INFORMATION TECHNOLOGY

and the Work of Managing Fires

We asked **Tom Zimmerman**, recently retired head of U.S. Forest Service Wildland Fire Management RD&A, to help us understand how the many promises of information technology may support the work of firefighters and decision-making of fire managers and policy-makers. He reached out to several experts for this state-of-the-tech review, for 2013 and beyond.

With mapping tablets, web-enabled smartphones, satellite uplinks and real-time situational awareness tools, the future of fire intelligence is on the firelines now.

Wildland fire management complexity and risk continue to increase dramatically. As a result, fire sizes and duration are increasing each year and possible impacts, negative outcomes and potential losses are becoming more serious.

In order to keep pace with this situation, new developments are occurring in firefighting equipment, communication equipment, tactical responses and support capabilities. But information management is an area that can often be overlooked when focusing on operational activities. This area is undergoing such rapid shifts in importance and emerging technology that it cannot be discounted. In fact, information management is quickly affording important and useful opportunities that can benefit and improve wildland fire management in the future.

It has been reported that the growth rate of information is doubling every 18 months, nearly two-thirds of all information users have multiple computing platforms and the majority of any organization's data is inefficiently managed. Plus, the rate of technology change can at best be described as frenetic. Electronic technology processing speed, viewing size portability and overall utility are improving almost daily. Situational variables such as these, in combination with the need by fire managers to obtain real-time information as fast as possible and make potentially impactful decisions very quickly, are driving a need to improve information management capability.

Figure 1: Fire Behavior Analyst mapping and noting real-time fire behavior with his mobile tablet during a reconnaissance flight on the McGuire Complex, 2012.

communications with photos, detailed mapping and same-time data on fire activity, ultimately painting a more complete picture for all fire resources.

Currently, fire and aviation resources are relying heavily on the geospatial capabilities of mobile devices, the ease of completing administrative duties while in remote environments and taking advantage of increasing situational awareness with fingertip access to up-to-date weather information. The end result of this technology use is that more comprehensive information is available to make timely and appropriate management decisions and actions (Figure 1).

WHERE DO WE NEED TO GO — AND WHY?

What's new this coming fire season is the increased emphasis on collaborative, real-time information transfer in different mobile applications as well as some established standard operating procedures for use of mobile technologies on fire incidents. In parallel with that, more applications are being fine-tuned for remote fire environments: An example is offline caching ability of maps. This is being pushed from the bottom up — fire resources using their personal mobile devices to do their jobs better.

Agencies and stakeholders need to coordinate together to support fire and aviation management operations with these emerging technologies. That means collaboration at a national level is the key to preventing duplica-

tive projects — leveraging and documenting each other's successes and operating across boundaries — just like fire. It's very important that the digital and spatial data these new technologies and tools produce is seamlessly incorporated into existing fire management systems and that information integrity is kept. Additionally, fire and aviation management needs to continue efforts to keep abreast of emerging new technologies in order to meet the dynamic, critical needs of fire resources.

HOW DO WE GET THERE?

In order to fully integrate emerging technologies into fire and aviation management strategies as well as remain flexible to changes, best management practices and procedures must be developed, and standards must be updated and applied across interagency boundaries. Interagency funding and support for the development of new technologies — and getting these into the hands of fire and aviation personnel — is paramount in achieving a safe, efficient and highly effective workforce. That will require continually defining business requirements, capturing field level innovation and ensuring new technology information is integrated into current programs and applications so the benefits of these technologies are maximized.

Lorri Peltz-Lewis is the FAM GIS Coordinator for Region 5. Peltz-Lewis works extensively with fire and aviation management personnel to create mobile mapping products for their devices with specific agency data.

Esther Godson is a Project Lead with Missoula Technology and Development Center. Godson has over 13 years experience in primary fire and focuses on testing emerging mobile technologies and defining the technology requirements of fire and aviation personnel.

Integrating Science and Technology into Decision-Making

Because of the development of disparate documentation and analysis processes applicable only to specific fire types and situations, a new method for wildfire decision documentation and analysis became highly desirable for the wildland fire management program. As a result, a new system, the Wildland Fire Decision Support System (WFDSS), was developed and put into use in 2009.

WFDSS is a single system that replaces all previous processes. It is a web-based system for documenting decisions, supporting analyses and providing information useful in completing operational plans applicable

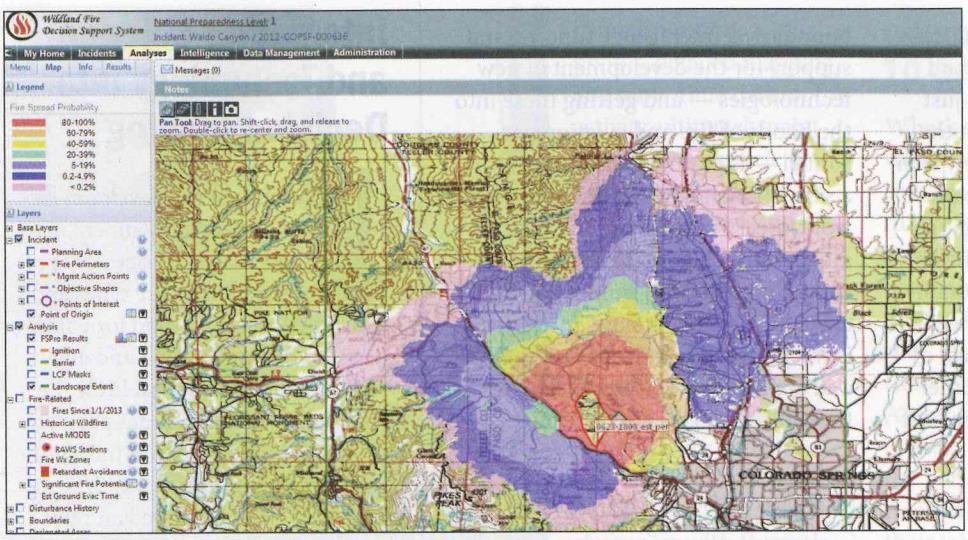


Figure 2: WFDSS Fire Spread Probability Simulation (FsPro) map for the Waldo Canyon Fire (Colorado, 2012).

to and used for all wildland fires. It promotes access to numerous information analysis tools in the areas of fire behavior modeling, fire weather information, economic principles, air quality and smoke management, and information technology to support effective wildland fire decisions consistent with land and resource management plans and fire management plans.

WFDSS greatly reduces text input requirements by using spatially oriented and graphically displayed information. The system incorporates a progressive decision documentation and analysis process that can be scaled and adapted to match situational changes.

The design of WFDSS improves existing documentation capabilities; provides rapid and efficient information acquisition; allows for information analysis; and makes the decision process accessible, consistent, flexible and geospatial. Maps and other spatial information of values, assets and the fire environment that help with risk assessment and support are available.

When a wildland fire starts, a progressive process of assessment, risk-characterization, analysis and deliberation begins to lead to a risk-informed decision. Maps of forest, brush and grass fuel types with other geospatial data such as values at risk (infrastructure and natural resources) are viewable and can be displayed with fire behavior and smoke modeling tools to visually project risk (Figure 2). When pre-planned actions are not successful or the situation significantly changes, additional or new decisions are needed. Managers can fully document their decisions, including rationale for those decisions, with all supporting analysis information as they proceed through the system.

WFDSS also can facilitate long-term implementation action planning. Managers can develop implementation actions that include short- or long-term tactical response information. Long-term actions can be designed around a planning area that represents the desired management area for the fire and creates a reference for all analysis, planning and implementation activities. Management action points that identify where defined actions will be taken in response to changes in temporal or spatial conditions, or other situational changes, can be spatially developed and displayed. Contingency actions for implementation during unplanned situations can also be developed and spatially represented.

Since 2007, nearly 50,000 wildland fires have been recorded in WFDSS by all federal wildland fire management agencies and several states, tribes and Alaska native corporations.

–Tom Zimmerman

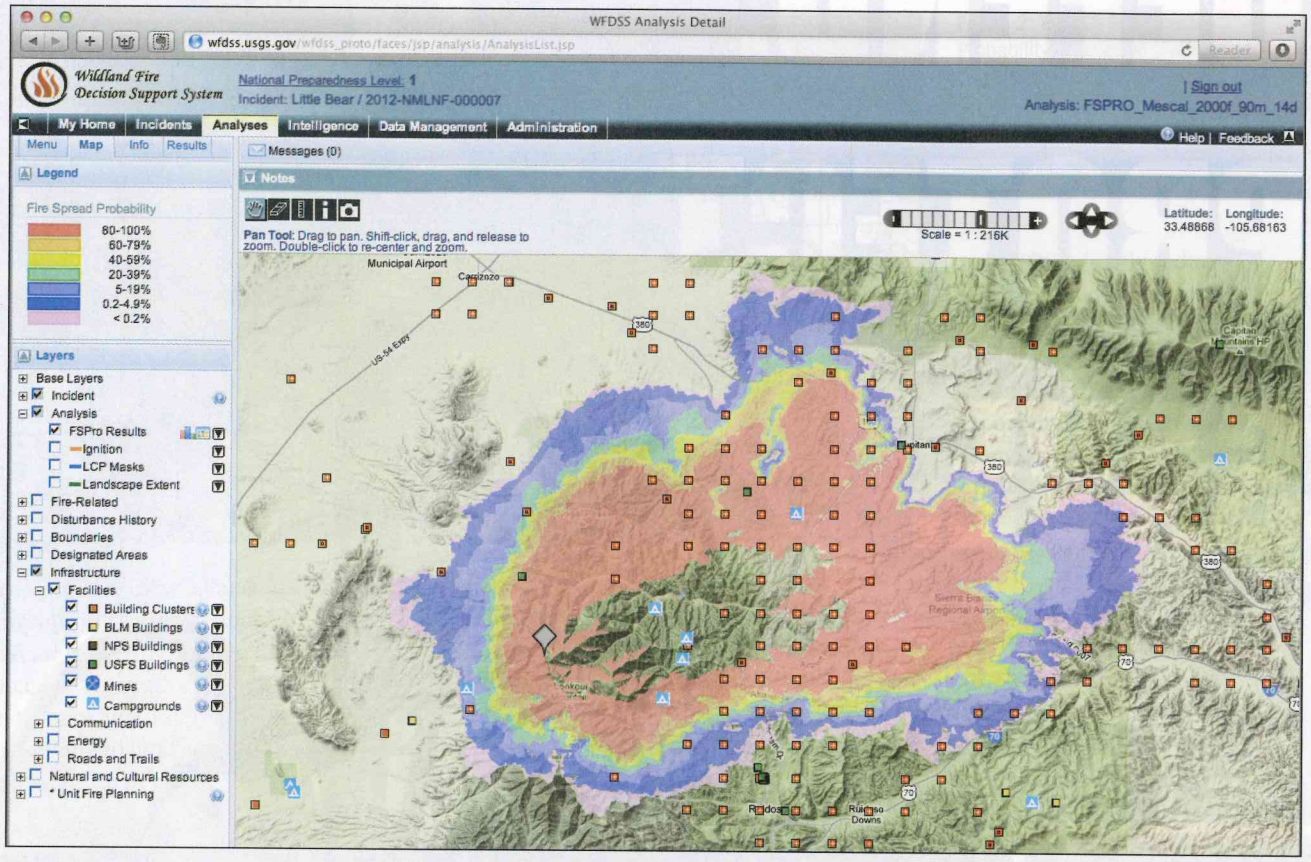


Figure 3: Fire spread probability simulation (FsPro) outputs provide a geospatial display of infrastructure values overlaid on various fire spread probability bands (produced in WFDSS). Managers can readily see what the projected probability of fire spread is to the existing values.

Leveraging the Geospatial Advantage

The Wildland Fire Decision Support System (WFDSS) web-based application leverages geospatial data to inform strategic decisions on wildland fires. A specialized data team, working within the Wildland Fire Management Research Development and Application group (WFM RD&A), assembles authoritative national-level data sets defining values to be protected. The use of such high-quality trusted data ensures that critical resources, infrastructure and firefighter risk exposure are considered in both the planning and implementation phases of incident management (Figure 3 and Table 1).

Values List

Category	80-100%	60-79%	40-59%	20-39%	5-19%	0.2-4.9%	<0.2%	Expected Value
BLM Range Allotments	11,723 acres	1,550 acres	1,436 acres	2,141 acres	2,880 acres	2,961 acres	798 acres	13,434 acres
Building Clusters: Lincoln, NM	1,774	371	178	204	106	569	477	2035
Building Clusters: Otero, NM	0	0	0	0	0	0	0	0.00
Campgrounds	2	0	0	0	1	0	0	1.93
Class 1 Airsheds	17,709 acres	3,928 acres	2,771 acres	3,554 acres	6,096 acres	3,373 acres	97 acres	21,989 acres
Communication Towers	17	15	2	5	1	19	10	28.9
County: Lincoln, NM	82,546 acres	14,144 acres	10,478 acres	12,920 acres	21,827 acres	32,727 acres	12,491 acres	96,899 acres
County: Otero, NM	3,741 acres	1,651 acres	1,461 acres	2,020 acres	2,993 acres	4,302 acres	2,680 acres	6,348 acres
Electric Sub Stations	2	0	0	0	0	0	0	1.80
Electric Transmission Lines	4.4 miles	3.1 miles	1.4 miles	1.1 miles	2.2 miles	5.2 miles	1.4 miles	7.57 miles
Habitat: Mexican spotted owl	27,418 acres	2,727 acres	1,781 acres	2,066 acres	2,494 acres	2,658 acres	254 acres	28,477 acres
IRA: Tucson Mountain IRA	0 acres	0 acres	0 acres	137 acres	844 acres	3,334 acres	1,669 acres	235 acres
Jurisdictional Agency: BIA	3,752 acres	1,652 acres	1,466 acres	2,022 acres	2,994 acres	4,301 acres	2,680 acres	6,362 acres
Jurisdictional Agency: BLM	10,273 acres	899 acres	1,038 acres	1,628 acres	2,319 acres	2,642 acres	635 acres	11,242 acres
Jurisdictional Agency: USFS	40,021 acres	8,042 acres	5,969 acres	7,261 acres	13,151 acres	15,742 acres	6,243 acres	48,871 acres
Natl Scenic Byways	15.7 miles	2.3 miles	0.4 miles	0.5 miles	0.5 miles	0.8 miles	1.0 miles	16.2 miles
Oil and Gas Pipelines	20.0 miles	1.2 miles	0.9 miles	1.4 miles	2.4 miles	2.6 miles	0.5 miles	20.1 miles
Other Areas: William G. Telfer PRNA	299 acres	0 acres	0 acres	0 acres	0 acres	0 acres	0 acres	269 acres
Responsible Agency: BIA	3,775 acres	1,652 acres	1,460 acres	2,019 acres	2,993 acres	4,306 acres	2,681 acres	6,378 acres
Responsible Agency: State	35,871 acres	4,324 acres	3,418 acres	4,259 acres	6,972 acres	13,829 acres	5,101 acres	39,534 acres
Responsible Agency: USFS	46,639 acres	9,819 acres	7,061 acres	8,661 acres	14,855 acres	18,895 acres	7,389 acres	57,333 acres
Retardant Avoidance	84 acres	16 acres	0 acres	7 acres	24 acres	48 acres	2 acres	93.2 acres
Roads	27.7 miles	3.6 miles	2.8 miles	1.9 miles	2.5 miles	3.1 miles	2.4 miles	29.8 miles
USFS Buildings	4	0	0	0	0	3	0	3.68
Wilderness: White Mountain Wilderness	17,578 acres	3,967 acres	2,808 acres	3,636 acres	6,425 acres	3,547 acres	108 acres	21,967 acres

Table 1: Tabular display of infrastructure values within each fire spread probability band (produced in WFDSS).

Since wildland fires are most expensive when they occur adjacent to populated areas, affect multiple jurisdictions, and damage private property and structures, the need for more and better data to represent homes

and individual structures throughout the country has become increasingly important. An accurate accounting of the number and approximate location of structures within the planning area for an individual fire is prerequisite to sound decision-making.

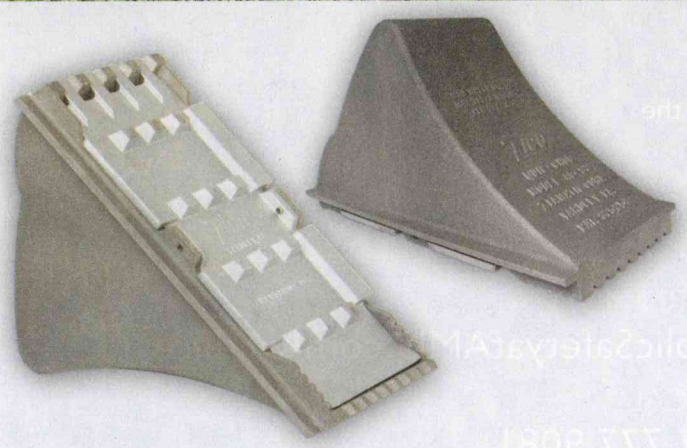
Successful acquisition and management of national-level data require considerable collaboration and communication among all affected jurisdictions and across all levels of government. The best data on where people live is maintained by county government agencies in the form of cadastral, or tax parcel, data. Since there are over 3,000 county governments in the United States, the magnitude of the necessary acquisition effort led to a partnership with wildland fire management agencies and other federal, state and local governments. This partnership was established by the creation of the Federal Geographic Data Committee (FGDC) National Cadastral Sub-Committee.

> "Cadastral data is one example of leveraging geospatial data to provide real-time intelligence and enhance wildland fire managers' decision-making capabilities."

Starting in 2006, this partnership has developed business cases, established necessary data standards, and outlined procedures to consolidate and use cadastral data. The cadastral sub-committee has reached out to local county assessors, planners, natural resources and GIS staffs to acquire county geospatial parcel records. From this, authoritative county data can be consolidated by trusted state data stewards to provide information needed by federal wildland fire managers for incorporation into WFDSS.

From the cadastre record, building clusters representing the general structure locations are derived. When wildfires occur, local jurisdictions can immediately see the importance of their own data in improving decision-making and assessing wildland fire risk to property and homes.

The WFM RD&A acquires nearly 40 geospatial data sets for use within WFDSS on an annual basis. Cadastral data is one example of leveraging geospatial data to provide real-time intelligence and enhance wildland fire managers' decision-making capabilities. It is also a good example of information that did not exist in a readily usable format as little as 10 years ago.


ZICO
Wildland Wheel Chocs
Model AC-32-W
• NFPA compliant for tires up to 32" in diameter
• Ideal for dirt, loose gravel, and other off-road locations
• Rugged, high-strength aluminum construction
• Easily stored away with ZICO choc holders
1-800-711-FIRE | ziamatic.com

Local land-use situations are changing rapidly with housing and infrastructure values dramatically expanding across the landscape. The ability to have and use this kind of data strongly advances decisions regarding kinds, types and numbers of firefighting response resources, tactics that will be used and where the highest priorities are.

Ben Butler is Wildland Fire Decision Support System (WFDSS) GIS Specialist with the Wildland Fire Management Research, Development, & Application Program at the National Interagency Fire Center in Boise, Idaho. Butler has an undergraduate degree in geography/GIS and a Master of Natural Resources degree with a concentration in fire ecology.

Andrew Bailey is Data Manager for Wildland Fire Management Research, Development, & Application Program, based at National Interagency Fire Center in Boise, Idaho. Bailey has 10 years of experience in wildland fire management, fuels and smoke research, land management planning and GIS. Previously, he was with the North Carolina Forest Service where he served as GIS Coordination Forester.

Virtual Situation Awareness Tools

The USDA Forest Service, in partnership with other wildland fire management organizations, is leveraging new mobile technologies to better equip fire managers and firefighters to respond to increasing wildfire risk. The use of mobile technologies will provide greater information access leading to more informed decisions and increased on-the-ground situational awareness.

A Mobile Technologies Integration Team was established and has been evaluating and testing the viability and use of mobile technologies in support of wildland fire and non-fire emergency response operations. Areas of focus for the development team include: **incident support operations, decision support, geospatial information management** and **situational awareness tools.**

Kings Peak Wildfire Module member views the updated IR Map on a mobile tablet during the morning radio briefing at a spike camp on the Vista Fire in the Selway Wilderness (September 2012).

Incident Support

The Mobile Technologies Integration Team began a series of mobile device pilot test projects during the

Professional Liability Insurance
Federal Wildland Firefighters

You are not immune to allegations of wrongdoing no matter how well you think you do your job. Good firefighting tactics will not protect you from the scope of the criminal and administrative investigations into a firefighting fatality or from the potential for civil lawsuits.

"No one can ever fully prepare for a fire tragedy, but having PLI (which means having legal counsel experienced in the array of federal investigations and proceedings) can make a world of difference. It saved my wild land firefighting clients from prosecution and then saved their jobs. Nothing could be more critical to preserving your career, livelihood, & freedom from prosecution than knowledgeable, tenacious, and experienced counsel – which is outright cost prohibitive for any federal employee without PLI."

-Debra L. Roth, Partner, Shaw, Bransford & Roth, P.C.

There are 3 ways to get FEDS PLI protection today:

- **Enroll on-line at www.fedsprotection.com**
- **Enroll by mail. Download form online.**
- **Enroll by phone at 866.955.FEDS**

Enrollment takes less than 5 minutes.
Payroll Deduction is available starting at $12 per month.

FEDS $1,000,000 policy is $290 annually.*
FEDS $2,000,000 policy is $390 annually.*

**Many wildland firefighters are eligible for agency reimbursement up to half the cost.*
Please call us or contact your HR representative for a copy of your agency's policy on professional liability insurance.

FEDS
Why Gamble with Your Career?
Protect Yourself with Professional Liability Insurance.

2011 western fire season. This effort focused on defining use cases and benefits of mobile devices. The initial review quickly revealed that tablet devices and personal web-enabled smart phones improved employee effectiveness, greatly lessened travel-dictated mobility impacts and increased overall situational awareness through more rapid information availability.

As the work continued in 2012, efforts expanded into fireline operational opportunities. Mobile devices were found to be markedly valuable to firefighters for quickly acquiring real-time decision-support information through browser-based information (e.g., weather updates) and application-accessible information. These devices also allowed operational personnel involved in tactical operations to concurrently complete administrative duties.

"The initial review quickly revealed that tablet devices and personal web-enabled smart phones improved employee effectiveness, greatly lessened travel-dictated mobility impacts and increased overall situational awareness through more rapid information availability."

Wildland Fire Decision Support

The Wildland Fire Decision Support System (WFDSS) was developed to support fire managers in decision-making. In use since 2009, new efforts are under way to develop a WFDSS application for portable tablets, smart phones, etc. This will expedite managers' ability to quickly access the system, view fire situation information and document decisions without being dependent on a computer.

Geospatial Information Management

The importance of the delivery, display and analysis of geospatial information in wildland fire management cannot be overstated. An effort, called the Enterprise Geospatial Portal (EGP), takes advantage of platform agnostic technologies to provide end users with open interfaces to view and exchange geospatial data. EGP gives users improved access to layers

of imagery and map data, applications and other services needed by federal, state and local governments during a wildland fire event. It also pools available information resources, eliminates redundancies, and more effectively and efficiently meets the challenges of managing geospatial data from multiple collaborators and responders.

Improving Managerial Situational Awareness

Geospatial and technology transfer staff at the National Interagency Fire Center (NIFC) are currently engaged in a development effort to create a geospatially based, web-enabled, wildland fire dashboard. This virtual situational awareness tool is currently in limited pilot testing. It will make it possible for decision-makers and planners to quickly and reliably review wildland fire situation information. The dashboard will assemble and display information not currently available from a single source in an immediate timeframe. When used in concert with the WFDSS suite of decision-making software, the dashboard will offer unparalleled interoperability at all levels of command: field users; support staff; fire and incident support managers; interagency partners; and other federal, state and local agencies.

WHAT DOES THE FUTURE HOLD?

Certainly, emerging technology will be utilized to the greatest extent possible to further wildland fire management capability. Two noteworthy efforts are under way to continue application of changing technology and include:

- Wildland fire managers at the USDA Forest Service and the Department of the Interior (DOI) have laid the groundwork to create a fully functioning, integrated virtual Fire IT support group, called Wildland Fire Information Technology (WFIT). This group is envisioned to evaluate and leverage cloud services in support of wildland fire operations.
- Mobile technology testing will continue and include development and evaluation of mobile fire applications, smart phone testing, mobile SATCOM capabilities, remote sensing and remote camera testing. W

–Laura L.Hill and Tom Zimmerman

Laura L. Hill is Strategic Planner IT, USDA Forest Service, Fire and Aviation Management; DBA Candidate, Information Technology and Enterprise Management.

A special thanks to Sean Triplett, FAM IT National Geospatial Lead; Andy Trent, Program Lead, MTDC; Esther Godson, member of the Mobile Technologies Group; and Lorri Peltz-Lewis, FAM GIS coordinator Region 5, for their input and photos.