. Furthermore, the technical support section of the Workforce Maturity Model (Model 4) was found to be a significant predictor of the KS2 performance data from the second year of the project accounting for 36% of variance ($F = 3.86$, $d.f_{2,16}$, $p < 0.05$) with dimension 7 (who provides reactive technical support) being the only significant predictor ($t = -2.55$, $p < 0.05$).

Similarly the KS1 improvement scores were found to be predicted by the pupil/learner section of the Curriculum Model accounting for 62% of variance ($F = 3.84$, $d.f_{5,17}$, $p < 0.05$), with dimension 18 (critical thought appropriate to relevant key stages) being the only significant predictor ($t = -3.87$, $p < 0.002$). The management systems section of the Management Maturity Model was also found to be a significant predictor of KS1 improvement scores, accounting for 60% of variance ($F = 7.1$, $d.f_{3,17}$, $p < 0.01$) with dimension 6 (data collection) being the only significant predictor ($t = -3.43$, $p < 0.01$).

Correlation Analyses

Correlation analyses further revealed the existence of significant positive correlations between the A level improvement measure and total mean scores on the Technological Maturity Model and the Curriculum Maturity Model ($r = 0.401$, $n = 31$, significant at the 0.05 level for Technological Maturity; $r = 0.410$, $n = 31$, significant at the 0.05 level for Curriculum Maturity).