

Model assessment database

Forecast model	Priorities for future modelling work						Summary of modelling issues and OBR priorities for future work
	Accuracy	Plausibility	Transparency	Effectiveness	Efficiency	Overall	
Onshore corporation tax (main industrial, commercial and financial components)	H	H	H	M/H	L/M	H	<p>Forecasting onshore corporation tax requires a relatively complex modelling approach due to the complicated relationship between gross profits and taxable profits due to various deductions and restrictions on use of those deductions, the variable time lags between tax liabilities accruing and cash payments being made to HMRC, the time-shifted proxy for full accruals used in the public finances data, and the volume of policy changes made in recent years.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 6.7 per cent, which on a volatility-adjusted basis is higher than average across our fiscal forecasts. The average difference has been positive at 6.7 per cent, again larger than average, with all the past four March forecasts under-predicting receipts at the two-year horizon.</p> <p>We consider modelling issues to have been a factor contributing to this relatively poor forecast performance and have agreed the following priorities with HMRC for development work over the coming year:</p> <ul style="list-style-type: none"> • Deeper analysis of the sources of recent fiscal forecasting differences. • Review the structure and specification of the econometric equations that drive the deductions forecasts. • Develop more transparent model outputs to facilitate scrutiny of the each of the steps required to derive the final time-shifted accruals forecast.
Self-assessment income tax	H	H	M/H	H	L/M	H	<p>Self-assessment income tax is a relatively complex receipts stream because the underlying liabilities relate to a range of different income sources about which there is generally a lack of timely data. This generates uncertainty about the tax base assumptions fed into the forecasting model. The effective tax rate modelling is relatively simple, based largely on historical averages, forecast judgement and off-model adjustments for the effects of policy measures, of which there have been many in recent years.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 9.3 per cent, which on a volatility-adjusted basis is higher than average across our fiscal forecasts. The average difference has been negative at 9.3 per cent, again larger than average, with all the past four March forecasts over-predicting receipts at the two-year horizon.</p> <p>While much of the relatively poor forecast performance will relate to tax-base assumptions and policy costings, we consider modelling issues to have contributed too and have agreed the following priorities with HMRC for development work over the coming year:</p> <ul style="list-style-type: none"> • Develop alternative approaches to modelling the effective tax rate. • Deeper analysis of trends in the tax base and (with the ONS) consider how these are reflected in the National Accounts so that the model can appropriately transform elements of our National Accounts-based economy forecast into tax base assumptions.
Universal credit marginal cost	H	H	L/M	M	M	H	<p>The effect of UC on welfare spending is currently estimated as a marginal effect relative to the existing 'legacy' benefits and tax credits that it will replace. The modelling underpinning our estimates is therefore more akin to a policy costing than a forecast. It is a highly complex process that involves a number of interlinked models, mainly operated in DWP but drawing on HMRC models where related to tax credits. These need to factor in the real-life complexity of claimants' circumstances, the many differences in entitlement between the legacy system and UC, the behavioural response to those differences and the conditionality and sanctions regimes, and the uncertain pace of natural and managed migration of claims from the old to the new system. Governments have also adjusted the UC policy design on a number of occasions, adding further complexity to the modelling.</p> <p>There are no administrative data for the marginal effect of UC relative to the legacy system, only for actual spending on UC and the legacy benefits, which will be affected by many other factors beyond the UC rollout. We are therefore not able to sense-check forecast assumptions against what is happening in reality. As the rollout of UC accelerates over the next year, the amount of spending flowing through the system will rise significantly, making it increasingly difficult to scrutinise the legacy benefit forecasts as well as the assumptions about the marginal effect of UC. It is important to emphasise that, while the modelling of the UC marginal cost is particularly uncertain, we see risks lying to both sides of what we judge to be a reasonable and central estimate.</p> <p>We have agreed the following priorities with DWP for development work over the coming year:</p> <ul style="list-style-type: none"> • Continued development of a bottom-up, full-cost forecast approach that can be built on administrative outturn data. • Review assumptions related to take-up rates, error and fraud, the 'minimum income floor' and other material elements of the marginal effect estimate. • Monitor emerging evidence on labour market effects. • Set out our November 2017 UC forecast in detail in our next Welfare trends report, to be published later in 2017-18.

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Capital gains tax	H	H	M	L/M	L/M	M/H	<p>Capital gains tax receipts are relatively volatile – this reflects the underlying volatility of asset sales and the extent to which they generate capital gains, overlaid by frequent and often material policy changes. Timely information about underlying liabilities is very limited, while the information that can be derived from tax returns is only available with a significant lag since the tax is paid via self-assessment and detailed analysis of the tax returns is not straightforward. The model relies on proxies to forecast changes in the tax base since the last year of self-assessment data. These proxies are relatively poor.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 18.1 per cent, which on a volatility-adjusted basis is higher than average across our fiscal forecasts. The average difference has been negative at 2.7 per cent, smaller than average, with an equal number of March forecasts since 2012 under- or over-predicting receipts at the two-year horizon.</p> <p>We have agreed the following priorities with HMRC for development work over the coming year:</p> <ul style="list-style-type: none"> • Deeper analysis of tax return data (led by HMRC, as OBR staff do not have access to taxpayer confidential data) in order to understand the drivers of recent trends and explain differences from forecast. • Review the econometric equations used to forecast tax liabilities (drawing on insights from the analysis of tax returns). • Potentially develop a more disaggregated model in order to capture better the tax implications of divergent trends across different asset types.
Civil service pension scheme model	M	M/H	H	H	L/M	M/H	<p>Our public service pensions spending forecasts require the modelling of many elements of individual schemes' spending and income. These are driven by a variety of factors, including the retirement decisions of current and future employees (both about when to retire and whether to take a lump-sum payment), mortality rates among scheme beneficiaries and trends in the pensionable paybill. Lump sum payments can be particularly volatile from year to year. The CSPPS is the third largest public sector scheme in terms of membership.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast for overall public service pension spending has been 6.7 per cent, which on a volatility-adjusted basis is lower than average across our fiscal forecasts. The average difference has been negative at 1.5 per cent, smaller than average, with an equal number of March forecasts since 2012 under- or over-predicting spending at the two-year horizon. Within that, the CSPPS model has tended to overestimate expenditure and underestimate receipts on a two-year ahead basis, although the profile of these differences has not been even across the forecasts.</p> <p>We have agreed the following priorities with Cabinet Office for development work over the coming year:</p> <ul style="list-style-type: none"> • Work with the scheme administrator to ensure robust, up-to-date membership and demographic data are utilised in forecasts, thus ensuring outputs are based on the best possible information. • Develop more transparent model outputs to facilitate forecast scrutiny. • Review the approach to modelling lump-sum payments.
Council tax	M	L/M	M	M	L	M	<p>Council tax is levied on domestic property. The amount paid is based on the property band (based on an historical estimate of its value). The forecast model is relatively simple, starting with a projection of growth in the number of Band D equivalent dwellings liable for council tax (the 'council tax base'), after discounts and exemptions. The current year's council tax requirement (as estimated by local authorities) is then multiplied by this growth in the tax base and the assumed growth in the average level of council tax (based on our assumptions, which are underpinned by latest government policy on, for example, the maximum percentage a local authority can increase its council tax rates by without a referendum) to arrive at future year projections.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 2.0 per cent, which on a volatility-adjusted basis is lower than average across our fiscal forecasts. The average difference has been positive at 0.4 per cent, smaller than average, with an equal number of March forecasts since 2012 under- or over-predicting receipts at the two-year horizon.</p> <p>We have agreed the following priorities with DCLG for development work over the coming year:</p> <ul style="list-style-type: none"> • Deeper analysis of the sources of forecast differences set out in our 2017 FER. • Develop more transparent model outputs and diagnostics to facilitate forecast scrutiny.

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Customs duties	H	H	L	L	L	M	<p>Customs duties are levied at various rates on a range of goods imported from outside of the EU. Our model uses a 'top-down' approach, estimating the share of overall imports that are subject to duty and applying this to our import growth forecast. This share has fallen consistently in recent years. The main forecasting challenge relates to the pace at which this downward trend will continue. At present, customs duties are considered to be a tax that the UK raises on behalf of the EU, so this forecast has no effect on current receipts. (It has a small effect on spending because it features in the calculation of contributions to the EU.) This will change after Brexit, so we considered it important to review this model now since the forecasts we produce with it will provide the baseline against which any future policy changes are costed.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 5.3 per cent, which on a volatility-adjusted basis is lower than average across our fiscal forecasts. The average difference has been positive at 5.3, larger than average, with all the past four March forecasts under-predicting receipts at the two-year horizon.</p> <p>We have agreed the following priorities with HMRC for development work over the coming year:</p> <ul style="list-style-type: none"> • Review the econometric specification of the duty share model.
Fuel duties	M/H	M/H	L/M	L	L	M	<p>Fuel duties are levied on purchases of petrol, diesel and a variety of other fuels. Our model estimates road fuel duty receipts by multiplying taxable fuel consumption – known as 'fuel clearances' – by the corresponding duty rate. Fuel consumption is estimated by multiplying our distance travelled forecast by assumptions on fuel efficiency. Typically the main forecasting challenges relate to estimating the relationship between economic activity, the cost of driving and vehicle mileages. The pace at which fuel efficiency will improve over time is also an important judgement in medium-term forecasts and is particularly important over longer horizons.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 2.3 per cent, which on a volatility-adjusted basis is lower than the average across our fiscal forecasts. The average difference has been positive at 2.3 per cent, smaller than average, but with all the past four March forecasts under-predicting receipts at the two-year horizon.</p> <p>We have agreed the following priorities with HMRC for development work over the coming year:</p> <ul style="list-style-type: none"> • Investigate the potential impact of compositional changes in the vehicle stock and its implications for trends in fuel efficiency. • Review the near-term miles-driven forecast, in light of recent unexpectedly strong growth (particularly from light commercial vehicles).
General government depreciation	M	M/H	L/M	L/M	L	M	<p>Depreciation is a measure of the reduction in the value of an asset over time, due in particular to wear and tear. In the National Accounts, depreciation is measured by assuming different assets have different lifespans and that their value depreciates smoothly over that lifespan. Depreciation does not affect public sector net borrowing, but it does determine the split between current spending and net investment (i.e. gross investment less depreciation), which means it does affect the current budget deficit.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 3.0 per cent, which on a volatility-adjusted basis is higher than the average across our fiscal forecasts. The average difference has been negative at 2.7 per cent, smaller than the average, with three of the past four March forecasts over-predicting depreciation spending.</p> <p>We have agreed the following priorities with the Treasury for development work over the coming year:</p> <ul style="list-style-type: none"> • Review the constraining factors that are applied to link the underlying forecast model to the outturn data. • Develop a new model that is more transparent and addresses the systematic over-prediction of outturn
Insurance premium tax	L/M	H	M	L/M	L	M	<p>Insurance premium tax is a relatively simple tax, with two separate rates and a relatively small number of exemptions. Typically the main forecasting challenge relates to modelling trends in the true tax base via proxy indicators drawn from the National Accounts and our economy forecast. Recently, successive rate increases and the complication of changes to the personal injury discount rate have complicated the modelling significantly leading to larger divergences between forecast and outturn.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 6.5 per cent, which on a volatility-adjusted basis is lower than average across our fiscal forecasts. The average difference has been positive at 0.3 per cent, smaller than average, with three of the past four March forecasts over-predicting receipts at the two-year horizon.</p> <p>We have agreed the following priorities with HMRC for development work over the coming year:</p> <ul style="list-style-type: none"> • Review external data sources to broaden analysis of trends in the tax base. • Review the econometric specification of the forecasting model (including in light of any insights from external data sources).

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PAYE and NIC1 integrated payment model	L/M	L/M	M	L/M	L	M	<p>Income tax and 'Class 1' NICs paid through PAYE are the largest item in our receipts forecast, so while they are not particularly volatile relative to some taxes, even small percentage forecast differences can be material for our overall fiscal forecast. Our PAYE forecast model uses our earnings and employment growth forecasts to project the tax base from the latest base year and applies average effective tax rates (AETRs) derived from the 'Personal Tax Model' (the PTM, which we have reviewed separately). The model was extended to incorporate NIC1 payments in 2015, which had a number of advantages relative to the previous modelling approach (see our November 2015 EFO for more detail). Abstracting from uncertainty around the key determinants, the main fiscal forecasting challenge relates to the judgements that are fed into the model, in particular the current year receipts estimate and assumptions about differential earnings growth, which drive the shape of the income distribution that underpins the effective tax rate assumption.</p> <p>For PAYE income tax, the average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 1.7 per cent, which on a volatility-adjusted basis is lower than the average across our fiscal forecasts. The average difference has been negative at 0.2 per cent, smaller than average, with an equal number of March forecasts since 2012 under- or over-predicting receipts at the two-year horizon. NICs fiscal forecasting differences have tended to be larger and positive, although these mostly reflect differences from forecasts produced using the old model.</p> <p>We have agreed the following priorities with HMRC for development work over the coming year:</p> <ul style="list-style-type: none"> • Improve the transparency of smaller receipts streams in the model (such as the tax on occupational pensions). • Exploit real-time information (RTI) data more to help inform key assumptions (such as the in-year estimate and differential earnings growth).
Personal tax model (PTM)	L/M	M/H	M	L	L	M	<p>The Personal Tax Model (PTM) is a micro-simulation model based on a survey of taxpayers' liabilities. This model calculates the average marginal tax rate on additional income by taking account of reliefs, allowances and our assumptions about inflation and any differences in earnings growth at different points in the earnings distribution. The model then applies these tax rate forecasts to income growth to generate a receipts forecast. The main forecasting challenge relates to the shape of the income distribution and the differential earnings growth assumptions that are fed into this model to project the distribution.</p> <p>The PTM model is a component of our overall PAYE income tax and NIC1 forecasts. The fiscal forecasting differences associated with these overall forecasts are discussed in relation to the PAYE and NIC1 integrated payment model.</p> <p>We have agreed the following priorities with HMRC for development work over the coming year:</p> <ul style="list-style-type: none"> • Exploit real-time information (RTI) data to help inform the projection of the base-year micro data. • Develop a top-down representation of the underlying income distribution to provide a cross-check on the model outputs in order to facilitate forecast scrutiny.
SDLT	L/M	M	M	L/M	L	M	<p>Stamp duty land tax is a relatively volatile source of receipts, reflecting the volatility of the underlying tax base: property transactions. Our models use a microsimulation approach to project a set of micro-level transaction data in line with our forecasts for aggregate transactions and average property prices. The main forecasting challenge relates to changes in the distribution of transactions by price, given the progressive structure of the tax. In particular, the number of transactions at the top-end of the distribution, which are taxed much more highly than the average transaction, is a key driver of aggregate receipts.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 6.0 per cent, which on a volatility-adjusted basis is lower than the average across our fiscal forecasts. The average difference has been negative at 2.5 per cent, smaller than average, with an equal number of March forecasts since 2012 under- or over-predicting receipts at the two-year horizon.</p> <p>We have agreed the following priorities with HMRC for development work over the coming year:</p> <ul style="list-style-type: none"> • Develop a cross-check on the underlying distribution projection by utilising a 'top-down' approach in order to facilitate forecast scrutiny.
Tobacco duties	M	M	L	L	L	M	<p>Tobacco duties are levied on purchases of cigarettes, hand-rolled tobacco, cigars and other forms of tobacco. They have been a relatively stable source of revenue, although on a declining trend as a share of GDP. Receipts are estimated by multiplying taxable tobacco consumption – known as 'tobacco clearances' – by the corresponding duty rate. The modelling approach is relatively simple, with the main forecasting challenge relating to the pace at which the downward trend in cigarette consumption will continue. In recent years, our forecasts have over-predicted receipts, reflecting a faster-than-expected decline in tobacco consumption. The effect of recent regulatory changes, including the EU Tobacco Products Directive and standardised packaging regulations also represent a source of uncertainty around the key assumptions embodied in the model.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 5.1 per cent, which on a volatility-adjusted basis is higher than the average across our fiscal forecasts. The average difference has been negative at 5.1 per cent, larger than the average, with all the past four March forecasts over-predicting receipts at the two-year horizon.</p> <p>We have agreed the following priorities with HMRC for development work over the coming year:</p> <ul style="list-style-type: none"> • Review and monitor the impact of recent regulatory changes. • Exploit external data sources more fully to inform judgements about the pace of the downward consumption trend.

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CG debt interest (main gilts model)	L/M	M	L/M	L	L	L/M	<p>Debt interest spending by central government is a relatively large and potentially volatile element of our overall spending forecast due to its sensitivity to movements in short-term interest rates and RPI inflation. The largest components are interest paid on government bonds (known as 'gilts'), of which there are two types: conventional gilts that pay a fixed amount of interest and index-linked gilts that pay an interest rate linked to RPI inflation. We have looked at the index-linked component of the model in this year's review.</p> <p>Forecasting debt interest spending requires assumptions about total financing (i.e. the cash deficit plus rolling over existing debt that reaches maturity), its composition in terms of different types of new debt issued, and the rates of interest that will be paid on new and existing debt (which reflect our forecasts for interest rates, derived from financial market expectations, and RPI inflation, for index-linked gilts). Both the quantity of new debt to be issued and its average cost are challenging to forecast, but this mainly reflects uncertainty around the assumptions we feed into the model rather than how the model itself works. One modelling challenge relates to how the refinancing of gilt redemptions is captured, which was the subject of a correction in our December 2014 forecast. The treatment of negative real interest rates and large issuance premia is also a modelling as well as a forecasting challenge.</p> <p>For overall CG debt interest spending, the average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 4.9 per cent, which on a volatility adjusted basis is lower than the average across our fiscal forecasts. The average difference has been negative at 4.9 per cent, larger than the average, with three of the past four March forecasts over-predicting spending.</p> <p>We have agreed the following priorities with the Treasury for development work over the coming year:</p> <ul style="list-style-type: none"> • Review the index-linked gilt component of the model to ensure that it captures the effects of gilt issuance above par. • Develop the model documentation to improve transparency.
PENFORM model	L/M	L/M	L	L	L	L/M	<p>State pension spending is the biggest item in our overall welfare spending forecast. It is a relatively simple element of the social security system, that is updated each year in line with the 'triple lock' (the highest of CPI inflation, average earnings growth or 2.5 per cent). Pension credit tops up the income of older people to a minimum level, through the 'guarantee credit', while a 'savings credit' provides extra support to those who have saved for their retirement so that the guaranteed income does not remove the incentive to do so. The savings credit has closed to new claims following the introduction of the 'new state pension'.</p> <p>The PENFORM microsimulation model is used to forecast both state pension and pension credit spending. The main forecasting challenge relates to pension credit, given its means-tested eligibility requirements. For the state pension, modelling the proportion of those reaching state pension age that choose to defer their payments is a key challenge. Mortality rates are important to all pensioner benefits, but these are imposed on the model using ONS population projections rather than being a feature of the model itself.</p> <p>The average absolute two-year ahead fiscal forecasting difference for state pension spending since our March 2012 forecast has been 0.4 per cent, which on a volatility-adjusted basis is lower than the average across our fiscal forecasts. The average difference has been negative at 0.4 per cent, smaller than average, with three of the past four March forecasts over-predicting spending.</p> <p>We have agreed the following priorities with DWP for development work over the coming year:</p> <ul style="list-style-type: none"> • Develop a top-down representation of the underlying micro-simulation model to facilitate scrutiny of the model structure and assumptions.
VAT (VTTL and SRS models)	L/M	L/M	L	L/M	L	L/M	<p>VAT is levied on the purchase of most goods and services. It is reflected in the price paid when items are bought and is collected from traders. The VAT model is based on the concept of a 'VAT theoretical liability' or VTTL – the total value of VAT that could theoretically be collected from the tax base. Each sector within this tax base is then grown in line with the relevant elements of our economy and fiscal forecasts. The main forecasting challenge relates to the standard-rated share (SRS) of each sector of the tax base – the proportion taxed at the standard rate of 20 per cent. In our March 2017 forecast, we overhauled our household-sector SRS model to better capture recent trends and to ensure better consistency with our overall economy forecast.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 2.4 per cent, which on a volatility adjusted basis is lower than the average across our fiscal forecasts. The average difference has been positive at 2.4 per cent, smaller than average, with all the past four March forecasts under-predicting receipts at the two-year horizon. A significant proportion of these under-predictions in recent years reflect an error related to the projection of government VAT deductions that we identified in our 2015 FER and corrected in our November 2015 forecast.</p> <p>We have agreed the following priorities with HMRC for development work over the coming year:</p> <ul style="list-style-type: none"> • Review the data used in the historical theoretical tax liability model to inform our forecast judgements.

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VAT refunds	L/M	L/M	L/M	L	L	L/M	<p>VAT refunds are given to departments in central and local government in relation to payments for contracted-out services. VAT refund receipts are fiscally neutral as they are fully offset in expenditure through AME. The VAT refunds model is split into central and local government sectors. Outturn VAT refunds are divided by respective total government spending to calculate the effective tax rate. The effective tax rate is held constant over the forecast period and is applied to our forecasts for government spending to derive VAT refund forecasts. Adjustments are made to reflect the latest in-year position.</p> <p>The average absolute two-year ahead fiscal forecasting difference since our March 2012 forecast has been 2.5 per cent, which on a volatility-adjusted basis is lower than the average across our fiscal forecasts. The average difference has been negative at 2.5 per cent, smaller than the average, but with all the past four March forecasts over-predicting receipts (and associated spending) at the two-year horizon.</p> <p>We produce this forecast ourselves and have set the following priorities for development work over the coming year:</p> <ul style="list-style-type: none"> • Work with HMRC to gain a better understanding of the outturn data and the drivers behind recent trends..
North Sea revenues	L	L/M	L	L/M	L	L	<p>UK oil and gas revenues consist of offshore corporation tax (which includes 'ring fence' corporation tax and the supplementary charge) and petroleum revenue tax. These taxes apply to the profits of companies involved in the production of oil and gas in the UK and on the UK continental shelf (UKCS) ('The North Sea'). The North Sea revenues forecast uses a micro-simulation model based on production and expenditure data from each individual oil and gas field. These field level data are collected through a survey now carried out by the Oil and Gas Authority. The fully disaggregated data in the model are subject to taxpayer confidentiality, so we only scrutinise the outputs of the model, not the individual field-level inputs. North Sea revenues are relatively volatile due to the underlying volatility of prices, production and tax-deductible expenditure. The relationships between the aggregate cashflows of North Sea firms, their taxable profits and the amount of tax revenue are complicated by the deductions regime and the use of past losses to offset current liabilities.</p> <p>Fiscal forecasting differences for North Sea revenues are not meaningful in percentage terms as revenues have been close to zero in recent years. For offshore corporation tax, an equal number of March forecasts since 2012 have under- or over-predicted receipts at the two-year horizon. For petroleum revenue tax, three of the past four have over-predicted receipts.</p> <p>We plan to move to a new North Sea forecasting model in our November 2017 forecast. We have agreed the following priorities with HMRC for development work over the coming year to enhance this new model:</p> <ul style="list-style-type: none"> • Develop modelling outputs to improve the transparency of the underlying structure and assumptions. • Develop the long-term forecasting capability of the model to inform our Fiscal sustainability report analysis..