The Value of Information In Fire Management

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Research Questions

Government created lots of information websites and keep creating some websites every year.

For example: Weather Service, Forest Service, Fire Management etc. and both locally and nationally.

- **Part 1: Who use these website as information source?**
- Part 2: How do they use this information?
- Part 3: Is information valued and helpful?

This project will try to answer questions and We focus on "**Part 1**" information in fire management today

Part 1: Hypothesis

- H1: Managers who make more decisions will access more types of information.
- H2: Managers operating at the regional scale will access more information than other managers as the benefits of information can be applied over a wider area.
- H3: The agency and dispatch center will affect an individual manager’s use of information.

Literature

Value information

John (2002), Babcock (1990) Study the certain information is valued in production

David (2002) and Frisvold (2013) developed a utility model included acquisition of information for decision-makers in agricultural economy.

Literature

Characteristics in decision-making

David (2002) and Frisvold (2013) analyzed the types of information, characteristics of producers, and factors that distinguished between users and nonusers in production and marketing decisions.

Data

- Conducted a survey in southwest of united states (Arizona, New Mexico)
- From the initial pool of 485 individuals contacted, 477 respondents. Out of these, 236 returned the surveys, 206 fully completed questionnaires
- Included websites, education, age, experience, job titles, and dispatch centers.
- Incorporated dummy variables

Sample Data

Agency	Age	Experience	Role	Education	Dispatch
NewMexicoForestry Division	40-49	10-14	FireManager Fuels	somecollege	AZFDC
FWS	50-59	15-19	FireManager Suppression	collegeGraduate	AZPHC
Tribal	60+	20-29	other	Master	AZSDC
C1_NOAA		30+		Doc	NMADC
……	……	……		……	……
forest service	<40	0-5	admin	highschool	NMSWC

Model

Full model: $TotalSources = \beta 0 + \beta 1During + \beta 2Totaldecisions + \beta 3Agency + \beta 4Age + \beta 5Experience + \beta 6Role + \beta 7Education + \beta 8Dispatch + u$

Model 2: $TotalSources = \beta 0 + \beta 1During + \beta 2Totaldecisions + \beta 3Agency + \beta 4Age + \sout{\beta 5Experience} + \beta 6Role + \beta 7Education + \beta 8Dispatch + u$

Model 3: $TotalSources = \beta 0 + \beta 1During + \beta 2Totaldecisions + \beta 3Agency + \sout{\beta 4Age} + \beta 5Experience + \beta 6Role + \beta 7Education + \beta 8Dispatch + u$

Results-Agency

TotalSources	Full model	model 2	Model 3
During	1.334951** (0.57)	1.334951** (0.57)	1.334951** (0.57)
TotalDecisions	1.223951** (0.18)	1.189713** (0.17)	1.205682** (0.18)
C1_BLM	-1.733178* (0.97)	-1.415566 (0.97)	-1.544306 (0.96)
C1_BureauofIndianAffairs	2.098136** (1.06)	2.229264** (1.05)	1.825241* (1.03)
C1_NationalParkService	-1.801812 (1.52)	-1.496315 (1.52)	-1.680606 (1.52)
C1_ArizonaDepartmentofForestr	-6.610028** (1.53)	-6.056949** (1.47)	-6.844401** (1.48)
C1_NewMexicoForestryDivision	1.451292 (1.67)	1.501946 (1.68)	1.723376 (1.60)
FWS	-.2545894 (1.53)	0.1633852 (1.52)	-0.2365459 (1.53)
Tribal	-2.491801 (2.72)	-2.274836 (2.66)	-2.227384 (2.68)
C1_NOAA	5.399141* (2.81)	6.161855** (2.81)	5.359364* (2.81)
C1_ArizonaDepartmentofEnviron	2.971957 (3.78)	3.523559 (3.74)	3.867835 (3.74)

Forest service is nationally service which would use more than Arizona Dept.

NOAA and Bureau of Indian Affairs prefer more source due to different fields

Managers in larger agency are more likely to use more sources

Results-Age

TotalSources	Full model	model 2	Model 3
C3_4049	-1.90273* (1.02)	-2.417304** (0.93)	
C3_5059	-2.171218** (1.10)	-2.409925** (1.05)	
C3_60andmore	-1.029843 (1.53)	-0.6469399 (1.36)	

Younger fire managers who under 40 years old are more likely to use more information sources

Results-Experience

TotalSources	Full model	model 2	Model 3
C4_59years	-2.338481 (2.10)		-2.949944 (2.08)
C4_1014years	-2.019567 (1.89)		-2.445844 (1.87)
C4_1519years	.9160674 (1.78)		0.3508717 (1.75)
C4_2029years	-1.728447 (1.90)		-2.871398 (1.78)
C4_30andmoreyears	-.0931845 (2.05)		-0.9125113 (1.89)

Compared to fire managers with 0-5 years experience, the more experienced managers are, the fewer information sources they consult

Results-Role

TotalSources	Full model	model 2	Model 3
C5_FireManagerSuppression	2.56719 (1.91)	2.049891 (1.34)	2.593996 (1.90)
C5_Other	1.452083 (1.78)	1.524992 (0.82)	1.324755 (1.77)
C5_FireManagerFuelsandfire	1.72824 (1.85)	1.583369 (0.93)	1.636903 (1.83)

Fire managers directly involved in firefighting use more sources to support rational decision-making. Administrator may spend more time on management or routine tasks.

Results-Education

TotalSources	Full model	model 2	Model 3
C6_Somecollege	2.612383* (1.29)	2.187846* (2.03)	2.302699* (1.27)
C6_CollegeGraduate	1.286048 (1.27)	0.8496139 (1.01)	0.7682137 (1.23)
C6_MastersProfessionaldegree	2.361168 (1.48)	1.441917 (1.59)	2.045198 (1.47)
C6_Doctoraldegree	1.807206 (3.43)	-0.4221001 (0.53)	1.306295 (3.39)

With the base line “high school” diploma, ”Some College” fire managers utilize more information

Results-Dispatch

TotalSources	Full model	model 2	Model 3
AZFDC	-5.588611** (1.52)	-4.947224** (-3.68)	-5.903995** (1.49)
AZPHC	-6.289909** (1.73)	-5.591316** (-3.63)	-6.225574** (1.71)
AZPDC	1.42036 (1.57)	1.384367 (0.90)	1.326806 (1.57)
AZSDC	-1.766272 (1.68)	-1.524954 (-1.05)	-1.437104 (1.67)
AZTDC	-5.493876** (1.45)	-5.449177** (-3.80)	-5.608311** (1.42)
AZWDC	-6.337374** (2.29)	-5.864913** (-2.76)	-6.286325** (2.30)
NMADC	-4.608623** (1.46)	-3.937828** (-3.16)	-4.576478** (1.45)
NMABC	-.4158596 (1.53)	-0.6784957 (-0.27)	-0.1760413 (1.52)
NMSFC	-1.849996 (1.36)	-1.53275 (-1.36)	-1.758983 (1.36)
NMSDC	-3.551163** (1.41)	-3.411325** (-2.52)	-3.420394** (1.41)
NMTDC	-6.545602** (1.53)	-6.255294** (-4.28)	-6.366413* (1.53)
Other	-7.892644** (3.45)	-9.113957** (-2.29)	-7.435216** (3.44)

NMSWC serves as the baseline. All results in the full model are negative, and most are statistically significant at the 5% level.

Moreover, national dispatch centers access more information than those serving smaller regions.

Part 2: how to use

In our survey, we also asked questions to get “how many decision they will make” in dispatch centers during/after one fire season

Will these dispatch center:

Hire more managers

Allocate managers

Request more resource

Sent public notice

Others

……

Part 3: is the info valued or helpful

We try to predict

in which situations managers think they need more sources of information or additional training opportunities,

and which characteristics of managers are most associated with the belief that information is helpful for them

Sample Questions

- B3 How useful is WFDSS in documenting fire management decisions?
- B4 I rely on WFDSS extensively to inform my fire management decisions before I make them
- B5 I use WFDSS primarily to document decisions that have already been made, rather than information
- B6 WFDSS decisions are completed and entered into the system after the fact
- ……
- B13 How useful is WFDSS in aggregating data in a common location?

More details will come this summer

Value of Information

One may express the value of information V_i to an individual fire manager making a particular decision i as

$$V_i = \{b\,[x\,(\mathrm{s})] - \mathrm{b}\,(x_0)\}\,A - c(s, k, A)$$

where

A	= land area managed
b $[x\,(\boldsymbol{s}_i)]$	= benefits per unit land area given information
$b_0\,(x_0)$	= benefits per unit land area when information is not accessed
x_{i0}	= decision made when information is not accessed (for decisions i = 1, …n)
$x_i\,(s)$	= decision made given new information (for decisions i = 1, …n)
$\boldsymbol{s}_i$	= a vector of information sources accessed or the intensity of use from a given source to make decision i
c	= costs of processing information, include time costs
k	= index of knowledge or technical capacity

Value of Information

The fire manager may be making multiple decisions (i = 1, …n). Their optimization problem can be expressed in terms of using information sources to achieve the highest net benefit from decisions made subject to a cost constraint

$$\max \Sigma V_i \{b_i [k, \rho, \alpha, \delta, x(\mathbf{s}_i)] - b_i (k, \rho, a, x_{i0)}\} A - \Sigma c_i (\mathbf{s}_i, k, A, \rho, \alpha, \delta)$$
with respect to $\mathbf{s}_i$ for $i = 1, \ldots n$ decisions

ρ	= individual's job or role within the fire management system
α	= agency that the individual works for
δ	= dispatch center where the individual works