

Advancements in the Design of Online Establishment Surveys and Usability Considerations

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An Overview

Establishment surveys (i.e., Business surveys, Economic surveys, Organizational surveys):

- Attitudinal data (e.g., attitudes towards economic policy)
- Monitoring data (e.g., investments)
- **Factual data (e.g., date that business began)**

Factual/Complex Data

Often requires the use of records

- Expenditures
- Products/Services
- Revenue
- Payroll

Mismatch

Subjective

Objectives

- Leverage on how establishments maintain their records
- Improve efficiency
- Lessen cognitive burden
- Enhance user experience

Improved Data Quality!

Machine learning

What is machine learning?

Machine learning is a branch of artificial intelligence focused on building applications that learn from data and improve their accuracy over time without being programmed to do so.

- Algorithms are 'trained' to find patterns and features in massive amounts of data in order to make decisions and predictions based on new data.
- The better the algorithm, the more accurate the decisions and predictions

Source: [What is Machine Learning? | IBM](#)

Examples:

- Email Spam blockers
- Facial Recognition in social applications
- Self-driving cars

Usability

**Usability is defined as “the extent to which a product can be used by specified users to achieve specified goals, with effectiveness, efficiency, and satisfaction in a specified context of use”
(International Organization for Standardization, 1993c)**

Machine Learning and Usability

How may the incorporation of advanced features like machine learning impact usability/user experience?

An Example: Usability Evaluation 2022 Economic Census

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Economic Census

The Economic Census is a mandatory survey conducted by the Census Bureau every five years. The survey collects data electronically from nearly 4 million businesses (including large, medium and small companies representing all U.S. locations and industries) on a range of operational and performance questions. Data from the survey are used as the official five-year measure of American business and the economy.

Source: <https://www.census.gov/programs-surveys/economic-census.html>

Economic Census Survey

North American Industry Classification System (NAICS)

Principal Business or Activity (PBA)

Historically, the Census Bureau has assigned an establishment's NAICS code before deploying the corresponding Economic Census form

- Misalignment of the NAICS could lead to survey questions that are not applicable to the respondent

Machine Learning and the Economic Census

Utilize a "Search" functionality with machine learning that enables determination of the "correct" questionnaire path, in real time (i.e., "dynamically"), based on respondents' self-identification of their Principal Business or Activity (PBA)

Business Establishment Automated Classification of NAICS (BEACON)

- BEACON presents the NAICS codes/descriptions

Results are based on *relevance scores*, ranging from 0 to 100

Scores are not presented to respondents

PRINCIPAL BUSINESS OR ACTIVITY: SEARCH AND SELECT

Please select the principal business or activity that best describes your establishment from the results below. You can also try a new search.

Manufacturing

Select	Description	Code
<input type="radio"/>	Telephone Apparatus Manufacturing	334210
<input type="radio"/>	Electronics Stores	443142
<input type="radio"/>	Other Electronic Parts and Equipment Merchant Wholesalers	423690
<input type="radio"/>	Communication Equipment Repair and Maintenance	811213
<input type="radio"/>	All Other Personal Services	812990
<input type="radio"/>	Wired Telecommunications Carriers	
<input type="radio"/>	Telecommunications Resellers	
<input type="radio"/>	Other Miscellaneous Nondurable Goods Merchant Wholesalers	
<input type="radio"/>	Telephone Answering Services	
<input type="radio"/>	Advertising Material Distribution Services	
<input type="radio"/>	Directory and Mailing List Publishers	

None of the Above

Pre-listed PBAs are presented

Results are presented based on relevancy scores

If not applicable/pre-listed, respondents are able to enter a PBA description-machine learning functionality

Usability Highlights

- **Initially unaware of the search functionality embedded in the *Other* response write-in field**

“Oh, so we were searching, but the words didn't seem like it...”

- **Respondents appear to understand how the feature worked**
- **There was little motivation to generate a new search when results were not applicable**
- **Alternative searches warranted – e.g., by known NAICS code**
- **Similarly, some wanted to bypass the feature altogether and rely on past information**

An Example: Debriefing Evaluation 2018 Annual Capital Expenditures Survey (ACES)

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Annual Capital Expenditures Survey (ACES)

The ACES is a mandatory annual collection that gathers data on business investment for new and used structures and equipment. It is a sample survey of approximately 70,000 companies.

These data are critical to evaluate productivity growth, the ability of U.S. business to compete with foreign business, changes in industrial capacity, and measures of overall economic performance.

Source: <https://www.census.gov/programs-surveys/aces/about.html>

Machine Learning and ACES

“Other” specify item allows respondents to enter expenditures that are not pre-listed.

In the past, these expenditures were manually reviewed by subject matter analysts and reclassified as spending for structures or equipment or not applicable. For the 2016 survey cycle, the presence of a value in “Other” accounted for 30 percent of total edit failures.

In 2017, ACES incorporated a machine learning component which automatically codes the write-ins for reclassification based on a series of keywords.

Survey respondents are prompted (via a warning message) to re-classify an item for a given expenditure if the prediction for the write-in is either **“Structures”** or **“Equipment”** and the probability associated with that prediction is **80 percent or higher**.

Item 3 Other Capital Expenditures ?

Respondents are asked to report

Respondents itemize expenditures from the *Other* category

3a. Other NEW Capital Expenditures

List the item(s) included in 'Other' NEW capital expenditures in Column 3, Row 1 of Item 2. **THE GRAND TOTAL IN ROW 4 SHOULD EQUAL \$50,000.**
If you are including more than one item, list the capital expenditures for each item separately in Rows 1-3 below, if possible.

Important

- Report furniture, fixtures, computers, capitalized computer software, motor vehicles, and planes as EQUIPMENT.

Description of NEW Capital Expenditures

Item	Description	Value
1	<div style="border: 2px solid red; padding: 5px;"><p>⚠ This is considered an EQUIPMENT expenditure. Take the following 3 actions to make this correction: 1) BLANK OUT THE DESCRIPTION AND VALUE YOU'VE REPORTED HERE; 2) HIT THE PREVIOUS BUTTON BELOW TO RETURN TO ITEM 2; 3) MOVE THIS VALUE FROM "OTHER" IN COLUMN 3 TO "EQUIPMENT" IN COLUMN 2 OF ITEM 2.</p></div>	
	fixtures	
2	<div style="border: 2px solid red; padding: 5px;"><p>⚠ This is considered a STRUCTURE expenditure. Take the following 3 actions to make this correction: 1) BLANK OUT THE DESCRIPTION AND VALUE YOU'VE REPORTED HERE; 2) HIT THE PREVIOUS BUTTON BELOW TO RETURN TO ITEM 2; 3) MOVE THIS VALUE FROM "OTHER" IN COLUMN 3 TO "STRUCTURES" IN COLUMN 1 OF ITEM 2.</p></div>	
3	and Improvement	
4	TOTAL (Add Rows 1+2+3)	\$ 50,000

Demo: ACES Machine Learning Functionality

Item 3 Other Capital Expenditures

3a. Other NEW Capital Expenditures
List the item(s) included in 'Other' NEW capital expenditures in Column 3, Row 1 of Item 2. **THE GRAND TOTAL IN ROW 4 SHOULD EQUAL \$50,000.**
If you are including more than one item, list the capital expenditures for each item separately in Rows 1-3 below, if possible.

Important

- Report furniture, fixtures, computers, capitalized computer software, motor vehicles, and planes as EQUIPMENT.
- Report leasehold improvements as NEW STRUCTURES or NEW EQUIPMENT based on what is being improved.

Item	Description of NEW Capital Expenditures	Value (NEW)
1.	<input type="text"/>	\$ <input type="text"/> ,000
2.	<input type="text"/>	\$ <input type="text"/> ,000
3.	<input type="text"/>	\$ <input type="text"/> ,000
4.	TOTAL (Add Rows 1+2+3)	\$ <input type="text"/> ,000

3b. Other USED Capital Expenditures
List the item(s) included in 'Other' USED capital expenditures in Column 3, Row 2 of Item 2. **THE GRAND TOTAL IN ROW 4 SHOULD EQUAL \$0.**
If you are including more than one item, list the capital expenditures for each item separately in Rows 1-3 below, if possible.

Important

- Report furniture, fixtures, computers, capitalized computer software, motor vehicles, and planes as EQUIPMENT.

Item	Description of USED Capital Expenditures	Value (USED)
1.	<input type="text"/>	\$ <input type="text"/> ,000
2.	<input type="text"/>	\$ <input type="text"/> ,000
3.	<input type="text"/>	\$ <input type="text"/> ,000
4.	TOTAL (Add Rows 1+2+3)	\$ <input type="text"/> ,000

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Debriefing Highlights

- **Unclear how to report line items**

Separate lines?

Separated by comma?

- **Respondents appear to understand how the feature worked**
- **Error messaging lacked detail that would have been helpful in understanding the recategorization of expenditures**
- **Resolving errors is a multi-step process and respondents may be less likely to make all the needed corrections**
- **Machine learning functionality is unlikely to aid in recall for future classification of expenditures**
- **Respondents assume that Other expenditures not prompted by the machine learning functionality were valid**
- **Respondents prefer a confirmation versus auto re-classification of Other expenditures**

“the system can be wrong at times so I would still want to review the reclassification to make sure that it’s correct”

“Depends what the ramifications are for reporting incorrectly. But OK with saying yes or no, but I know I sign my name to the reports”

Benefits: Machine Learning

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Machine Learning in Survey Research

Primary benefits:

Reduction in staff workload

- Data processing

Customization of survey

Informs the respondent about criteria

Considerations for Usability

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Usability Considerations

- **Visibility/prominence of functionality**
- **Guidance on acceptable write-in responses**
 - Field size
 - Examples, other descriptors
- **Respondent needs/wants in search features**
 - Keywords, descriptors
 - Search by known information (e.g., NAICS code)
- **Non-applicable search results**
 - Generating a new search- motivation
 - Carryover of write-in responses
- **Delivering/presenting results**
 - Error message
 - Order
 - Conveying additional information (e.g., scoring)
- **Reconciling information**
 - Additional effort

Looking Forward

- **Auto-classification/categorization**

Criteria/threshold

- **Respondent confirmation/verification**

Could this lead to increased burden on the response process?

Thank you!

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