Labor Market Early Warning System

Introduction to the Model Developed by the Orange County Business Council for use by the Orange County Workforce Investment Board

Marlon G. Boarnet
Richard Funderburg

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Executive Summary

This document introduces the labor market early warning system. The Orange County Business Council (OCBC) developed the Early Warning System for the Orange County Workforce Investment Board. The Early Warning System possesses three broad capabilities:

- One-, two-, and five-year projections of employment in 10 industry clusters based on six alternative macroeconomic scenarios involving changes to statewide total employment

- Estimates of the effects of an immediate change in employment or final demand in one industry cluster on each of the 10 clusters and total Orange County employment through use of inter-industry input-output multipliers

- Projections of occupations within the 10 industry clusters based on outputs from the macroeconomic and multiplier effects models

The Early Warning System models build upon the research and analysis conducted by the OCBC and included in the report titled Development of A Labor Market Early Warning System, June 2001. Particularly, the macroeconomic effects models further the findings from the shift-share analyses and economic shock simulations developed in that report. Additionally, the models unite findings from recent research regarding the interdependence of industry clusters in Orange County and the occupational makeup of the 10 industry clusters.

The multiplier effects model is derived from an input-output study of inter-cluster dependencies. The analysis summarized these relationships with employment multipliers that estimate the effects of a change in one or more industry clusters on each of the 10 clusters. Furthermore, the model permits one to estimate the response of total Orange County employment to immediate changes in local industry cluster employment or revenue.

The occupations forecast model combines data from the recent employer survey commissioned by the Board with data available through the Employment Development Department. All three models are designed to work interactively. Once the models are updated with current employment data and assumptions are input, the occupations forecast model returns estimates of the change in employment for 165 occupations in the 10 industry clusters.

The OCBC designed the models to be easily updated and interpreted quickly. The following report details the models and describes how they can be updated and interpreted.

ORANGE COUNTY LABOR FORCE EARLY WARNING SYSTEM

This paper introduces the Orange County Labor Force Early Warning System (EWS) developed by the Orange County Business Council (OCBC) for use by the Orange County Workforce Investment Board (OCWIB). The EWS models possess three broad capabilities that are easy to use. First, they facilitate analysis of County industry cluster employment effects from hypothetical changes in statewide total employment. Second, the models can be used to assess the interdependencies of County industry clusters and their contribution to total County employment. The third capability allows one to examine how employment changes in the 10 industry clusters affect demand for related occupations. The following sections of this paper describe each of the three capabilities and the processes for updating and interpreting the models.

Industry Clusters

The partnership between the OCWIB and the OCBC has identified 10 industry clusters to facilitate analysis and manage industry employment and occupation projections. The EWS models respond consistently to federal Workforce Investment Act (WIA) mandates to improve the use of labor market information in workforce preparation policy design, improve the coordination of workforce training with economic development initiatives, and ration scarce WIA training funds toward occupations with unmet demand for labor. Interest among state and local governments in isolating industry clusters for both analytic and prescriptive purposes preceded enactment of the WIA in 1998, but the Act formally encouraged nationwide acceptance of cluster analysis in the public job-training arena.

The table below identifies the 10 industry clusters examined in the EWS models and their constituent Standard Industry Classification (SIC) coded sectors.

Industry Cluster Name	Constituent SIC Codes
Biomedical	SICs 283, 3821, 3824, 3826, 3827, 384, 385, 386, 7352, 873
Business and Professional Services	SICs 275, 276, 279, 731, 732, 733, 7359, 736, 7382, 81, 8711, 8712, 8713, 872, 874
Communications	SICs 3661, 3663, 3669, 481, 482, 484, 4899
Computer Hardware and Electronics	SICs 3429, 3559, 357, 364, 367, 3695, 3699, 5065

Industry Cluster Name	Constituent SIC Codes
Computer Software	SICs 7371, 7372, 7373, 7374, 7375, 7377, 7379
Construction	SICs 153, 17, 6552, 7353, 7553, 7699
Defense / Aerospace	SICs 348, 372, 373, 376, 381
Energy and Environment	SICs 3433, 3511, 3519, 3533, 3564, 3589, 3612, 3694, 3822, 3823, 3825, 3829, 492, 493, 495, 5093
Health Services	SICs 801, 802, 803, 804, 805, 806, 808, 809
Tourism	SICs 472, 478, 581, 5963, 701, 79

Macroeconomic Effects Models

The macroeconomic effects models permit simple analysis of how hypothetical changes in the state economy might influence employment in 10 important Orange County industry clusters. The models provide one-, two-, and five-year estimates of County industry cluster employment for each of six economic scenarios. The California economy has experienced each scenario during the last 30 years. The scenarios, or economic shocks, include a moderate economic contraction, an economic slowdown, a period of inflationary growth, a severe recession, and two periods of sustainable expansion. The macroeconomic effects models draw on the economic shock simulations included in the 2001 EWS report and extend the analysis to two- and five-year horizons.

Methods

For the one-year estimates, the model combines the findings from the 1991-93 and 1994-2000 shift-share analyses and the economic shock simulations included in the June 2001 report titled Development of A Labor Market Early Warning System. The six original one-year scenarios and their corresponding change in total state employment are included in the table below.

Economic Scenario	Base Period	Annual % Change
Severe Recession	1990-1991	-2.87%
Moderate Contraction	1970-1971	-0.67%
Economic Slowdown	1974-1975	0.47%
Sustainable Expansion 1	1994-1995	2.00%
Sustainable Expansion 2	1985-1986	2.92%
Inflationary Growth	1977-1978	7.57%

Shift-share analysis apportions each industry's employment growth in a region into three distinct categories. The share accounts for employment growth in the local industry that would occur if the sector expanded at the same rate as total state or national employment growth. The industry mix component estimates the expected growth for the local industry, given state or national industry employment trends. The local factors represent the residual change in local industry employment after subtracting the share and industry mix effects. As a result, the local factors indicate whether the region has a comparative advantage or disadvantage in accommodating the particular industry.

The shift-share calculations require three data elements and two time-ordered records of employment for each element. The three required data elements include local employment in the industry, state (or national) employment in the industry, and state (or national) total employment. The two time-ordered records are simply two values for each of the three elements reflecting two points in time, the beginning and end points of the period to study. The share is calculated by multiplying the figure for local employment in the industry at the beginning of the study period by the absolute percentage change in total state employment over the range of the study. The industry mix is calculated by simply subtracting the share from the product of the beginning local employment in the industry and the percentage change in state employment in the industry. Similarly, the local factors component is calculated by subtracting the product of the beginning local industry employment and the percentage change in state industry employment from the ending local employment in the industry for the study period. Please see page 41 of Development of A Labor Market Early Warning System, June 2001, for a mathematical representation of the shift-share equations.

The share component evaluates whether the local industry grows faster, slower, or at the same pace as total state employment growth. If employment increases faster for the state, the share component will be larger than local industry employment at the end of the study period. The converse is true when statewide employment expands at a slower rate. The industry mix component summarizes the extent that statewide

employment in the particular industry increases faster, slower, or at the same rate as total statewide employment. A positive industry mix depicts the scenario when the industry expands more rapidly than total statewide employment. The converse is true for a negative industry mix. The local factors component compares the local industry growth to the statewide industry growth. A negative local factors calculation indicates that local employment in the industry grew slower than statewide employment in the industry. The converse is true for a positive local factors calculation. When the local factors component is positive, one concludes that the local area possesses a comparative advantage for that industry because firms choose to expand more rapidly in the locality than elsewhere in the state. When the local factors component is negative, one concludes that the local area possesses a comparative disadvantage.

The six scenarios from the economic shock simulations included in the 2001 report establish the basis of the macroeconomic effects models. The three macroeconomic effects models apply six alternative state employment growth rates representing the scenarios to the most recent actual value of local employment in the industry and recalculate the share component for the industry. A forecast of local employment in each industry is obtained by adding the previously calculated estimates of the industry-mix and local factors to the new estimate of the share factor resulting from an assumed change in state employment. In that sense, the models estimate the extent each industry's mix and local factors offset or contribute to the employment effects of the statewide economic assumption. Please see pages 68-79 of Development of A Labor Market Early Warning System, June 2001, for a detailed discussion of the six scenarios for one-year estimates.

To ensure feasible two-year and five-year estimates, additional assumptions were necessary. Simply extending the one-year estimates into multi-year scenarios is not reasonable. The spirit of the previous analysis was to capture extreme, yet experienced, events in statewide employment in addition to the moderate counterparts. The extreme events, such as a 2.87 percent single year decline or a 7.57 percent single year increase in total state employment, have not occurred over multiple years in California. Furthermore, there is no reason to expect macroeconomic cycles in the future to be more extreme than in the historical record. Therefore, the two- and five-year macroeconomic effects models account for realistic scenarios, consistent with the spirit of the original analysis. To maintain this intent of reasonableness, two- and five-year periods that most closely resemble the assumptions made in the original one-year model were identified and incorporated into the EWS.

Two-Year Outlooks

The two-year estimates for each of the six economic scenarios have been modeled after two-year base periods in the state employment series that, on average, most closely approximate the single year assumptions. To the extent reasonable, the two-year scenarios model a two-year base period that comprises the single-year change in total state employment in the original model. For example, the two-year

moderate contraction scenario that models a 0.46 percent annual decline in total state employment between 1969 and 1971 comprises the one-year base period for that scenario with a 0.67 percent decline between 1970 and 1971. The table below provides the base periods for the two-year outlook scenarios.

Economic Scenario	Base Period	Annual % Change
Severe Recession	1990-1992	-2.40%
Moderate Contraction	1969-1971	-0.46%
Economic Slowdown	1980-1982	0.10%
Sustainable Expansion 1	1994-1996	2.21%
Sustainable Expansion 2	1988-1990	2.51%
Inflationary Growth	1976-1978	6.28%

The table above shows that base periods could reasonably be expanded from the one-year change to the two-year outlook in all cases except for the economic slowdown and the first sustainable expansion scenario. However, the annual percentage changes reflected in the two-year scenarios track fairly close to the state employment changes in the one-year model. For the extreme events, the two-year base periods moderate the statewide employment change from the one-year experience, consistent with a reasonable expectation and this moderating influence becomes more pronounced in the five-year outlooks.

Five-Year Outlooks

Including five-year employment estimates necessitated the reconsideration of base periods to account for multi-year changes in the macroeconomic effects models. California's recent 30-year employment history includes few five-year intervals of continuous employment increase or continuous employment decline, and no five-year intervals of statewide employment change at a constant annual rate. For example, the five-year period with the sharpest annual statewide employment decline, -0.59 percent between 1990 and 1995, contrasts distinctly with the 2.40 percent average annual decline between 1990 and 1992, and even more significantly with the 2.87 percent decrease between 1990 and 1991. In fact, total statewide employment increased by 0.93 percent in 1994 and by an additional 2.00 percent in 1995. Because such extreme events have not persisted for five consecutive years, the EWS employs the more reasonable base period approach.

Using the same process, five-year base periods were identified that best capture the spirit of the one-year analyses. Of course, the goal for consistency in base periods

shared with the one-year estimates had to be relaxed even further. The six macroeconomic scenarios for the five-year outlook are identified in the table below.

Economic Scenario	Base Period	Annual % Change
Severe Recession	1990-1995	-0.59%
Moderate Contraction	1978-1983	1.82%
Economic Slowdown	1969-1974	1.94%
Sustainable Expansion 1	1993-1998	2.25%
Sustainable Expansion 2	1985-1990	3.07%
Inflationary Growth	1975-1980	4.70%

Modeling the six economic scenarios with separate one-, two-, and five-year base periods permits a realistic accounting of state-level employment changes in the EWS model. The tables above indicate that extreme events become moderated over longer durations, consistent with a reasonable expectation. For example, a five-year period that includes a moderate contraction would be expected to include employment growth within the period, causing a net average annual increase in employment over the whole period.

Updating the Macroeconomic Effects Models

Note: To ensure the integrity of the EWS models, one should save the workbook as a new name each time before updating the input column C.

We designed the EWS models to be easily updated and interpreted quickly. The table in the section above titled “Industry Clusters” identifies the SIC codes corresponding to each of the 10 industry clusters in the models. Therefore, the table identifies the data needed to update the macroeconomic effects models. Currently, the input table includes the 2000 annual employment level for each cluster in cells C4 through C13 of the Excel Workbook tab titled “Input and Output Master Sheet.”

The Input and Output Master Sheet is the only Excel spreadsheet in the workbook that requires updating or other entries to perform analyses. Except for the Occupations Forecast sheet that is explained below, the user does not need to access the remainder of the workbook. The additional worksheets perform the mathematical operations explained in this paper and in the 2001 EWS report and do not require inputs or adjustments. To preserve the integrity of the models, we advise against making edits to the workbook other than changing inputs in column C of the Input and Output Master

Sheet. Cells in the Input and Output Master Sheet requiring inputs from the user are colored white and cells generating output for the user are colored yellow.

Cells A1 through D14 in the Input and Output Master Sheet comprise the input table for the EWS models. The models require only cells C4 through C13 in the input cluster employment column to be updated with the current employment data available. Currently, 2000 is the latest available annual employment data from the California Employment Development Department (EDD) for the SIC codes comprising the industry clusters. Although the models will work with quarterly or monthly employment data, the user is encouraged to use caution when inputting data that are quarterly or monthly, since such data can reflect seasonal distortions. Yet, if the results are interpreted as year-over-to-same-quarter or year-over-to-same-month estimates, use of quarterly or monthly data should not present problems.

Updating the macroeconomic effects models begins with contacting the EDD. The EDD's Labor Market Information Division must compile a special report for Orange County employment in the SIC codes comprising the industry clusters and such reports are available for purchase only. To purchase a special report of employment in Orange County's high technology industry clusters, please contact:

Mary Rippey
Information Services Group
Labor Market Information Division
(916) 262-2266
lmid.mrippey@edd.ca.gov

Ms. Rippey will require the list of SIC codes identified in the table in the "Industry Cluster" section above and the specification of Orange County as the region.

Once more current employment data become available through the EDD, employment levels for the SIC coded constituent sectors need to be summed to their corresponding industry cluster as indicated by the Industry Cluster table. Usually, it is easiest to perform this function in a spreadsheet so that the totals can be copied and pasted. Once the industry cluster totals have been obtained, enter or copy/paste the values into the input cells C4 through C13 in the Input and Output Master Sheet. The one-year, two-year, and five-year outlooks for each of the six scenarios will automatically update from the new data input. Save the workbook to preserve a record of the EDD's recent employment estimates for the 10 industry clusters.

When the EDD converts from the SIC to the North American Industrial Classification System (NAICS) in May 2003, the employment data must be requested by the NAICS codes corresponding to the previous SIC codes. The table below provides the conversion from SIC to NAICS for each of the industry cluster constituent sectors to facilitate such a request.

Industry Cluster Name	Constituent NAICS Codes

Biomedical	NAICs 325411, 325412, 325413, 325414, 339111, 334514, 334516, 333314, 332994, 339111, 339112, 322291, 339113, 334510, 339114, 334517, 334510, 339115, 333315, 325992, 532291, 53249, 51471, 51472, 51491, 54171, 54172, 54194, 54138
Business and Professional Services	NAICs 323114, 323110, 323111, 323113, 323112, 323115, 323119, 323116, 323122, 54181, 54185, 54184, 54183, 54187, 54189, 56144, 56145, 51114, 54186, 561439, 541922, 54143, 56141, 561492, 53221, 53231, 532299, 532412, 532411, 562991, 53242, 53249, 541612, 56131, 56132, 56133, 561621, 54111, 54133, 54131, 54136, 54137, 541211, 541214, 541219, 56111, 23, 541611, 541613, 541614, 54182, 56121, 61171, 54169, 54132, 54133, 541618
Communications	NAICs 33421, 334418, 33422, 33429, 513321, 513322, 51333, 51331, 51334, 51321, 51322, 48531, 51339
Computer Hardware and Electronics	NAICs 332999, 332439, 332722, 336399, 332919, 337215, 33251, 33322, 33241, 333319, 333295, 333111, 333298, 334111, 334112, 334113, 334418, 334613, 334119, 333311, 333313, 339942, 334518, 33511, 335931, 332212, 335932, 335121, 335122, 336321, 335129, 334411, 334412, 334413, 334414, 334415, 334416, 334417, 33422, 33431, 334418, 334419, 334613, 333319, 333618, 333992, 335129, 335999, 42169
Computer Software	NAICs 541511, 51121, 334611, 541512, 51421, 514191, 53242, 541519

Industry Cluster Name	Constituent NAICS Codes
Construction	NAICs 23321, 23322, 23331, 23332, 23511, 23521, 23531, 23541, 23542, 23543, 23551, 23552, 23561, 23571, 23581, 23591, 23592, 23593, 23594, 23595, 56291, 23599, 23311, 23499, 532412, 23511, 442299, 561622, 562991, 56179, 562998, 48839, 81131, 45111, 11521, 811211, 811212, 811219, 811411, 71151, 811412, 81143, 81149
Defense / Aerospace	NAICs 332992, 332993, 332994, 332995, 54171, 336411, 336412, 332912, 336413, 48839, 336611, 81149, 336612, 336414, 336415, 336419, 334511
Energy and Environment	NAICs 333414, 333611, 336399, 333618, 333132, 333411, 333412, 333319, 335311, 336322, 334512, 334513, 334514, 334515, 334514, 339112, 334518, 334519, 48621, 22121, 221111, 221112, 221113, 221119, 221121, 221122, 22132, 56292, 562211, 562212, 562213, 562219, 488119, 56291, 56171, 562998, 42193
Health Services	NAICs 621493, 621491, 621112, 621111, 62121, 62131, 62132, 621391, 62133, 62134, 621399, 623311, 62311, 62321, 62211, 62221, 62231, 62161, 621492, 62141, 62142, 621498, 621991, 54143, 541922, 621999

Industry Cluster Name	Constituent NAICS Codes
Tourism	NAICs 56151, 56152, 488999, 561599, 488911, 48839, 48849, 48711, 72231, 48821, 72211, 722211, 722212, 722213, 72232, 71111, 72241, 72233, 45439, 72111, 72112, 721191, 721199, 71399, 61161, 56131, 71141, 561599, 71151, 71112, 71131, 71132, 51229, 53249, 71113, 71151, 71119, 71395, 711211, 711212, 711219, 71394, 71391, 71312, 71329, 71399, 71311, 71391, 71394, 71399, 561599, 48799, 71321, 71329, 71219, 61162, 611699, 532292, 48721, 71399

The correspondence between the SICS and the NAICS is not one-to-one. The table above represents a best attempt to retain the properties of each industry cluster through the transition from the SIC to NAICS. Any apparent inconsistencies of including certain NAIC codes in a cluster definition are purposeful, to retain the measurements as best as possible over the break in series. Therefore, omission of a NAIC code from a cluster definition due to its apparent irrelevance is not recommended. Similarly, inclusion of additional codes not referenced above is not advised.

Interpreting the Macroeconomic Effects Models

The macroeconomic effects models derive local industry cluster employment estimates under each scenario using the economic shock simulation approach detailed in the 2001 EWS report. To summarize, the models evaluate County employment in each cluster from the cluster's regional shift-share factors by applying a hypothetical change in total state employment designated by each economic scenario. The resulting estimate shows how changes in the state economy influence employment in Orange County's industry clusters.

The models estimate one-, two-, and five-year impacts of each macroeconomic scenario from the most current data available. Interpreting each model requires the user to make a judgment as to which of the six scenarios best represent California's future economy. Otherwise, the models are still useful at presenting a wide range of best-case, worst-case, and more likely situations for the state economy, and the potential consequences to local industry cluster employment of each event. Each model should be interpreted by reading across a row identifying a cluster and tracing the row to its intersection with a column indicating an employment estimate for a particular scenario.

One-Year Macro Effects Model

Cells A18 through P47 in the Input and Output Master Sheet comprise the one-year macro effects model. The table below illustrates the interpretation of one-year outlooks for the six scenarios, given the 2000 annual data input in the model.

One-Year Employment Outlooks for Six Economic Scenarios

	Severe Recession (-2.87%)	Moderate Contraction (-0.67%)	Economic Slowdown (+0.47%)	Sustainable Expansion 1 (+2.00%)	Sustainable Expansion 2 (+2.92%)	Inflationary Growth (+7.57%)
Biomedical	-1,185	-504	-182	250	509	1,823
Bus. & Prof.	-4,562	-1,540	4,157	6,267	7,536	13,956
Communic.	-276	225	1,271	1,620	1,831	2,895
Comp. Hard.	-1,116	-160	353	1,041	1,454	3,547
Comp. Soft.	-646	53	3,162	3,650	3,944	5,431
Construction	-5,889	-4,571	2,779	3,699	4,253	7,053
Defense/Aer.	-2,504	-1,693	-1,431	-1,079	-868	201
Enrgy & Env.	-320	-38	-23	174	292	890
Health Svc.	-3,706	-1,796	-936	217	911	4,421
Tourism	-4,396	-1,126	562	2,827	4,190	11,082

For Biomedical, a severe recession scenario where total state employment declines 2.87 percent in a single year suggests County Biomedical industry cluster employment would decrease by 1,185 jobs over the same single-year period. In a moderate contraction scenario where statewide employment decreases 0.67 percent, the model suggests local employment in the Biomedical cluster would decline by 504 jobs. The remaining scenarios should be interpreted in a similar manner, reading across columns for each row identifying an industry cluster.

Two-Year Macro Effects Model

The two-year macro effects model is interpreted in the same manner, but each output cell in yellow now represents a change in cluster employment over a two-year period, given the assumed scenario indicated by the column. Cells A51 through P80 comprise the two-year model. Results for the two-year outlooks based on the 2000 employment data are provided in the table below.

Two-Year Employment Outlooks for Six Economic Scenarios

	Severe Recession (-2.40%)	Moderate Contraction (-0.46%)	Economic Slowdown (+0.10%)	Sustainable Expansion 1 (+2.21%)	Sustainable Expansion 2 (+2.51%)	Inflationary Growth (+6.28%)
Biomedical	-1,965	-884	-572	633	807	3,029
Bus. & Prof.	-7,758	-2,475	7,296	13,186	14,037	24,898
Communic.	-326	550	2,373	3,349	3,490	5,290
Comp. Hard.	-1,845	-123	374	2,294	2,571	6,111
Comp. Soft.	-977	247	6,088	7,452	7,649	10,164
Construction	-11,182	-8,878	5,114	7,683	8,054	12,791
Defense/Aer.	-4,165	-3,285	-3,031	-2,050	-1,909	-100
Enrgy & Env.	-513	-21	-140	408	487	1,499
Health Svc.	-6,150	-3,262	-2,428	792	1,256	7,195
Tourism	-7,275	-1,603	32	6,355	7,268	18,929

Assuming an inflationary growth scenario over two years, where state employment increases 6.28 percent annually, Orange County employment in the Business and Professions cluster would be expected to increase by 24,898 jobs over the two-year period. Therefore, the model estimates average increases in Business and Professions employment of 12,449 in each of the two years, given the inflationary growth scenario. For the second sustainable expansion scenario of +2.51 percent annual statewide growth, the model projects annual average increases of 7,019 jobs in each of the two years for Business and Professions employment for a total increase of 14,037 over the two-year period.

Five-Year Macro Effects Model

The five-year model is included in cells A84 through P113. The table below presents results of the five-year macro effects model as a five-year difference from the 2000 employment level.

Five-Year Employment Outlooks for Six Economic Scenarios

	Severe Recession (-0.59%)	Moderate Contraction (+1.82%)	Economic Slowdown (+1.94%)	Sustainable Expansion 1 (+2.25%)	Sustainable Expansion 2 (+3.07%)	Inflationary Growth (+4.70%)
Biomedical	-2,394	1,090	1,284	1,751	3,039	5,716
Bus. & Prof.	-7,089	9,944	31,508	33,790	40,085	53,174
Communic.	1,224	4,048	8,131	8,509	9,553	11,722
Comp. Hard.	-600	4,951	5,259	6,003	8,055	12,321
Comp. Soft.	408	4,352	18,292	18,821	20,278	23,309
Construction	-22,588	-15,159	18,571	19,566	22,312	28,021
Defense/Aer.	-8,362	-5,526	-5,368	-4,988	-3,940	-1,760
Enrgy & Env.	-135	1,450	884	1,097	1,683	2,902
Health Svc.	-8,647	665	1,182	2,429	5,871	13,027
Tourism	-4,977	13,308	14,323	16,773	23,531	37,583

As illustrated in these tables, the macroeconomic effects models demonstrate the sensitivity of each industry cluster to the state economic cycle. An assessment of which of the economic scenarios represent future state employment is therefore extremely important when the model is used for planning purposes. The occupations forecast model that is explained below requires the user to select a scenario.

Multiplier Effects Model

The multiplier effects model permits analysis of how changes in one industry cluster impact changes in every other industry cluster and total employment in Orange County. Stated simply, the model estimates the ripple effects of a sudden change in revenue (final demand) in the affected industry cluster on subsequent revenues for the other nine industry clusters and all other sectors of the economy. The multiplier effects model is derived from an input-output analysis of Orange County's industry and other institution transactions that models the 10 industry clusters examined in the macroeconomic effects models in addition to other County economic activity. In short, the input-output analysis summarized the patterns of trade in Orange County using inter-industry employment multipliers.

Methods

Employment multipliers used in this model were derived using Minnesota IMPLAN Group's software, model, and data for Orange County. IMPLAN Group's products facilitated the estimation of a Social Accounts Matrix (SAM) for Orange County that was used to derive technical coefficients of production, outputs per worker, and Type SAM employment multipliers that estimate effects between industry clusters and from one industry cluster to the entire Orange County employment base.

The Social Accounts Matrix method permits the inclusion of non-industrial yet important transactions that influence final demand. In addition to modeling all purchases, both imported and exported goods and services, the SAM method includes tax collection by governments and transfer payments to businesses and households, transactions that are omitted in other methods. The SAM method incorporates the flow of money between such institutions. After considering these desirable qualities, we concluded that the SAM method for deriving employment multipliers for the EWS would be the most appropriate.

The multipliers that estimate employment impacts in the multiplier effects model are derived from the Type SAM method. Type SAM multipliers are typically smaller than standard Type II multipliers due to leakages not accounted for in other transaction matrices. Type SAM multipliers capture more inter-institutional transfers than the Type II method, using all social accounting matrix information from households, businesses, government, and other institutions as well.

The multiplier effects model captures direct, indirect, and induced effects on employment in one industry cluster caused by a change in final demand in another. Direct effects are simply the change in the industry cluster you hypothesize in the input to the model. For example, if you predict the Biomedical industry cluster will experience an immediate increase in employment of one percent, you would expect to see an addition of jobs appear as an effect for Biomedical employment corresponding to a one-percent job increase for Biomedical employment in the input column that is more than one-percent greater than the last historical value. The hypothesized change in the input column that also appears in the corresponding output cell is the direct multiplier effect. A one-percent independent increase in Biomedical employment predicts a 285.9 job increase to Biomedical employment. One percent of the 28,216 Biomedical jobs reported for 2000 in cell C4 equals 282.2, the direct effect.

In addition to direct impacts, the multiplier effects model predicts changes due to indirect and induced effects. Indirect multipliers measure the interaction between industries as they provide intermediate goods and services to one another. Any two industries have a supplier / consumer relationship. For example, the Business and Professional Services industry cluster purchases equipment and services from the Communications cluster, such as telephone, broad-band computing connectivity, etc. Reciprocally in this example, the Communications industry cluster purchases services from the Business and Professional Services cluster, such as legal and accounting services. Although transactions are not always reciprocal, and rarely equivalent, input-output analysis permits the estimation of these inter-industry exchanges. A change in revenue or employment can also stimulate economic activity within an industry as well affect the revenue or employment of another. For the affected industry, the indirect multiplier estimates the additional response of firms within the same industry to the initial employment change. For all industries linked to the affected industry, the indirect multiplier captures the response of firms in each associated industry to the initial employment change in the affected industry.

Induced effects multipliers account for alterations in household spending caused by direct changes in the patterns of trade. For example, an increase in County Computer Hardware and Electronics cluster employment translates directly to an increase in personal income for County households. Some of that additional money might be spent on Health Services, thus an induced multiplier effect. Similarly, a decline of employment in the Health Services industry cluster means less total County personal income. Less money then might be spent on Health Services, which has its own induced multiplier effect. The multiplier effects model adds the direct, indirect, and induced effects to portray a complete picture of what might be expected to occur if any of the 10 industry clusters encounters a sudden shock to employment or revenue.

As the example in the previous paragraph suggests, the multiplier effects model is designed to estimate impacts from negative as well as positive changes in industry cluster final demand. The multipliers are symmetric, meaning that they simply assume a positive or negative sign, depending on whether the input value is an increase or decrease, respectively, from the current state of the industry cluster. Therefore, the

model can be used to estimate the effects from the pessimistic of predictions to the optimistic.

The multiplier effects model uses the information updated for the macroeconomic effects models but analysis can be performed independently. The model can be used to hypothesize a sudden impact, or shock, to one or more local industry clusters that is expected to occur beyond macroeconomic influences. The user simply enters a hypothesized percent change to one or more clusters and examines how the other clusters and total Orange County employment are affected. Uses of this model and its interpretations are discussed below.

Updating the Multiplier Effects Model

The multiplier effects model assumes that the macroeconomic effects models have been updated with the most current employment data available for the 10 industry clusters. If you possess recent EDD data for the clusters, be sure to update the macroeconomic effects models before conducting a multiplier effects analysis. The workbook should be saved each time the macroeconomic effects models are updated, but it is not necessary to save changes to the input column for the multiplier effects model. The multiplier model is designed to allow the user to quickly input assumptions and easily interpret results.

The multiplier effects model is located in cells A117 through F144 of the Input and Output Master Sheet. The outputs in column E are estimated changes in employment for each cluster identified by a corresponding row indicating the industry cluster. The inputs in column C attribute a hypothesized percent change in total output or employment to the corresponding row cluster. The input percent changes can be interpreted either as a change in total revenue for the cluster or a change in employment because the input-output analysis that estimates the multipliers employs constant outputs per worker. Thus, a dollar change in a cluster divided by its output per worker yields an employment change and an employment change for a cluster multiplied by its output per worker yields a dollar change. The multiplier effects model therefore has the desirable characteristic of allowing a user to conceive sudden changes in a particular cluster in either dollar or employment terms.

The multiplier model is designed to assess a single hypothesized impact independently or estimate effects from changes in two or more industry clusters simultaneously. To assess the impact of a percent change in revenue or employment in one or more industry clusters, simply enter a positive or negative percent change for the cluster you wish to shock in the % change input cells C122 through C140. Be sure that 0.00% is entered in each input cell for an industry you don't wish to impact. The column values to the right of the input percent change will automatically update. The user should not make edits to cells other than those in the input column C. For assessing independent impacts, set all row industry clusters equal to 0.00% except for the one you wish to shock.

Interpreting the Multiplier Effects Model

Each yellow output cell in column E identifies an estimated change in the employment level for the corresponding cluster in rows 122 through 140 due to one or more nonzero white input cells in column C containing a hypothesized percent change corresponding to the affected row cluster. When analyzing effects independently, the employment changes are largest in the yellow output cell on the row where the white input cell for the affected row industry cluster is not zero. This is because the multiplier model incorporates direct effects, as well as indirect and induced effects, into the estimates. The shocked row cluster receives the direct effect. The table below demonstrates the estimated employment changes to each of the 10 clusters caused by a one-percent increase in Biomedical industry cluster final demand.

	A	C	E
		Input % Change	Change in Cluster Employment
122	Biomedical	1.00%	285.9
124	Business and Professional Services	0.00%	63.2
126	Communications	0.00%	1.7
128	Computer Hardware and Electronics	0.00%	9.8
130	Computer Software	0.00%	11.0
132	Construction	0.00%	7.6
134	Defense/Aerospace	0.00%	0.1
136	Energy and Environment	0.00%	0.5
138	Health Services	0.00%	22.3
140	Tourism	0.00%	29.6
143	Total Change in Orange County Employment		600.8

In the example above, a one-percent increase in total output in the Biomedical industry cluster results in an estimated 285.9 jobs gained in the Biomedical cluster. As mentioned above, 282.2 of this change is hypothesized as the direct effect input in cell C122. Therefore, the model predicts an additional 3.7 job increase due to indirect and induced effects within the Biomedical industry cluster. An additional 63.2 jobs would be expected in the Business and Professional Services cluster due to the one percent hypothesized increase in Biomedical activity. The model predicts a one-percent immediate increase in Biomedical employment would cause an increase of 1.7 jobs in the Communications cluster.

The table above illustrates the independent effects of a one percent increase in the Biomedical cluster. The data in column E are interpreted as an estimated change in employment for the particular industry cluster corresponding to a hypothesized change in employment or final demand input as a nonzero value in column C, in this case, a one percent increase in Biomedical.

When the model includes two or more direct effects, the employment change can be interpreted as resulting from the multiple combinations of indirect and induced effects caused by each shocked industry cluster and the direct effects for each cluster row with a nonzero white input cell in column C. The table below demonstrates how the model can assess multiple shocks to two or more clusters simultaneously.

	A	C	E
		Input % Change	Change in Cluster Employment
122	Biomedical	-1.00%	-293.7
124	Business and Professional Services	-1.00%	-2,062.4
126	Communications	-1.00%	-269.9
128	Computer Hardware and Electronics	-1.00%	-602.3
130	Computer Software	-1.00%	-454.2
132	Construction	-1.00%	-717.0
134	Defense/Aerospace	-1.00%	-230.6
136	Energy and Environment	-1.00%	-140.6
138	Health Services	-1.00%	-1,108.4
140	Tourism	-1.00%	-1,975.3
143	Total Change in Orange County Employment		-10,219.3

The table above shows the results of the multiplier effects model, assuming a one-percent decline in employment or revenue in each of the 10 industry clusters. Each yellow output cell in column E must now be interpreted as the effect of all 10 simultaneous shocks. Therefore the 1,975.3 jobs predicted to be lost in Tourism in cell E140 is the result of a one-percent decline in all 10 clusters. One percent of the decline, or 1,480.6 of this job loss, is due to the direct effect of the one-percent hypothesized decline for the Tourism cluster. The remaining loss of 494.7 tourism jobs must be attributed to the combination of all indirect and induced effects from changes hypothesized for the 10 industry clusters.

As the above example demonstrates, the multiplier effects model estimates impacts from negative as well as positive changes in the input column. To evaluate a negative cluster impact, simply enter a negative sign before the percent change in cells C122 through C140. Furthermore, the model can take as inputs any combination of negative and positive shocks and will return the simultaneous effects. The table below demonstrates this desirable quality.

	A	C	E
		Input % Change	Change in Cluster Employment
122	Biomedical	1.00%	286.1
124	Business and Professional Services	1.00%	1,538.3
126	Communications	1.00%	250.3
128	Computer Hardware and Electronics	1.00%	548.9
130	Computer Software	1.00%	372.5
132	Construction	-1.00%	-574.4
134	Defense/Aerospace	-1.00%	-229.4
136	Energy and Environment	-1.00%	-132.8
138	Health Services	-1.00%	-701.2
140	Tourism	-1.00%	-1,440.1
143	Total Change in Orange County Employment		215.5

The example above illustrates how positive and negative effects offset one another in the net cluster impact calculations. While the peculiar hypothesis of five increasing and five decreasing clusters results in an expected loss of 574.7 jobs in the Construction industry cluster, the percent change is less than the one-percent decline direct effect assumed for Construction in the scenario, a –601.6 direct effect. Furthermore, the simultaneous shocks result in an expected net gain of 215.5 jobs to total Orange County employment.

The total change in Orange County employment in row 143 employs the total employment multiplier for each industry cluster to estimate the overall County employment effect. The total employment multipliers account for every other industry in the County in addition to the 10 industry clusters examined elsewhere in the analysis. Therefore, the total change in Orange County employment is the estimated change in the number of jobs throughout the county due to all hypothesized employment or final demand assumptions input in cells C122 through C140.

One application of the multiplier effects model might be to assume a significant decline in revenue from tourism due to a national recession or a tragic event such as the one that occurred on September 11. The model requires only an assumption about the magnitude of the revenue or employment change in terms of a percent difference.

Occupations Forecast Model

The occupations forecast model projects changes in industry cluster employment for 165 occupations based upon the results from the macroeconomic effects and multiplier effects models. Therefore, the model requires the user to enter the most recent cluster employment data into cells C4 through C13 and enter assumptions about impacts to

one or more industry cluster in cells C122 through C140 before interpreting effects on occupations.

The occupations forecast model resides on a separate worksheet titled “Occupations Forecast” in the Excel workbook. The name of each occupation is located in column A and column E relates the projected change in Orange County occupational employment based on the estimated change in employment for the industry cluster. Occupation titles span cells A14 through A371 and are grouped under their corresponding cluster name. Occupations in the Biomedical industry cluster begin on row 14. The Business and Professional Services occupations begin on row 53. Occupations in the Communications and Computer Hardware and Electronics clusters begin on rows 98 and 137, respectively. Computer Software occupations can be found between rows 172 and 204. Occupations in the Construction and Aerospace/Defense industry clusters begin on rows 207 and 238, respectively. Energy and Environment occupations can be found after row 277. Health Services and Tourism occupations begin in rows 308 and 345, respectively.

The table below lists the occupations for which estimates are available with their corresponding industry cluster.

Industry Cluster	Occupation Title
Biomedical	Assembler, Fabricators--Ex Machinery ,Electric
	Biological Scientists
	Chemical Technicians
	Chemists
	Elect And Electronic Engineers
	Electrical Equip Assemblers--Precision
	Electromechanical Equip Assemblers--Precision
	Engineer, Math, And Nat Science Managers
	First-Line Sup/Manager-Production
	General Managers, Top Executives
	Mach Builder, Other Precision Machine Assembler
	Marketing, Advertising, Pub-Relation Managers
	Medical, Clinical Lab Technologists
	Optical Goods Workers
	Physical Scientists
	Product Inspectors, Testers, Graders
	Quality Assurance Auditors
	Sales Reps, Scientific--Ex Retail

Industry Cluster	Occupation Title
Business and Professional Services	Accountants and Auditors Accounting Clerks Administrative Services Managers Bill and account collectors Drafters / CAD Employment Interviewers Financial Managers First-line sup/mgr--clerl,adm sup Freight, material movers-hand, nec General managers, top executives Guards and watch guards Hand packers and packagers Hand workers, nec Legal Secretaries Material recording, related, nec Other prof, paraprof, technical Paralegal Personnel Receptionists, information clerks Sales Agents Systems Analysts Telemarketers and Solicitors
Communications	Communications Systems Engineers Digital and Hardware Engineers Electrical and Electronic Assemblers Electrical and Electronic Technicians Field Engineers First-Line Sup/Managers--Clerical, Administrative Support Frame Wirers, Central Office Freight, Material Movers-Hand, NEC Managers And Administrators, NEC Marketing, Advertising, Pub-Relations Managers Other Professionals, Paraprofessionals, Technical Prod. Inspectors, Testers, and Graders Sales Agents—Selected Bus Services Sales And Related Workers, NEC Service Representatives Software Engineers Systems Analysts--Electronic Data Processor Telephone, Cable TV Installers

Industry Cluster	Occupation Title
Computer Hardware and Electronics	ASIC Engineers Assembler, Fabricators--Ex Machinery ,Electric Computer Engineers Computer Scientists, Related Workers, NEC Elect And Electronic Engineers Elect, Electronic Engineering Tech Electrical Technicians Electrical Technologists Electrical, Electronic Assemblers Electronic Semiconductor Processor Engraving, Printing Workers--Hand Facility or Quality Control Manager General Managers, Top Executives Sales Engineers Sales Representatives Systems Analysts--Electronic Data Processing
Computer Software	Computer Engineers Computer Programmers Computer Scientists, Related Workers, NEC Computer Support Specialists Data Base Administrators Data Entry Keyers Engineer, Math, And Nat Science Managers First-Line Sup/Manager--Clerical, Administrative Support General Managers, Top Executives Inspectors, Testers, and QA Auditors Network Systems Administrators Other Professional, Paraprofessional, Technical Project Managers Sales Representatives Systems Analysts--Electronic Data Processing Technical Writers

Industry Cluster	Occupation Title
Construction	Carpenters Cement Masons Construction Managers Drywall Installers Electricians First-Line Supervisor/Managers-Construction General Managers, Top Executives Heating, Ac, Refrigerator Mechanics Laborers, Landscaping/Grounds-keeping Operating Engineers or Con. Machine Operators Painters, Paperhangers--Construction Plasterers And Stucco Masons Plumbers, Pipe-fitters, Steam-fitter Roofers
Defense/Aerospace	Aeronaut, Astronautical Engineers Assemblers, Fabricators--Ex Machinery, Electrical Computer Engineers / Programmers Electrical and Electronic Assemblers Electrical and Electronic Engineers Engineer, Math, And Nat Science Managers Engineering Technicians Engineering, Related Techs, NEC General Maintenance Repairers General Managers, Top Executives Hand Workers, NEC Industrial Production Managers Inspectors and Testers Machinists Mechanical Engineers Misc. Helpers, Laborers--Hand, NEC Sheet Metal Mechanics / Welders Systems Analysts--Electronic Data Processor

Industry Cluster	Occupation Title
Energy and Environment	Adjustment clerks Assembler, fabricators--ex machine, electrical Electric and Electronic Engineers Electrical equip assemblers--precision Electromechanical equipment assemblers--precision Environmental & Health Analysts First-line sup/manager-production General managers, top executives Instrumentation / Calibration Technicians Numerical mach tool ops--metal, plastic Optical goods workers, precision Refuse Collectors Sales reps, scientific--ex retail Truck drivers, heavy
Health Services	Certified Home Health Aides Certified Nursing Aides Dental Assistants Dental Hygienists General Office Clerks Health Care Profs, Paraprofs, Nec Licensed Vocational Nurses Medical Assistants Medicine, Health Services Mgrs Non-Certified Home Health Aides Nurse Aides, Orderlies, Attendants Occupational Therapists Physical Therapy Assistants Physicians And Surgeons Radiology Technologists Registered Nurses Respiratory Care Practitioners

Industry Cluster	Occupation Title
Tourism	Amusement, recreation attendants
	Bartenders
	Cashiers
	Combined food prep and service
	Cooks--restaurant
	Cooks--specialty fast food
	First-line sup/managers service workers, NEC
	Food preparation workers
	Food Service & Lodging Manager
	Guards / Watch Guards
	Hosts, hostesses--restaurants
	Maids and housekeeping cleaners
	Waiters and waitresses

Methods

The occupations forecast model combines data from the employer survey commissioned by the Orange County Workforce Investment Board with occupation data available through the EDD. Godbe Research and Analysis surveyed firms in the 10 industry clusters with 50 or more employees and provided the percentage of cluster employment in 89 occupations.

The Godbe survey findings were complemented with the EDD's 1999 employment data for the fastest growing Orange County occupations. These data are available at http://www.calmis.ca.gov/file/occproj/Oranf&g.htm. The EDD data increased the coverage to include 76 additional occupations. The percentage of cluster employment was calculated by dividing total County employment in each occupation by total employment in the cluster. The Godbe survey and the EDD source reported different employment proportions for 24 occupation titles. Where occupations were redundant between the two sources, the EDD data were employed in the model. Because the Godbe survey included only firms with 50 or more employees, we expect the EDD data to be more representative of the full Orange County economy when there are two available sources.

The occupations forecast model multiplies the percentage of cluster employment for each occupation by the employment in the corresponding industry cluster estimated by the macroeconomic effects and multiplier effects models. The model requires the user to select a macroeconomic scenario that he or she believes most appropriate for current conditions. Furthermore, any nonzero values in cells C122 through C140 of the Input and Output Master sheet will be accounted for in the occupations estimates. In short, the occupations forecast model adds the results of the macroeconomic effects model for a selected scenario to the results of the multiplier effects model from input shocks, and then multiplies each cluster employment estimate to the percentage of occupational

employment in the cluster. The process yields estimates of employment in key occupations given the user's assumptions in the prior two models.

Updating the Occupations Forecast Model

Although the occupations forecast model assumes that the historical data above the macroeconomic effects models have been updated and inputs to the multiplier effects models have been specified, this model requires only that the user specify a macroeconomic scenario. Simply click on the drop down window in cell B5 of the "Occupations Forecast" worksheet, scroll down, and select an appropriate scenario. Estimates of occupational employment will automatically update per the selected scenario.

The model can be used with or without impacts specified as inputs to the multiplier effects model. To examine the occupational breakdown attributable to only the selected macroeconomic scenario, without a local shock, be sure that all input values in cells C122 through C140 in the Input and Output Master Sheet are set equal to 0.00%. Otherwise, any combination of direct impacts to one or more industry clusters may be specified to assess the effects on occupational employment. The models have been designed to work interactively so the user can make changes to any of the white input cells at any time.

Interpreting the Occupations Forecast Model

The user should interpret the yellow cells in column E of the occupations forecast model as the change in the number of jobs for each occupation attributable to the scenario selected and the assumptions about local impacts made in the multiplier effects model. Each job change is relevant only to the particular cluster and therefore does not represent a total change in occupational employment for Orange County.

The table below demonstrates the interpretation of estimated occupational employment changes in the Tourism cluster, given the first sustainable expansion scenario of two percent statewide employment growth and assuming an immediate one-percent increase in local Tourism employment.

	A	C	E
		Input % Change	Change in Cluster Employment
122	Biomedical	0.00%	0.5
124	Business and Professional Services	0.00%	58.0
126	Communications	0.00%	1.9
128	Computer Hardware and Electronics	0.00%	1.3
130	Computer Software	0.00%	8.5
132	Construction	0.00%	10.1
134	Defense/Aerospace	0.00%	0.0
136	Energy and Environment	0.00%	0.7
138	Health Services	0.00%	33.3
140	Tourism	1.00%	1,567.7
143	Total Change in Orange County Employment		1,907.5

The table above demonstrates what the multiplier effects model in the Input and Output Master Sheet would look like for an immediate one-percent increase to local tourism revenue or employment. The table below displays the selected scenario at the top of the Occupations Forecast sheet.

	B	C	D	E
	Forecast Scenario			
5	Sustainable Expansion 1			
6				
7				
8				
9	Annual change in CA employment			2.00%

The Annual change in CA employment in row nine indicates that the model is working properly. The value in cell E9 should equal the change in statewide employment hypothesized by the particular scenario. Because the first sustainable expansion scenario is based upon a one-year statewide employment growth of two percent, 2.00% appears in this cell. The table below demonstrates the output for Tourism occupations, given sustainable expansion 1 and a one-percent positive shock to the local Tourism cluster.

A	B	C	D	E
345	Tourism Occupations			
346				
347	Amusement, recreation attendants			110
349	Bartenders			30
351	Cashiers			148
353	Combined food prep and service			436
355	Cooks--restaurant			240
357	Cooks--specialty fast food			142
359	First-line sup/managers service workers, NEC			143
361	Food preparation workers			199
363	Food Service & Lodging Manager			29
365	Guards / Watch Guards			4
367	Hosts, hostesses--restaurants			136
369	Maids and housekeeping cleaners			121
371	Waiters and waitresses			584

In a sustainable expansion scenario where statewide employment increases two percent and with an immediate one-percent increase to local tourism, employment as amusement or recreation attendants in the Tourism cluster would be expected to increase by 110 jobs. Similarly, 30 new jobs as bartenders would be expected to become available under those conditions. The remaining occupations in the table above can be interpreted the same way.

The occupations forecast also works for declines in employment as hypothesized either by choosing one of the two contractions as a macroeconomic scenario, severe recession or moderate contraction, or by entering a negative shock as an input to the multiplier effects model.

Applications of the Early Warning System

This section provides four examples of Early Warning System uses. The examples demonstrate each of the three broad capabilities. The first hypothetical situation is an economic expansion in Asia that increases California's exports in all industries, but also has an immediate and disproportionately positive effect on local Orange County Computer Hardware and Electronics output and employment. The second scenario is an earthquake in southern California, which decreases tourism locally, but simultaneously increases construction activity in Orange County. Situation three involves an immediate and significant contraction in the local communications industry cluster caused by declining values of technological assets. Hypothetical scenario four is a significant expansion of a major amusement and entertainment venue in Orange County such as Disneyland.

Example One – Hypothetical Collapse of Asian Competition

In this hypothetical scenario, we assume that Asian economies grow faster than has been typical of the past few years, which results in higher demand for California exports. Additionally, in this scenario, the Orange County Computer Hardware and Electronics industry cluster benefits disproportionately from the Asian expansion, due to especially strong demand for components supplied by that Orange County cluster. The inputs that best reflect these events require user judgment. By consulting macroeconomic forecasts and industry experts, a user can determine a range of inputs that reflect the possible effects of these economic events. Here we show, for exposition purposes, an immediate one-percent increase in local Computer Hardware and Electronics employment coupled with an optimistic macroeconomic forecast, such as the 2.92 percent one-year increase in statewide employment suggested by the second state-level scenario. The tables below demonstrate how this situation would be input into the EWS models and the outputs that the models will generate.

One-Year Macro Effects Model

A		K
		Sustainable Expansion 2 (+2.92%)
24	Biomedical	509
26	Business and Professional Services	7,536
28	Communications	1,831
30	Computer Hardware and Electronics	1,454
32	Computer Software	3,944
34	Construction	4,253
36	Defense/Aerospace	-868
38	Energy and Environment	292
40	Health Services	911
42	Tourism	4,190

Multiplier Effects Model

A		C	E
		Input % Change	Change in Cluster Employment
122	Biomedical	0.00%	1.0
124	Business and Professional Services	0.00%	74.1
126	Communications	0.00%	3.1
128	Computer Hardware and Electronics	1.00%	528.7
130	Computer Software	0.00%	14.9
132	Construction	0.00%	16.8
134	Defense/Aerospace	0.00%	0.2
136	Energy and Environment	0.00%	1.2
138	Health Services	0.00%	46.1
140	Tourism	0.00%	58.8

143	Total Change in Orange County Employment	1,080.2

Occupations Forecast Model

	A	B	C	D	E
	Forecast Scenario				
5	Sustainable Expansion 2				
6					
7					
8					
9			Annual change in CA employment		2.92%
137	Computer Hardware & Electronics Occupations				
138					
139	ASIC Engineers				3
141	Assembler, Fabricators--Ex Machinery, Electric				88
143	Computer Engineers				56
145	Computer Scientists, Related Workers, NEC				18
147	Elect And Electronic Engineers				77
149	Elect, Electronic Engineering Tech				49
151	Electrical Technicians				24
153	Electrical Technologists				17
155	Electrical, Electronic Assemblers				88
157	Electronic Semiconductor Processor				34
159	Engraving, Printing Workers--Hand				6
161	Facility or Quality Control Manager				25
163	General Managers, Top Executives				66
165	Sales Engineers				34
167	Sales Representatives				73
169	Systems Analysts--Electronic Data Processing				31

Example Two – Hypothetical Earthquake in Southern California

The user might anticipate that an earthquake in southern California would deter tourism to the region. The Orange County construction industry cluster, however, would benefit from increased demand for its trade due the tragic event. The tables below demonstrate the estimates from the EWS models, given a 10 percent decline in regional tourism revenue and a five percent increase in Orange County construction employment.

The one-year macroeconomic effects model demonstrated in the first table below assumes an economic slowdown for statewide employment growth.

One-Year Macro Effects Model

	A	G
		Economic Slowdown (+0.47%)
24	Biomedical	-182
26	Business and Professional Services	4,157
28	Communications	1,271
30	Computer Hardware and Electronics	353
32	Computer Software	3,162
34	Construction	2,779
36	Defense/Aerospace	-1,431
38	Energy and Environment	-23
40	Health Services	-936
42	Tourism	562

Multiplier Effects Model

	A	C	E
		Input % Change	Change in Cluster Employment
122	Biomedical	0.00%	-2.5
124	Business and Professional Services	0.00%	-106.7
126	Communications	0.00%	-5.0
128	Computer Hardware and Electronics	0.00%	20.5
130	Computer Software	0.00%	-52.0
132	Construction	5.00%	2,943.0
134	Defense/Aerospace	0.00%	0.5
136	Energy and Environment	0.00%	1.0
138	Health Services	0.00%	-141.5
140	Tourism	-10.00%	-15,443.8
143	Total Change in Orange County Employment		-13,355.3

Occupations Forecast Model

	A	B	C	D	E
	Forecast Scenario				
5	Economic Slowdown				
6					
7					
8					
9			Annual change in CA employment		0.47%
207	Construction Occupations				
208					
209	Carpenters				295
211	Cement Masons				109
213	Construction Managers				170
215	Drywall Installers				127
217	Electricians				293
219	First-Line Supervisor/Managers-Construction				145
221	General Managers, Top Executives				186
223	Heating, Ac, Refrigerator Mechanics				143
225	Laborers, Landscaping/Grounds-keeping				137
227	Operating Engineers or Con. Machine Operators				162
229	Painters, Paperhangers--Construction				338
231	Plasterers And Stucco Masons				205
233	Plumbers, Pipe-fitters, Steam-fitter				223
235	Roofers				34
345	Tourism Occupations				
346					
347	Amusement, recreation attendants				-372
349	Bartenders				-101
351	Cashiers				-500
353	Combined food prep and service				-1,477
355	Cooks--restaurant				-814
357	Cooks--specialty fast food				-482
359	First-line sup/managers service workers, NEC				-484
361	Food preparation workers				-674
363	Food Service & Lodging Manager				-98
365	Guards / Watch Guards				-15
367	Hosts, hostesses--restaurants				-461
369	Maids and housekeeping cleaners				-409
371	Waiters and waitresses				-1,978

Example Three – Hypothetical Devaluation of Communications Technology Stocks

A significant decline in the values of stock in high-technology communications firms might convince one to predict that the Orange County communications cluster is particularly vulnerable. The user might assume that such an immediate event would

result in a two-percent negative shock to the multiplier effects model. The tables below demonstrate how such an analysis might be constructed.

Assuming two-percent statewide employment growth, one would select the first sustainable expansion scenario.

One-Year Macro Effects Model

	A	I
		Sustainable Expansion 1 (+2.00%)
24	Biomedical	250
26	Business and Professional Services	6,267
28	Communications	1,620
30	Computer Hardware and Electronics	1,041
32	Computer Software	3,650
34	Construction	3,699
36	Defense/Aerospace	-1,079
38	Energy and Environment	174
40	Health Services	217
42	Tourism	2,827

Multiplier Effects Model

	A	C	E
		Input % Change	Change in Cluster Employment
122	Biomedical	0.00%	-1.0
124	Business and Professional Services	0.00%	-129.6
126	Communications	-2.00%	-495.7
128	Computer Hardware and Electronics	0.00%	-45.5
130	Computer Software	0.00%	-34.5
132	Construction	0.00%	-54.5
134	Defense/Aerospace	0.00%	-0.4
136	Energy and Environment	0.00%	-1.6
138	Health Services	0.00%	-67.5
140	Tourism	0.00%	-103.4
143	Total Change in Orange County Employment		-1,388.2

Occupations Forecast Model

	A	B	C	D	E
	Forecast Scenario				
5	Sustainable Expansion 1				
6					
7					
8					
9			Annual change in CA employment		2.00%
98	Communications Occupations				
99					
100	Communications Systems Engineers				22
102	Digital and Hardware Engineers				14
104	Electrical and Electronic Assemblers				21
106	Electrical and Electronic Technicians				54
108	Field Engineers				21
110	First-Line Sup/Managers--Clerical, Admin Support				22
112	Frame Wirers, Central Office				4
114	Freight, Material Movers-Hand, NEC				6
116	Managers And Administrators, NEC				23
118	Marketing, Advertising, Pub-Relations Managers				19
120	Other Professionals, Paraprofessionals, Technical				22
122	Prod. Inspectors, Testers, and Graders				13
124	Sales Agents—Selected Bus Services				34
126	Sales And Related Workers, NEC				46
128	Service Representatives				70
130	Software Engineers				145
132	Systems Analysts--Electronic Data Processor				21
134	Telephone, Cable TV Installers				60

Example Four – Significant Disneyland Expansion in Orange County

Plans to build a new entertainment and amusement venue in Orange County or expand an existing one might include an estimate of increased employment in the local tourism cluster of one percent. The tables below demonstrate the output from such an assumption including an economic slowdown macroeconomic scenario of 0.47 percent one-year statewide employment growth.

One-Year Macro Effects Model

	A	G
		Economic Slowdown (+0.47%)
24	Biomedical	-182
26	Business and Professional Services	4,157
28	Communications	1,271
30	Computer Hardware and Electronics	353
32	Computer Software	3,162
34	Construction	2,779
36	Defense/Aerospace	-1,431
38	Energy and Environment	-23
40	Health Services	-936
42	Tourism	562

Multiplier Effects Model

	A	C	E
		Input % Change	Change in Cluster Employment
122	Biomedical	0.00%	0.5
124	Business and Professional Services	0.00%	58.0
126	Communications	0.00%	1.9
128	Computer Hardware and Electronics	0.00%	1.3
130	Computer Software	0.00%	8.5
132	Construction	0.00%	10.1
134	Defense/Aerospace	0.00%	0.0
136	Energy and Environment	0.00%	0.7
138	Health Services	0.00%	33.3
140	Tourism	1.00%	1,567.7
143	Total Change in Orange County Employment		1,907.5

Occupations Forecast Model

	A	B	C	D	E
	Forecast Scenario				
5	Economic Slowdown				
6					
7					
8					
9			Annual change in CA employment		0.47%
345	Tourism Occupations				
346					
347	Amusement, recreation attendants				53
349	Bartenders				14
351	Cashiers				72
353	Combined food prep and service				211
355	Cooks--restaurant				116
357	Cooks--specialty fast food				69
359	First-line sup/managers service workers, NEC				69
361	Food preparation workers				96
363	Food Service & Lodging Manager				14
365	Guards / Watch Guards				2
367	Hosts, hostesses--restaurants				66
369	Maids and housekeeping cleaners				58
371	Waiters and waitresses				283

The examples above merely demonstrate the capabilities of the EWS models and are not intended to provide assumptions if such an event does occur. The EWS requires the user to employ his or her judgment when making assumptions about the statewide macroeconomic effects and inputs to the multiplier effects model.

Conclusion

The Labor Force Early Warning System provides three broad capabilities. It permits the user to assess the effects of six statewide economic scenarios on Orange County employment in 10 industry clusters. It allows the user to input additional assumptions about one or particular clusters to examine their interdependencies and estimate impacts on the industry clusters and total Orange County employment. Finally, it converts the results of the first two models into employment by occupation so the user can assess the future training needs in the County.

The models require the user to make assumptions about the status of the statewide economy and about the expected impacts of unexpected events on particular industry clusters. The models assist the user in obtaining analytically defensible employment estimates, but cannot substitute for good analytical judgment that assesses trends and events in their momentary context.

Contact Information for Additional Assistance

If the user requires additional assistance in the use and/or interpretation of the Early Warning System models, he or she should contact Marlon G. Boarnet, who oversaw the development of this model for the OCBC and the Orange County Workforce Investment Board. Boarnet may be reached by e-mail at mboarnet@cox.net or by telephone at (949) 654-8633.