History of an Accountability Database, *Oregon Invests!*

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Introduction

This paper explains how *Oregon Invests!* got started in 1992 and its progress over the decade up to its debut on the World Wide Web in 2000. The first part of the story, up through 1994, is written by Thayne Dutson, then director of the Oregon Agricultural Experiment Station (now Dean of the College of Agricultural Sciences, Oregon State University). Dutson explains how the idea for *Oregon Invests!* came about and was developed into a useful communication tool. With this database that described most of the research projects of the station, he was able to demonstrate to the legislature, government agencies, commodity groups, and the interested public, what Oregon State University was doing for them in terms of agricultural research. The history goes on to explain the important addition of Extension Service programs in 1995-96 and new features that were added at each biennial update. We close with an explanation of what was involved in moving this important communication tool from a personal computer platform up to the web.

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1992: How *Oregon Invests!* helped the Oregon Agricultural Experiment Station describe contributions made by research

Thayne Dutson with Gwil Evans

Financially austere times challenge public agencies to prove their worth but, in the public sector, a commitment to accountability pays dividends whether the taxpayers are skeptical or enthusiastic in their support. In response to this challenge, the Oregon Agricultural Experiment Station developed a systematic, flexible, and accessible database tailored to communicating with key decision makers and general audiences. The information conveyed: the outcomes of almost 300 research projects in terms of actual and potential environmental, economic, and social consequences.

The unusually high quality of science being carried out by faculty and staff at Oregon State University is evident in the number and volume of research grants received, the number and excellence of graduate students who choose Oregon State, the qualifications of applicants who seek positions on the faculty, and peer recognition such as national awards and appointment to prestigious committees. Beyond these traditional indicators of scientific excellence, it is also clear that the Station is tangibly and directly contributing to the advancement of Oregon's major and diverse agricultural industry, to management of the state's natural resources, and to betterment of society in terms of health, welfare, and economic development.

Linking our research to people's lives

It is one thing to recite the Station's mission: To conduct research in the agricultural, biological, social, and environmental sciences for the economic, social and environmental benefit of Oregon. It is another to back that up by effectively communicating how that mission ties to local economies, jobs, food safety, the environment, and dozens of other matters of contemporary public interest and concern.

My predecessors invested thoughtfully in efforts to keep the Station's constituencies informed. The Station has for years published a quarterly magazine, Oregon's *Agricultural Progress*. The magazine is more colorful and attractive because of generous contributions of private funds from the Agricultural Research Foundation. Available to anyone, *Progress* is aggressively targeted for audiences not well acquainted with agriculture and natural resources research.

In addition, Station administration has published a biennial booklet, "What Have We Done for You Lately?" As its title suggests, this publication has not been bashful about extolling our contributions. Although the format is modest, publications in this series are well-designed, well-written, and attractively illustrated. Usually, numerous single-page articles describe the Station's work by telling the stories of the people (faculty and staff) who are responsible for the many contributions we make.

Continuing this anecdotal tradition, but seeking more systematic accounting than these publications offered, I enlisted help from colleagues in preparing a simple but illustrative summary of as many contributions of the Station as we could identify. The format of this *Balance Sheet* resembled an old-time bookkeeper's columnar pad intended as a metaphor for the concept of "investment and return on investment." We wanted to leave people with the thought that public investment in research can, and often does, provide identifiable and beneficial returns.

The Balance Sheet reinforced messages I hoped people would remember about the Station's work and paybacks. It provided helpful illustrations and a summary for legislators, congressional aides, and others.

Subjecting estimated paybacks to scrutiny

It was *The Balance Sheet* that first attracted the attention of David Ervin, then head of the OSU Department of Agricultural and Resource Economics, who asked me how I could be confident the estimated economic paybacks would hold up to scrutiny. Although I was confident the figures we were citing were the best estimates made by scientists closest to each project, they had not undergone the kind of systematic professional review Dave Ervin had in mind. For me, Ervin's question crystallized the necessary next steps in the evolution of our effort to be accountable: We should be certain the stated economic benefits meet commonly accepted standards, and we should strive for a consistent and comprehensive inventory of the contributions of *all* our projects.

A plan emerged to achieve this. I agreed to invest in a systematic inventory of our current projects. Review of the contributions of each project by agricultural economists would draw on a body of professional knowledge for evaluating research benefits. Mindful that our mission statement recognizes benefits from our

work are not only economic, we added environmental and social benefits to those we would catalog. My decision to gather comprehensive data and to subject it to professional scrutiny led directly to what we now call *Oregon Invests!* It brought consistency, balance, and perspective to an effort that, at its inception, was both informal and anecdotal. It was not without cost, however. Funds were required for gathering, analyzing, refining, and packaging the information, and each principal investigator (PI) took the time to describe his or her project in detail.

The next step: creating *Oregon Invests!*

In 1992, project economists Carole Nuckton and Bruce Bechtel worked closely with Ervin and other Agricultural and Resource Economics department faculty designing a questionnaire soliciting information from all Agricultural Experiment Station principal investigators.

The agricultural economists' work involved analysis of the PIs' reports of the potential economic, environmental, and social effects from their research, comparisons with other data sources, data entry, and comprehensive and systematic review by other agricultural economists.

The project team also began evaluating computer software applications suitable for storing and manipulating information that would provide ease and flexibility of presentation. The Department of Agricultural Communications recommended a flat-file database from Claris Corporation, *Filemaker Pro 2.0,* that offered both a user-friendly working environment and unusually versatile formatting capabilities for printed and on-screen display. In addition, *Filemaker Pro* is available for both IBM and Macintosh platforms and is network compatible.

When the 1992 database was complete, Nuckton and Bechtel provided it to Gwil Evans, director of communications and planning for the College of Agricultural Sciences. Evans, a close associate of mine and an experienced *Filemaker Pro* user, created on-screen layouts to display selected information in ways that would address the interests of legislative and other audiences. He created a "front-end" for *Oregon Invests!* that displays a standard opening screen, a series of subsequent screens, on-screen buttons, and dialog boxes that make it easy for even a naive user to find information of interest by making selections and clicking buttons. This user-friendly approach is evident in many dimensions of *Oregon Invests!* Projects may be called up, for example, by geographic area of the state; commodity; topic, such as water quality or cancer research; department; branch station. The database can also be sorted by selected criteria—for example, by date of project origination, or alphabetically by project title, PI's last names or their departments. A click on an icon of a printer delivers a hard copy of information about a particular project.

Recognizing constraints on the use of our information

Our experience with Oregon *Invests!* led us to recognize some constraints, particularly with respect to the economic estimates. For about one-third of the projects, the economists estimated the additional net income that agricultural producers or food processors were likely to receive as a result of adopting or otherwise implementing the results of OSU research. And they projected these estimates five years hence. Although one may infer that this additional net income

enjoyed by those immediately and directly benefiting from the research will ripple through the Oregon economy, my economist colleagues cautioned me about including such "multiplier effects" in *Oregon Invests!* They also cautioned me about aggregating these benefits, although our *Filemaker Pro* database makes it easy for us to sum them. Neither should we calculate a rate of return to Oregon's investment in research. Thus, it is my job to respect the character of the information supplied me, at the same time interpret it broadly and responsibly, in terms those to whom the Station is accountable can understand and use.

1994: Incorporating what we learned: updating *Oregon Invests!*

In 1994, to update projects in the existing database, delete terminated projects, and add new ones, we distributed a redesigned survey with several new questions to all PIs. To ease the review process, the questionnaires included a printed report of information already in the database about a particular project. Nuckton interpreted new and revised information, entered it into a new database, and later revised the reports in light of a review coordinated by Lu Eisgruber in the Department of Agricultural and Resource Economics.

The 1994 version of *Oregon Invests!* places greater emphasis on potential environmental and social consequences of the research projects. These expanded verbal descriptions of the noneconomic benefits offer an important new dimension to the database. When I search the "effects" fields, I am reminded how complex the effects of our research often are. Not surprisingly some projects with positive economic benefits carry negative effects for the environment. Other projects that benefit the environment may ultimately curtail economic activities. Having this information readily available enables me to illustrate for decision makers some of the policy issues and trade-offs evident from our findings.

A new feature is the project profile—a subjective ranking on scales of -3 to +3 for a project's environmental, economic, and social contributions. For example, a project that leads to reduced pesticide use may rank "+3" environmentally, "-1" economically (because increased monitoring adds to growers' costs), and "1" socially (because it reduces farmworker exposure to toxic chemicals). A zero in the profile means the benefits and costs in that category net to a meaningful zero; a blank means that there was no effect from the project in that category. Note that a project may score high in the economic category even though there are no direct economic benefits to Oregon agricultural producers—e.g., a project whose results lower health costs. (Details about these rankings are given in another PDF file, "Explaining the Project / Program Profile.")

Another addition tells how each project's results are disseminated to users. Entries report the use of many traditional research dissemination media, but also are testimony to imaginative and creative means our faculty employ to deliver information to people who can use it. Many projects include the important role of the Extension Service in conveying and applying research results. The display screen portraying dissemination methods for each project also shows how many students are actively involved in the work. This has proved to be a valuable asset in

demonstrating how research offers learning experiences for more than 700 of our graduate and undergraduate students.

Perhaps the most dramatic addition to the the 1994 database, at least from the viewpoint of our audiences, is digital movies of selected projects. Steve Dodrill, communications specialist and videographer with the Department of Agricultural Communications, created 15- to 20-second video clips portraying each of 76 projects. He then transferred these tightly edited synopses to a digital format playable in QuickTime™ and QuickTime for Windows™, the Apple computer standard multimedia format. FileMaker Pro for both Macintosh and IBM-compatible computers can display and play these digital movies as the content of any picture/sound data field.

Digital movies help personalize the information on *Oregon Invests!* and bring it to life. Most clips follow a common format: an individual, seen briefly on the screen, describes the essence of the project while related images are displayed. Those who describe our projects on camera include principal investigators, other senior faculty and research faculty, graduate students, and undergraduates. We had not fully anticipated the power of these brief video clips, but have discovered they are unusually effective at conveying personal conviction about the centrality and importance of the work being described. Without our prompting, our faculty and students passionately and eloquently express the relevance of their work, not only to the present, but for the welfare of future generations. Most audiences are at first surprised we have video clips; surprise becomes rapt attention to the colorful messages.

1995-6: Adding Extension programs to the *Oregon Invests!* database

In 1995, when Dutson became Dean of the College of Agricultural Sciences, his responsibilities broadened to include that part of the Extension Service related to agriculture. Realizing the considerable success of *Oregon Invests!* in explaining the value of experiment station research projects, he wanted a parallel database that would effectively describe outcomes of agricultural Extension education programs. Accordingly, a new questionnaire was designed and sent out to department heads and Extension county chairs to get reports on the work of Extension specialists and county agents. Some 50 program descriptions were added to *Oregon Invests!* at that time. The Extension database operates seamlessly with the research one. For example, someone searching for work on berries is able to examine both research projects and Extension education programs on that subject.

1998: Updating *Oregon Invests!* and making valuable additions

A change, for convenience, is that we began moving from making a grand effort at a biennial database update (i.e., after its initiation in 1992, the research database was updated in 1994, 1996, and 1998) to one of more continual attention. Because the actual reporting and data entry stretches out over an entire year and even into the following one, we began in 1998 to record the date and month that each project or program was added or updated. This will allow us to ask for an update about one month before its two-year anniversary in *Oregon Invests!* Of course, reports on new projects or programs are welcome at any time.

A valuable addition in 1998 was the citation of up to three publications most relevant to a project or program, including refereed journal articles, book chapters, conference proceedings, experiment station annual reports, commodity commission reports, and articles in trade journals or the popular press. These references will allow users of the database to find out more about a topic of interest.

Email addresses for principal investigators and lead Extension faculty are now recorded, as are web addresses for sites relevant to the work.

2000: *Oregon Invests!* moved to the World Wide Web

Even before the 1998 update, we began thinking about moving *Oregon Invests!* from the personal computer platform up to World Wide Web, thus making it much more available to all. Up to this point, the College was distributing individual copies of the *Oregon Invests!* database to department heads, station superintendents, and others. We realized that web access will solve the serious problem of users not having the latest version of the database. Now, on the web anyone searching the database for subjects of interest will be using the same version. This web access should open great possibilities for cross fertilization of research and Extension efforts as OSU and faculty around the planet learn what is being done about a particular problem.

Despite the tremendous advantages to having *Oregon Invests!* as a website, the move was certainly no simple matter to accomplish. It was not until August 1998 when, through Lew Nelson, a computer consultant for OSU, Gwil Evans met Yvonne Garcia and the dream became realizable. Yvonne, a free lance computer specialist and webmaster who specializes in information management systems (company name: Digital Diva) began working with Gwil in fall 1998. Below, Yvonne outlines what was and still is involved in transferring *Oregon Invests!* from its residence on personal computers to the World Wide Web.

What we wanted to do

• Create a central data storage of *Oregon Invests!* information so that all users and contributors have the same, and latest, version available.

• Maintain the user friendliness and the versatility of the database by:
~ Allowing access to the data through standard or customized paths,
~ Facilitating output of information online, in print, or by email.

• Allow contributors to submit new reports on their work or update reports already in the database.

• Maintain cross platform accessibility (i.e., Mac or PC).

What we needed to consider

• Limitations of the web to implement some features taken for granted in FileMaker:
~ Inability to navigate multi-record search results. That is, if Filemaker scripts are used to call up a number of records, only the first 25 are displayed and the “next”

button does not lead to the rest of the found records; therefore, these Filemaker scripts had to be replaced by another method of retrieval.

~ Inability to "lock" navigation while in process. That is, closing a window may interrupt a process. For example, when contributors are entering data, they must complete their entire report; they cannot close it and come back to it later.

• Security issues

A big leap was required from the database version of Oregon Invests! that needs just two security levels. That is, the Internet version's structure is much more open than FileMaker Pro's controlled interface. For example, on the Internet, when the web address is set to perform a find, a savvy user could change one word in the URL address field and delete the entire database. Barriers needed to be set up against such a possibility.

At the same time, a security system was needed that would allow (1) users to create a new record without having to login, (2) other users to submit edits to existing records (through a password), and (3) everyone to view the data without changing it.

• Complexity issues—the database becomes a system

What had existed as a single database is now an integrated system of web pages and multiple databases sharing information in one relational database. This has two different consequences on implementing changes:

~ Dynamic information needs to be changed frequently by the database managers, as, for example, when a report is updated or a contributor's email address changes. Dynamic information is now updated in one place and "pushed" through the system. Consistency is ensured by creating a central data storage for information that needs to be displayed in multiple places.

~ Static information is, for example, the language used on a form to solicit a response or to instruct users about how to proceed. Before now, such changes meant going to a layout or two to change the text; now changing even one word involves a half dozen different files, scripts, calculations, and layouts. But such changes do not occur often enough to justify the expense of creating a quick procedure.

• ADA and retro-technology accessibility

The American Disabilities Act meant that we could not necessarily use the latest and best technology available because of the consideration that vision-impaired persons may be using text-only browsers that read the content to them. Retro-technology accessibility meant that we needed to be sure that users didn't have to have the latest browsers in order to manipulate the features of the site. Both of these constraints eliminate our use of some fairly common web design tools (e.g., frames and java applications).

• Speed

Navigation must be quick and cannot require much narrative to get to the needed information. Fast access was a primary consideration in the website design. The top priority was given to search capabilities.

• The website becomes less personal
We realized that we no longer would be able to talk to every user about the context of *Oregon Invests!* Instead, the website has to provide quick access to information to users who already know what they are looking for, yet, at the same time, needs to have sufficient help available for a user unfamiliar with *Oregon Invests!* This was a big shift in that the pre-web versions of *Oregon Invests!* that existed only as a communication tool used in a context of persons very familiar with both the database and the information in it. Now, the information must stand on its own as a user interacts directly with the data, rather than with a person who is vested in *Oregon Invests!*

• Appropriate language
The language used in the database must serve to:
~Convey information to users,
~Solicit information from contributors,
~Address both research and Extension needs without becoming cumbersome.
And we must always try to simplify, rather than elaborate. Thus, a very large effort and time were spent on getting the language just right.

Hardware and software
FileMaker has proven to be a good solution for migrating *Oregon Invests!* to the Internet. FileMaker Pro 5.0 offers load balancing, so it should be able to handle future growth, and, because the information is not highly sensitive, the security is adequate. So far, we have been able to work around any sticky points, but it is possible that some day we may need better searching functionality or higher security measures. When needed, the current coding should translate easily into the coding language needed to move to Lasso or Tango.

• Setting up the servers
We were able to get *Oregon Invests!* running with only a small investment in hardware due to the great capabilities of relatively inexpensive entry level iMacs. We also added a combo hardware/software package (Kickoff) to restart the server if it crashes and a zip drive to allow for backups and file transfers.

• Setting up the software
The bare minimum is FileMaker Pro Unlimited for use as a web server. We also added other software to allow for better management and fewer interruptions:
~ Timbuktu Pro to allow for remote access via the Internet or direct dial up.
~ Okey Dokey Pro to dismiss dialog boxes so as not to hinder the performance of FileMaker Pro that would be 30% slower if it is not the foremost application.
~ Speed Double/Copy Agent to assist with backups.
[Note that this server/software setup may be changed in the future.]

• Redundancy/backups
Because the database is now updated randomly (i.e., new or revised information may be submitted whenever a contributor chooses), we must back up frequently in case new information has been submitted. Currently, *Oregon Invests!* is backed up four times a day into a folder architecture that allows for backup redundancy of at least 48 hours. That is, instead of simply writing over the previously backed-up files

with new ones, we keep multiple backup copies with the oldest backup copy going back 48 hours.

Preparing the database
Moving *Oregon Invests!* as it had developed over the last eight years involved quite a bit of restructuring. All field names needed to be single words. The user interface was redesigned and information about the contributors (phone number, email address, etc.), reformatted. The field content had to be standardized, e.g., the format for a contributor's name is now consistently last name, first name, middle initial—if there is one. Another example of required standardization is for functionality as in hotlinking the web url field (e.g., all urls reported must start with "http://" and be active sites). Also, the numerous layouts created for the incrementally developed databases had to be selectively cleaned up.

Going relational
Oregon Invests! moved from two single databases (flat files) to a system with 14 different databases working together to share information and functionality. So, now we have a relational database system. The main reasons for going relational are:

• The ability to store data in one place and have it appear throughout the database as needed (e.g., the email address to reach a database manager). As was mentioned earlier, this allows the data to be updated in one place and let it cascade through the system.

• The capability to, for security reasons, introduce databases specific for creating user accounts and setting access privileges.

• The capacity to allow contributors to submit edits without affecting the actual online *Oregon Invests!* We call this feature the Modification Bin (or ModBin for short). Another database "Requests" allows us to process users' email requests.

People considerations
The original purpose of *Oregon Invests!* was as a communication tool for the Dean (see earlier in this history). As the database developed, its uses expanded. For example, someone beginning a new research project could search to find other related work. Information could quickly be pulled together to create reports needed on a particular topic. And *Oregon Invests!* has been drawn upon annually to make reports to USDA for its Impact statements of Extension work.

In the mid-1990s, other states became interested in *Oregon Invests!* and began creating their own accountability databases, e.g., *Minnesota Impacts!, Oklahoma Dividends!, South Carolina Grows!* Gwil Evans was spending a lot of time in conference with them and others who wanted to use *Oregon Invests!* as a prototype. Thus, he designed and called for a hands-on workshop in October 1997 that was attended by people from 40 states. It was a valuable time of sharing.

Oregon Invests! is still first and foremost for the Dean's use. His presentations are somewhat complicated by needing web access. Currently, the data from the website has to be transferred back to his laptop so he can travel with the latest version.

Things on the web are different and complex enough to have required intense training sessions for the database managers, Gwil Evans and Carole Nuckton, plus continually addressing their questions that come up. They both now realize that a change that used to be simple, such as changing a field name, can "break" the system.

Contributors always have the hard copy option to enter new reports or update existing ones, and it's simple to print the forms from the website. Nevertheless, we want to encourage them to report directly the web. Some are enthused; others want to continue as they have in the past. Some departments are assigning a web savvy person to enter the information for faculty.

Feature creep

Like many projects in process, *Oregon Invests!* fell victim to "Feature creep." That is, as we worked with the database in its new environment, it became obvious how much more it was capable of offering, so the wish list of features grew. The end result is a website that is more feature-rich than originally imagined. At the same time, the budget (both of money and time) must be kept in mind. We are reaching a point where we have to pull back from the "wouldn't it be nice if it did this" requests and, instead, focus on finalizing what we already have.

Testing and rolling out the website

We did some preliminary testing of the website, asking people for feedback on what they liked and didn't like, what worked and didn't work, and what features they would like added. We sorted the ideas into categories: bug fixes, good ideas to implement right away, and "wouldn't it be nice."

Now we're ready to "market" our website. While we have talked it up in several OSU departments and units out in the state, we need to register with search sites and link up with web pages at OSU and elsewhere. In other words, we need to make it known that *Oregon Invests!* is on line as a resource for anyone in the world to use.