



# Understanding the Intersection of Resilience, Big Data, and the Internet of Things in the Changing Insurance Marketplace

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*Editor's Note:*

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## Abstract

There has been a recent explosion of data and technology, affecting every aspect of society. The resilience movement is no different. This paper examines the intersection of big data, including efforts to measure resilience and telematics, and the Internet of Things (IoT), including smart home technology.

From the 2005 initiative to score individual houses as part of the \$250 million *My Safe Florida Home* program, to current efforts at the U.S. Resiliency Council to rank buildings for seismic performance, one thing is clear—comprehensive building rating programs are emerging alongside the call for disaster resilience in communities across the globe.

The other side of measuring resilience and big data generally is the IoT. Specifically, the smart home technology movement has the potential to create an enormous amount of data, and that data can revolutionize how we understand risk. This paper explores how smart home technology can make homes not just smarter, but safer and stronger as well.

The potential for smart home technology is limitless. A home can be transformed in a way that both optimizes the functionality of a dwelling, and provides previously unknown insights about the behavior of the homeowner to more accurately assess risk. There are crucial considerations to the success of smart home technology, and security and data privacy are essential. The status of telematics is examined, as well as how they represent a full circle back to the role of big data.

This paper provides a framework of considerations for approaching the potentially groundbreaking convergence of big data and the IoT to transform the resilience movement and the overall safety and strength of residential structures.

## Introduction

This commentary delivers our perspective as a leader in the disaster resilience movement through the prism of our experience as a diverse, nonprofit organization that brings together more than 120 public, private and nonprofit entities—all of whom share our mission of strengthening homes and safeguarding families from disasters. Our private sector partners include select U.S. domestic insurers, State Farm Insurance and USAA, as well as global corporations like BASF – The Chemical Company, The Home Depot, Kohler Co., and The Walt Disney World Company. Our governing body includes representatives of those corporations as well as leading academics, building trade associations, former elected officials, insurance regulators, product manufacturers like Simpson Strong-Tie Co., and the leading U.S. building code developer—the International Code Council.

We benefit from continuous collaboration with the leaders of our movement, including U.S. National Hurricane Center Director/World Meteorological Organization Region VI Lead Dr. Richard Knabb, FEMA Administrator Craig Fugate, and National Weather Service leadership.

We advance our mission through award-winning outreach and education efforts that draw on our diverse identity by supporting innovation, collaboration, and integrity in the pursuit of disaster resilience.

For this particular effort, we are focused on the issue of disaster resilience with application to the United States insurance marketplace and its drivers, including<sup>1</sup>:

- Natural disasters losses in the United States
- U.S. P&C market is five times larger than the next largest markets (2014 Report)<sup>2</sup>
- Outlook for U.S. marketplace maturation
- P&C insurer imperative for digitization despite slow adoption
- Ongoing pursuit to develop more granular data to support superior risk profiles
- Advent of telematics in auto and home insurance lines
- The need for information fluency to effectively leverage the creation of new data through the IoT, telematics, and other information technology<sup>3</sup>

#### Billion-Dollar Weather and Climate Disasters in the U.S. 1980-2014 (CPI-Adjusted)

- Flooding - \$88 Billion
- Freeze - \$25 Billion
- Severe Storm - \$155 Billion
- Tropical Cyclone - \$539 Billion
- Wildfire - \$26 Billion
- Winter Storm - \$26 Billion

Source: NOAA. Billion-Dollar Weather and Climate Disasters: Summary Stats. Available: <https://www.ncdc.noaa.gov/billions/summary-stats>

## Roadmap

After brief discussion of catastrophe losses and global attitudes, we begin with an examination of past and current efforts to rate structure performance, what it means for the insurers and reinsurers, and the potential implications for the construction industry as a whole. This includes a discussion of how measuring data can reduce loss and uncertainty within the realm of building resilience.

Next, we explore the universal, societal issue of big data and how it relates to resilience metrics. And when we look at what data is examined to create resilience metrics and frameworks, we will learn that this is a big data problem in itself.

We continue with the IoT and the emerging consumer trend of smart homes with the question—can homes become smarter against more than routine water losses to include disasters of all kinds?

Smart home technology is defined, and consumer interest in such technology is explored. Additionally, we discuss the players in the smart home technology field, and

vulnerabilities that this technology must address and overcome. The related concept of smart cities is considered.

The telematics movement in the context of insurance and the IoT is discussed at length, including the challenges that the industry must address and overcome. We also examine the potential application of wearables in this movement.

We will see that the creation and use of data in smart/connected homes and the home telematics movement, another big data application, has potential to support family safety, exponentially expand the granularity of property risk data, and support better building performance overall. We expand on this resilient smart home concept by adding our vision of how resilient smart homes can make inhabitants safer, protect the integrity of the structure, and benefit the insurance industry through reduced risk and increased insights on home performance under ordinary and catastrophic conditions.

As we conclude, we will have created a framework for the following discussion around the most important question of all...

Is there a collaborative intersection between societal and insurers/reinsurers' interests that can advance the disaster resilience movement by creating shared value through safer communities and stronger markets overall?



## The Case for Resilience as a Cause

The need for resilience is clearer than ever, with extreme weather and geological events across the world.

In 2014 worldwide there were at least 258 separate natural disaster events, with Asia Pacific sustaining the most events and the United States representing the second-most active region of the world.<sup>4</sup> According to Aon Benfield, annual average economic losses from world-wide weather disasters have increased each decade since 1980 for an annual increase of 7.3 percent in nominal dollars.<sup>5</sup>

In the U.S., economic losses have increased 3.0 percent annually (inflation-adjusted basis) since 1980, with insured losses increasing at 6.6 percent.<sup>6</sup> From 1980 to 2014, flooding, freeze, severe storm, tropical cyclone, wildfire, and winter storm U.S. losses totaled \$870 billion dollars.<sup>7</sup>

Weather catastrophe losses are increasing and are predicted to continue to increase, with the main driver of the increases tied to true economic growth, with additional factors like weather and climate contributing to the remainder of the loss trend increase.<sup>8</sup>

These figures illustrate a simple notion: without improving the resilience of communities across the globe, natural disaster costs will continue. The convergence of new technology with the cause of resilience can create unprecedented opportunities to help communities bounce back better when disaster strikes.

## Rating Residential Structures for Resilience

Our organization focuses on strengthening homes and safeguarding families from disasters of all kinds, with emphasis on strong building codes, beyond-code mitigation, and personal preparedness as part of a culture of resilience. But while our mitigation focus is on the structural aspects of residential construction, and hazards therein, the broader resiliency movement is largely espousing the notion of community resilience. A community-wide approach ensures that every vulnerability is considered, so this paper will examine the metrics developed and being developed to measure community resilience.<sup>9</sup>

When successful, resilience metrics will capture how and whether a community will adapt and thrive when faced with disaster. Opportunities for the insurance industry and recommendations going forward will be addressed.

## Resilience Metrics/Ratings Systems Overview<sup>10</sup>

This section will address the current metrics of resilience. Either developed or in development, metrics are essential to making the case for resilience. If we can show homeowners, decision-makers, and other stakeholders the value of safer, disaster-resilient construction, there will be progress. Further, companies, and communities require accurate information regarding the cost and value of disaster-mitigation benefits to make sound decisions.

The 2012 publication *Disaster Resilience: A National Imperative* made the case for resilience metrics, citing: (1) numerical means of assessment is required to prioritize improvement needs; (2) measurement is required to monitor progress; and, (3) a basis of measurement is needed to compare resilience benefits to associated costs.<sup>11</sup>

In a recent U.S. workshop on measuring community resilience, one participant again cited the *Disaster Resilience* publication, noting that it:

...outlined 17 distinct assessment tools and systems, and that in the two years since the report was released there has been an explosion in the number of additional resilience measuring tools developed by government agencies, academia, NGOs, communities, and the private sector.<sup>12</sup>

Interestingly, the conclusion of the *Disaster Resilience* report noted that not one of the 17 studied metrics answered the questions paraphrased as: (1) how communities can measure resilience?; and (2) how can communities assess resilience decisions and investments for success?<sup>13</sup> Accordingly, their main recommendation was to develop a national resilience scorecard, from which communities can develop their own, tailored scorecards, and other reviews of same have provided similar recommendations.<sup>14</sup>

Another review of disaster resilience metrics was conducted for the United Nations Development Programme, entitled *Disaster Resilience Measurements: Stocktaking of Ongoing Efforts in Developing Systems for Measuring Resilience*.<sup>15</sup> It noted that identifying the metrics and standards for assessing resilience is a significant challenge, and there is no current consensus on same.<sup>16</sup>

Additionally, a 2015 research article, *Community Disaster Resilience: a Systematic Review on Assessment Models and Tools*, conducted a literature review of existing community disaster resilience metrics, focusing only on assessment tools or models—not frameworks, actions, planning, characteristics, and indicators.<sup>17</sup> It found, “at least five defined and measurable domains for community disaster resilience including social, economic, institutional, physical, and natural.”<sup>18</sup> It also noted that the apparent first step for community resilience is determining indicators for same.<sup>19</sup>

Below are some examples of current resilience metrics/frameworks/indices:

- CARRI Community Resilience System<sup>20</sup>
- NOAA Coastal Community Resilience Index<sup>21</sup>
- Baseline Resilience Indicator for Communities (BRIC)<sup>22</sup>
- SPUR model (San Francisco Planning and Urban Research Association)<sup>23</sup>
- ResilUS<sup>24</sup>
- PEOPLES Resilience Framework<sup>25</sup>
- Community Disaster Resilience Index<sup>26</sup>
- US Resiliency Council's Building Rating System<sup>27</sup>
- Oregon Resilience Plan<sup>28</sup>
- Rockefeller Foundation City Resilience Framework<sup>29</sup>
- Resilience Capacity Index (Buffalo Regional Institute, NY)<sup>30</sup>
- MCEER R4 Resilience Framework<sup>31</sup>

Additional resilience metrics/frameworks/indices in the context of national level resilience measurements:<sup>32</sup>

- United Nations University Institute for Environment and Human Security, World Risk Index<sup>33</sup>
- United Nations Development Programme Disaster Risk Index<sup>34</sup>
- Hyogo Framework for Action Monitor; now see Sendai Framework for Disaster Risk Reduction 2015-2030<sup>35</sup>

Examples of Additional Efforts to Measure Resilience include:

- Climate Disaster Resilience Index<sup>36</sup>
- UNISDR Disaster Resilience Scorecard for Cities and Local Government Self-Assessment Tool<sup>37</sup>
- Risk Reduction Index (designed by DARA international)<sup>38</sup>

The U.S. Resiliency Council's Building Rating System, noted above, is an excellent example of the benefits of establishing resilience metrics. This initiative is focused on creating building "report cards", initially focusing on seismic risk, and later planning to extend to resilience metrics for catastrophic wind and flood risk.<sup>39</sup> Required disclosure of the individual building ratings has many benefits, including an increase in the value of strong new or retrofitted structures.<sup>40</sup> The ratings can serve policy makers as a guide to the relative risks in a community, and hopefully the ratings create market demand for stronger building construction.<sup>41</sup>

As is evidenced by these examples of current resilience metrics, there is a challenge for uniformity and consistency in this realm. We need a consensus on resilience metrics in order to move fully into development/implementation.

What are these metrics? Are they frameworks, indices, models, or assessments? It is time to identify what works, and perhaps most importantly, what can be verified to accurately predict resilience. While much of the above focuses on broader community resilience, quality building stock must at least be an indicator (with important details like age of the structure, built to code, details of same, retrofits, the location's disaster history, etc.) in any metrics that measures resilience against disaster. Again, this must all be supported by the best available data and then translated into something that reduces risk and incentivizes better preparation for future disasters.

Two of the articles mentioned above isolate physical systems, and building stock would likely be categorized as such.<sup>42</sup> But what about building codes? Perhaps the takeaway is that ensuring strong buildings in a community can cross over many potential systems (e.g., physical, political, economic), and we should try to better understand these interactions, and how they relate to resilience.

Furthermore, do we currently have quality, sufficient data to consider in these resilience metrics? Or is more needed to measure/predict future resilience?

The insurance industry is arguably best-situated to provide input on the quality and accuracy of resilience metrics. With centuries of experience in measuring, predicting, and managing risk, the insurance industry can look to extensive data to support its notion of resiliency.

Throughout this paper, the major themes point to the issue of managing data: from the resilience metrics looking to extract value from various data sources (big data issue), to the issue of creating valuable data (IoT—sensors, etc., focused on data creation). Hopefully, the issue of resilience metrics will drive quality data to be created, and, such data will improve the value and accuracy in measuring truly resilient communities, as well as the homes therein.

### **Early Rating System – 2005**

One past initiative that preceded the current drive for resilience metrics is instructive as we devise a strategy for the future measurement of a home's performance against natural disasters. That initiative was the 2005 initiative to score individual houses as part of the USD \$250 million *My Safe Florida Home* program.

After the 2004 and 2005 hurricane seasons, the State of Florida created the Task Force on Long-Term Solutions for Florida's Hurricane Insurance Market to identify solutions for continued property insurance affordability and availability problems.<sup>43</sup> The Task Force made widespread recommendations to the Legislature in its Final Report, including the creation of a Mitigation Consumer Assistance Program to include (1) free



consumer mitigation retrofit inspections, (2) retrofit grants for low-income families, and (3) provision of low- or no-interest loan programs for proven mitigation methods.<sup>44</sup>

In 2006, the Florida Legislature implemented one of the recommendations through creation of the USD \$250 Million Florida Comprehensive Hurricane Damage Mitigation Program (later the *My Safe Florida Home*, or MSFH Program).<sup>45</sup> Among other strategies, the program was tasked to conduct 400,000 free windstorm inspections<sup>46</sup> on single-family, site-built homes, and deliver at least 35,000 mitigation grants to homeowners<sup>47</sup>. The program focused on evaluating existing homes built without modern codes, and identifying needed wind-mitigation retrofits to reduce hurricane vulnerability. The evaluation included identification of available insurance incentives for mitigation features.<sup>48</sup>

As part of the program requirements, homeowners were provided with a report that (1) recommended up to seven home improvements to increase hurricane protection with construction cost estimates for such improvements; (2) outlined potential insurance incentives if improvements were made; and (3) provided an unprecedented hurricane-resistance rating for the home before and after potential improvements.<sup>49</sup> Seven classes of wind mitigation improvements were evaluated per home: “roof deck attachments; secondary water barriers; roof coverings; gable-end bracing; roof-to-wall connections; opening protection for glazed openings (e.g., windows, skylights, sliding glass doors); and opening protection for non-glazed openings (e.g., entry doors, garage doors, gable-end vents).”<sup>50</sup>

The Florida Department of Financial Services commissioned a pilot program to administer the MSFH program,<sup>51</sup> and contracted with our organization to develop same.<sup>52</sup>

In 2007, we completed successful development and testing of all aspects of the program from inspection design, report design, database development, grant administration protocols, inspector and building contractor screening, and education/testing. Along with our project partners from Applied Research Associates, we developed the first home rating scale for high wind construction, and we implemented 12,000 home inspections to test and calibrate same.

On schedule, the State of Florida implemented the larger program beginning on April 23, 2007 until its conclusion on June 30, 2009.<sup>53</sup> The MSFH program delivered 401,372 home inspections and USD \$82,650,215 in mitigation grant reimbursements.<sup>54</sup> Fifty-five percent of the homeowners who received a free wind inspection were eligible for discounts averaging USD \$217.<sup>55</sup> Additional hurricane-prone states including Alabama, Louisiana, Mississippi, and South Carolina went on to adopt and implement similar initiatives based on the original Florida model. Many of those programs continue today.

## A Uniform Home Grading Scale – Early Days

The most relevant aspect of the MSFH program to our discussion here is the home rating scale that scored individual, single family homes' wind resistance on a scale from 1 to 100. By way of background, in 2007, Section 215.55865, F.S. required the adoption of a uniform home grading scale consistent with the rating system required by 2006 legislation of the development of a program to deliver an objective rating method evaluating relative capability of Florida dwellings to withstand the sustained severe tropical storm or hurricane wind load.<sup>56</sup> A Home Structure Rating System Advisory Board was created<sup>57</sup>, and the rating scores reflected a homes' ability to withstand tropical storm or hurricane wind load on a scale of 1 to 100.<sup>58</sup>

The main factors used to compute the score include "roof shape, secondary water resistance, roof cover, roof deck attachment, roof-to-wall connection, opening protection, number of stories, and roof covering type". General geographic features of wind zone location and local terrain are also incorporated.<sup>59</sup>

Uses of the uniform home grading scale included the following:

- In 2008, the Florida Legislature required sellers of homes within the state's windborne debris region to provide the home's windstorm mitigation rating from the home grading scale to buyers; however, this is no longer required.<sup>60</sup>
- The mitigation inspection in the MSFH program specified the property's hurricane resistance rating through use of the uniform home grading scale.<sup>61</sup>
- Section 627.0629(1)(b), F.S., required development of a correlation method for the uniform home grading scale rating of a home with mitigation discount amounts and the adoption of rules for property insurers to make a rate filing correlating mitigation discounts to the home grading scale.<sup>62</sup> This is no longer in place (repealed during 2011 Session).<sup>63</sup>

The home scoring was very successful in the context of the MSFH program to help homeowners understand their home's status quo or starting point, as well as opportunities for improvement after making wind retrofits. The MSFH analysis reports clearly showed how the home that started at 55 could move to 65, 75, or even 90 if the specified wind retrofitting activities were completed. Insurers supported the scale as a means to better understand and evaluate risks. In fact, several data companies quickly captured the publicly available database.

According to a 2009 program evaluation by Risk Management Solutions, "...MSFH provided two valuable services to the insurance industry: first, a wealth of high-resolution exposure information; and second, a reduction of absolute risk level through mitigation grants."<sup>64</sup> They concluded that the program "... reduced the 100-year probable maximum loss (PML) by at least \$1.50 per dollar invested in grants," and that the reduction was equivalent to a reduction of approximately \$140 million in the 100-year PML of \$61.9 billion.<sup>65</sup> They noted that the savings represented only 0.2% of the

PML value, but that the \$140 million savings were larger than the \$93 million spent on the grant program.<sup>66</sup>

However, an important finding arose out of the inspection program and rating effort with respect to insurance incentives. Homeowners and elected leaders embraced the insurance discounts granted for new and existing homes with wind-resistant features. In fact, the insurance department promulgated a uniform inspection instrument so that any homes with superior features (in or outside the program) could secure their insurance discounts. Unfortunately, there was reluctance to allow insurers to surcharge low scoring, subpar homes even after their features were validated by inspection. As a result, insurers lost premium for superior homes but did not receive new premium for inferior homes.

Does this mean that insurers shouldn't support resilience metrics? Not at all, but it does mean that metrics must be fairly and uniformly applied so that they do not disrupt the marketplace and actuarially-sound practices.

This historic first exercise with rating ended in 2008 after only two years due to the overall economic downturn, however, we can see how innovation delivered value to homeowners, insurers, and society through stronger, more resilient homes. And we are certain that home rating systems are fundamental to any community resilience score. Such a score should be transparent and disclosed at the time of construction, purchase, or resale, to deliver value. Yet, we do not have this type of standardized, consumer disclosure yet.

We do have the Home Energy Rating System (HERS) Index that serves as the industry standard for energy efficiency.<sup>67</sup> Similarly, the resilience movement can have standardized, inspection-verified metrics for homes. We have called for disclosure on homes along the lines of the Monroney sticker, a U.S. federal requirement for new cars that includes make, model, safety ratings, and whether or not the car has been tested for safety.<sup>68</sup>

In general, the U.S. real estate industry's Multiple Listing Service (MLS) does not require disclosure of information regarding the structural integrity of a home (roof construction, compliance with the building code, etc.) or its location relative to hazards.<sup>69</sup> Although, in California, if a property falls within a "special study zone" identified by the California Geological Survey as an area of potential landslide, liquefaction, or fault rupture hazard, buyers are required to sign a form acknowledging their awareness of the potential hazard and potential additional inspections or work if future modifications are made to the property.<sup>70</sup> In this example, high risk zones must be disclosed, but the real estate industry stops short of including the disclosure in its MLS system. Perhaps the real estate industry hesitates to embrace resilience disclosure out of fear of differentiating not just the superior, but also the subpar homes. But we suggest that the ability to obviate this information is fading fast.

## Ratings Systems and the Insurance Industry

Whether the insurance industry leads the creation of a measuring stick for homes or not, we are certain that someone will gather and deliver this information in the interest of consumer interest and a societal move toward transparency. For example, commercial, digital real estate listing services like Zillow and Trulia compete for users by offering the most detailed profiles on homes and neighborhoods that include school districts, crime profiles and more. It is only a matter of time before they add building code data, or any other relevant, attainable facts about a prospective purchase. In fact, Trulia recently added natural disaster history maps to their searchable real estate database.

In the U.S., they could start today by including the Verisk/Insurance Services Office (ISO) “Building Code Effectiveness Grading Scale” macro score that indicates a community’s rating on three factors—building code version, quality of enforcement system, and training level of code officials. The ratings range from 0 to 10, and are already a factor in U.S. company insurance ratings.

The Building Code Effectiveness Grading Schedule (BCEGS) is an evaluation system of building code enforcement in communities. This classification can be used by insurers to award premium credits for buildings within jurisdictions with the latest codes. BCEGS depends on key criteria, including staffing levels, plan reviewers’ and field inspectors’ qualifications, code adoption/amendment, and building code enforcement. ISO considers the following information in its analysis:

- Public awareness programs
- Building code development activities
- Adequacy of the inspection process
- Zoning provisions mitigating against natural hazards
- Building department’s plans review details

Additional data is collected and analyzed in determining the BCEGS classification. Evaluations are done approximately every five years.

**Reference:** ISO. *Building Code Effectiveness Grading Schedule (BCEGS)*. <http://www.verisk.com/cp-v/resources/bcegs-classification.pdf>

The industry is engaged on many fronts from research to practice, as resilience rating systems inform to insurer and reinsurers’ ability to understand, profile or, in some cases, reduce catastrophic risk. In tandem with catastrophe modeling, detailed and reliable resilience metrics could revolutionize property risk profiling the same way that data granularity affected automobile underwriting 20 years ago.

From a societal standpoint, risk-based insurance pricing is a metric as well because it sends a signal, good or bad, regarding risk. But in the absence of commonly-accepted, standardized metrics, stakeholders can still find a common, agreed value system for resilience. For now, consumers, leaders, regulators and insurers must agree upon key resilience ingredients like building codes. And, insurers must be allowed to differentiate through risk-based pricing, not only for solvency, but as a means to incentivize and motivate leadership and sound public policy for the built environment.

The recent Nepal earthquake may serve as an opportunity to evaluate this idea. In the aftermath of the devastating magnitude 7.8 earthquake on April 25, leaders, insurers and stakeholders called for stronger building codes, strict enforcement, and insurance pricing that accurately reflects buildings' disaster resilience. This is often the case post-disaster, but will the political will to use risk-based pricing be lost if insurance prices rise?

Perhaps once we achieve a system of accepted resilience metrics, we will not only provide insights into future buildings performance, but we will provide leaders with a much-needed case for adopting and enforcing modern, building codes without exception.

### **How Resilience Metrics Relate to Big Data**

How to create these resilience metrics poses what can be considered a big data problem—an issue of abstracting value from a variety of data, including unstructured data.

Gartner, Inc. defines big data as: “high-volume, high-velocity and high-variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making.”<sup>71</sup> This just skims the surface of the concept that is rapidly becoming the world that businesses look to in order to assess performance and predict future behavior.<sup>72</sup>

The big data movement is driven by increased data—largely unstructured. Currently an estimated 80 percent of existing data is unstructured.<sup>73</sup> In 2005 there were 150 exabytes of available digital data at the global level, and in 2010 that number grew to 1200 exabytes.<sup>74</sup> This number is projected to increase 40% every year for the next several years—approximately 40 times the growth of the world's population.<sup>75</sup>

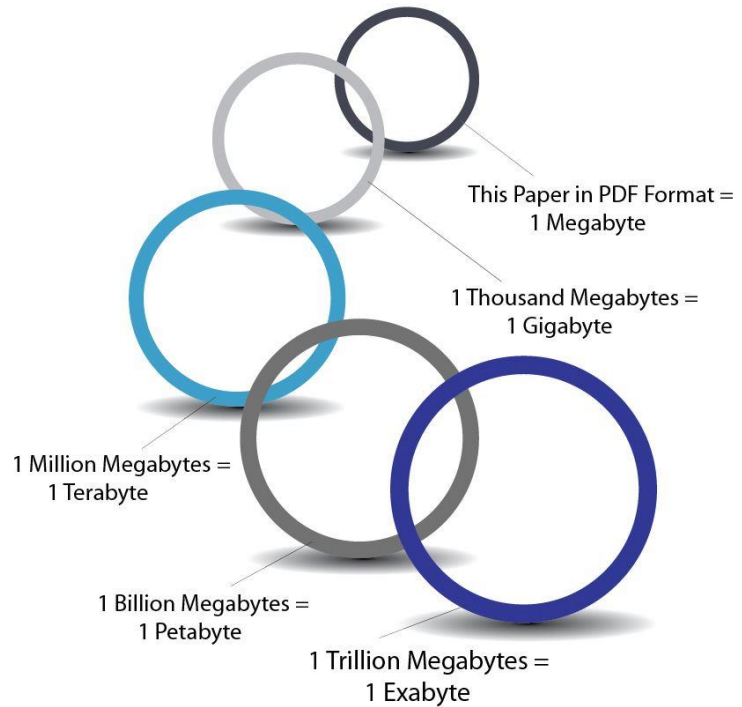
What is creating all of this data? One source of increased data is from the growth of the IoT.

Gartner defines the IoT as “the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.”<sup>76</sup> Another defines the IoT “as a network of uniquely identifiable endpoints (or “things”) that communicate without human interaction using IP connectivity – be it locally or globally.”<sup>77</sup>

The significance of the IoT cannot be overstated. The increased machine-to-machine communication built on cloud computing, as well as sensors gathering data has the capacity to transform how we gather information and then behave based on that information.<sup>78</sup> One article captured well the intersection of big data and the IoT, stating that the value created by the IoT is at the junction of collecting and leveraging data.<sup>79</sup>

The IoT was the big focus of the 2015 Consumer Electronics Show (CES), with a specific focus on the *future of home automation and the internet of things* – overview of new home automation technology<sup>80</sup>. One source states that the IoT applications market reached as much as \$1.9 trillion last year, and that should more than triple in the near future, to reach \$7.1 trillion by 2020.<sup>81</sup>

We will continue to discuss the IoT specifically relating to the Smart Home concept, but will now turn to the issue of big data and resilience.



## The Language of Disaster Safety and Resilience

The issue of “hazards and disasters informatics”<sup>82</sup> (i.e., “the management of data collection, analysis, maintenance, and dissemination”)<sup>83</sup> is addressed at length in the National Academy of Science’s *Facing Hazards and Disasters: Understanding Human Dimensions*, in the context of social science research.<sup>84</sup>

This publication provides insight into the complexity of the issues of data collection and management in one realm of disaster-safety and resilience—the social sciences.<sup>85</sup> However, one must also consider the many other realms involved in disaster-safety and resilience, including for example, natural science and engineering.

Trends and related issues to hazards and informatics includes the changing environment within which such research is conducted, the standardization of data, data accumulation and storage, and providing researchers and practitioners user friendly data access.<sup>86</sup> *Facing Hazards and Disasters* identifies that standardization and data archiving together pose potentially the most consequential challenge to social science hazards and disaster research.<sup>87</sup>

Regarding standardizing data collection, the U.S. National Earthquake Hazards Reduction Program (NEHRP) has recommended the standardization of data collection and strategies to facilitate comparisons over time and across earthquake events.<sup>88</sup> *Facing Hazards and Disasters* notes that NEHRP support has helped develop a knowledge base on physical and social vulnerabilities, their risks, and the standard data requirements to create critically needed loss estimation models.<sup>89</sup>

*Facing Hazards and Disasters* identifies that “[i]ssues of standardization and data archiving, when combined, pose perhaps the most significant informatics challenge facing social science hazards and disaster research.”<sup>90</sup>

## Current Big Data and Resilience Initiatives

There are several recent initiatives examining the interrelation of big data and resilience.

First, The United Nations’ Global Pulse is a focus on the intersection of big data, sustainable development, and humanitarian action.<sup>91</sup> Global Pulse is a network of innovation labs where big data for development research is conceived and coordinated, in partnership with UN agencies, governments, academia, and the private sector.<sup>92</sup> Objectives of Global Pulse include: “(1) Achieve a critical mass of implemented innovations; (2) Lower systemic barriers to adoption and scaling; and, (3) Strengthen the big data innovation ecosystem.”<sup>93</sup> The vision of Global Pulse is the safe and responsible leveraging of big data as a public good.<sup>94</sup> In this spirit, Global Pulse addresses the advancement of the conversation around [Data Philanthropy](#), or the partnership among private sector companies sharing data for public benefit.<sup>95</sup>

Second, in August 2013, a conference of diverse participants was held at the Rockefeller Foundation’s Bellagio Center addressing the theme of “Community Resilience Through Big Data and Technology.”<sup>96</sup> A white paper outlines its findings, including the development of a framework to guide data use for building community-driven resilience, identifying six domains: ethics, governance, science, technology, place, and sociocultural context.<sup>97</sup> A draft “Code of Conduct” seeking to give guidance on best practices regarding resilience building projects integrating big data and advanced computing identified seven core principles: (1) Open Source Data Tools; (2) Transparent Data Infrastructure; (3) Develop and Maintain Local Skills; (4) Local Data Ownership; (5) Ethical Data Sharing;<sup>98</sup> (6) Right Not To Be Sensed; and (7) Learning from Mistakes.<sup>99</sup>

Third, the U.S. National Science Foundation (NSF) and the [Japan Science and Technology Agency](#) (JST) are engaged in a joint funding program to assist in future disasters through supporting research leveraging big data and data analytics.<sup>100</sup> On March 31, 2015, NSF and JST announced awards for six joint research projects to address capturing and processing disaster data and improving the resilience and responsiveness of computer systems and networks in disasters to facilitate real-time data analytics.<sup>101</sup>

Fourth, the World Bank held an event titled *Big Data for a More Resilient Future* this April, and discussed various issues, including how communities and governments can use big data and the IoT to end extreme poverty and boost shared productivity.<sup>102</sup> During this event, Andrew Zollie spoke about various aspects of big data and resilience, including looking towards the Grand Synthesis of the following: machine learning, ground senses/IoT; mobile usage, geospatial, open datasets, aerial/UAV, and crowd sourcing.<sup>103</sup> He noted that it’s impressive to say that 90 percent of the world’s data was

created in the last two years because it's additive, but that the burden is now bigger to get through the noise.<sup>104</sup> He also stated that big data gives us an unconventional opportunity to bring together new players.<sup>105</sup> Other panelists offered valuable insights, including Nigel Snoch the Project Manager for Google Crisis Response.<sup>106</sup> He pointed out some tangible benefits to big data, specifically Google person finder and Google flu trends.<sup>107</sup> Then he warned that while big data can give insights to resilience, it's not a silver bullet—that due to models based on very small data sets, spurious outcomes are possible.<sup>108</sup>

In addition to the above initiatives, a blog post for the *Stanford Social Innovation Review* discussed big data and coping with climate change.<sup>109</sup> It cited as opportunities: feedback (citing examples like Twitter earthquake detector<sup>110</sup>), diversity (citing Google Flu Trends as diversifying traditional disease surveillance), and self-organization (citing the value of social media to enhance situational awareness and facilitate collective action).<sup>111</sup> It noted as risks: eroding trust (citing heightened privacy concerns), mistaking correlation for causation (citing [one study](#) correlating the changes in the SMP 500 index and butter production in Bangladesh), and failing to see the big picture (citing an overemphasis on the hyper-local and hyper-now).<sup>112</sup> The blog entry concluded with noting that ultimately the value of big data to resilience will depend on what trade-offs we are willing to make, and asking if it is time for an “appropriate big data movement”—one that considers the needs of communities, captures the broader context in which they exist, and pushes society to confront the trade-offs in the decisions (or non-decisions) we are making?”

After examining these existing initiatives and reviews of big data and resilience, we have further questions, including:

- How will all these efforts integrate into an understandable system?
- Who are the decision-makers?
- Should insurers/reinsurers heighten engagement or simply design their own system?

## IoT and Resilience Generally

While we look at big data as creating value from existing data, IoT looks to the creation of data through machine-to-machine communications and sensors. More specifically, we look at the IoT in the context of the “smart homes” concept and how it impacts the insurance industry and resilience movement more broadly.

We believe that the IoT has meaningful potential to increase the implementation and efficacy of disaster-safety, resilience, and mitigation efforts. Emergency preparedness and loss estimation and decision support software tools are improved by remote sensing technologies.<sup>113</sup>

The insurance industry generates and maintains a great amount of data relating to resilience, and that data creation (IoT) and maintenance (big data) can, and does,



further resilience goals. For example, consider modeling tools like Swiss Re's proprietary hazard data on five perils and its *Mind the Risk* report ranking cities across the globe relative to their resilience against different perils.<sup>114</sup>

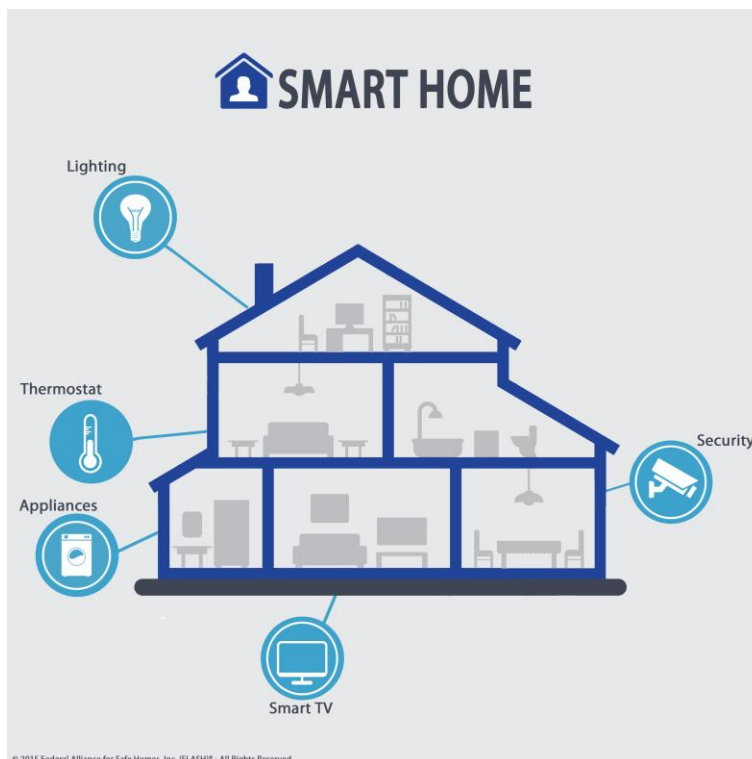
Additionally, the U.S. Federal Emergency Management Agency (FEMA) HAZUS methodology is a "GIS-based decision support tool that helps identify potential losses from a number of different scenarios."<sup>115</sup>

## Smart Home Technology

When discussing the implications of harnessing and leveraging data, we must examine the data creation side, specifically the rising consumer trend toward smart homes. Smart homes are those that leverage technology to sense and/or automate functions. Courtesy of smart home technology, light bulbs, televisions, swimming pool filters, and many other devices within a home can all be managed from a tablet or smartphone.

As a result, consumers are managing home security systems even from other countries. But can our house truly be "smart" from the perspective of natural disaster resilience? Can we automate our homes to sense threats like earthquakes and send signals to urge residents to evacuate? Can the data created by smart homes create a culture of disaster-resilient behavior change through insurance premiums or other financial incentives that reward safe behavior or superior structures? This section will examine some of these concepts.

## Defining Smart Home Technology



One definition of smart home technology is "the integration of technology and services through home networking for a better quality of living."<sup>116</sup> Smart homes are also called connected homes, automated homes and, home automation systems, and are also identified by other terms. One article discussed "smart" in practice as simply networked infrastructure: "a wireless network of nodes that provide and exchange real-time information."<sup>117</sup>

Smart home technology is not only considered for new construction, it was identified as one of the top home remodeling

trends for the next five to ten years by Harvard Joint Center for Housing Studies 2013.<sup>118</sup> And, Gartner estimates that smart homes and commercial buildings will represent 81% of all connected things in use by 2020.<sup>119</sup>

One article identified ten key features in a home automation system, citing: interoperability; remote access; expandability; upgradability; variety of interfaces; time-tested; strong dealer network; commitment to energy-savings; layer of protection; and can-do attitude (referring to importance of both installer and manufacturer making the automation fit homeowners' lifestyles).<sup>120</sup>

#### Examples of Current Smart Home Products

- Aros Smart Window, smart air conditioner
- Google's Nest, smart thermostat
- The Norm, smart thermostat
- Tapt, smart wall switch
- Outlink, smart wall outlet with energy monitor
- Overflow, sensor that monitors for standing water
- Tripper, alerts when doors/windows/cabinets open/shut
- Ascend, smart remote garage door adapter
- Spotter UNIQ, customizable multipurpose sensor
- Pentair, swimming pool remote management

**Source:** AppleInsider Staff. *Quirky and GE unveil new suite of affordable smart home devices, sensor 'micro-factory'*. AppleInsider. Nov. 11, 2014. Available: <http://appleinsider.com/articles/14/11/11/quirky-and-ge-unveil-new-suite-of-affordable-smart-home-devices-sensor-micro-factory>.

Insurers find water intrusion, fire prevention, and security devices especially appealing.<sup>121</sup> For example, in 2011, AXA UK reported that in the last two years, one in 1,000 individuals experienced burst pipes, with average claims of £25,000.<sup>122</sup> One article reviews *6 Wireless Water Leak Detectors for DIY Smart Home Systems* and several of the devices are in the USD \$30-40 range.<sup>123</sup>

State Farm Insurance Company partners with ADT and IRIS to provide “security, water detection, smoke and carbon monoxide, and door and window” monitoring, and Allstate partners with Rogers Smart Home Monitoring offering similar features.<sup>124</sup> Both State Farm and Allstate offer customer discounts for those with these features.<sup>125</sup> We will examine the role of insurers in this realm in more detail later in the paper.

#### Future Trends in Smart Home Products

- Interoperable platform success
- Connected appliances offering early defect warnings
- Connected consumer hardware bought as a service
- Usage-based home insurance
- Geolocation to control homes
- Wearables and the connected home

**Source:** Carter, Jon. *How smart homes will get smarter throughout 2015*. Jan. 23, 2015. Techradar.pro. Available: <http://www.techradar.com/us/news/world-of-tech/how-smart-homes-will-get-smarter-throughout-2015-1281858>.

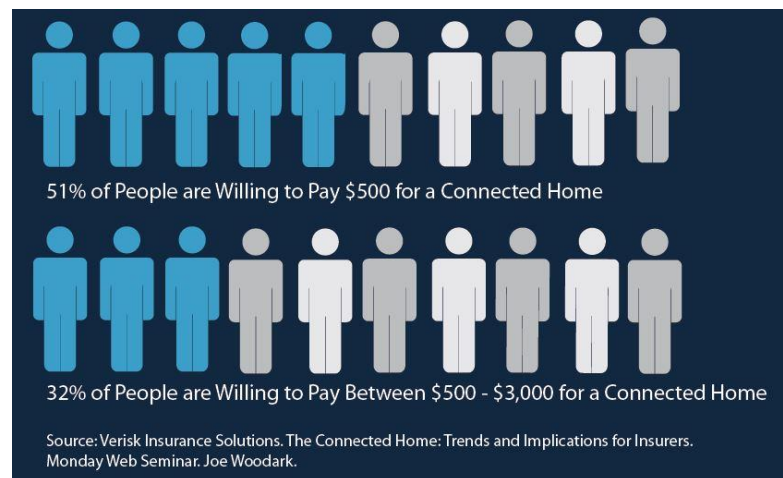
Future smart home devices stretch the imagination. Even possible are smart homes that know us by our heartbeats.<sup>126</sup> And we strongly believe that resilience innovations will be among these future smart home devices with perhaps the greatest potential for property protection overall.

By 2016, the global connected home market is predicted to reach \$235 billion, with home security (\$110 billion), smart utilities (\$33 billion), and home entertainment (\$68 billion) as the largest revenue-generating segments.<sup>127</sup>

### Consumer Interest in Smart Home Technology

The predicted take-up of smart home technology is impressive. One estimate states that global smart home penetration will reach approximately 225 million total households by 2019.<sup>128</sup> Of course, drivers of smart home technology may vary by region. For example, one article notes how energy savings and comfort are driving smart home technology in Europe, while safety functionalities and discrete monitoring for elderly people are drivers in Japan.<sup>129</sup>

Several reports provide insight on consumer interest in smart home technology. *Consumer Reports Magazine* indicates that 20 percent of its surveyed readers use smart home products currently, and 70 percent of those who don't, plan to in the near future.<sup>130</sup> [Another study](#) shows almost two-thirds of respondents are "moderately or extremely interested" in smart home products, and 44 percent claim efficiency cost savings would be key in deciding to purchase such products.<sup>131</sup> However, 66 percent expressed concern with smart home solutions' potential privacy issues.<sup>132</sup>



Icontrol Network's *2015 State of the Smart Home Report* provided a breakdown of consumer perceptions of smart home technology by four different regions across the United States that indicated a majority of those surveyed would pay up to \$500 for a connected home, and 32% were willing to pay up to \$3,000. These findings should be considered individually as well as for preference variations across broader geographical regions.<sup>133</sup>

Gartner's Hype Cycle predicts a "connected home" expectation of reaching a plateau in 5-10 years.<sup>134</sup> This makes a clear case that the opportunity is now.

## Who are the Players in the Smart Home Technology Field?

As we would expect, some of the globe's largest companies are leading the smart home technology movement, including Amazon, Apple, Google, The Home Depot, Lowe's, and Samsung. And they are leveraging their unique customer relationships. Amazon now offers a "dash button" in the U.S. on an invite-only basis to allow Amazon Prime customers to reorder the same item.<sup>135</sup> Apple is using its Apple TV as the hub for its smart home platform, HomeKit.<sup>136</sup>

While not on the top ten list yet, the insurance industry has an important role to play in smart home technology. As noted above, both State Farm and Allstate offer discounts for their customers who use certain smart home features. State Farm offers home automation and security savings of up to 10% for customers who buy a discount eligible system.<sup>137</sup> Allstate offers a 25% premium discount for security applications users, through a partnership with Rogers, a supplier of Smart Home Monitoring equipment.<sup>138</sup> Additionally, Allstate customers receive a free water leak sensor, as well as an easy-to-use touchpad, window and door sensors, and a motion detector.<sup>139</sup>

In late 2013, BNP Paribas in Italy launched Habit@t, the first home insurance product "that you can touch."<sup>140</sup> Habit@t is a home security telematics device that monitors and protects against perils like fire and flooding by alerting the customer as well as an operation center that, in turn, can activate an assistance service.<sup>141</sup>

Allianz and Deutsche Telekom in June 2014 announced they will offer "connected life" services for the European market.<sup>142</sup> Connected life will combine Telekom's "Smart Home" solution and "Allianz Assist" home emergency assistance.<sup>143</sup>

Pure Insurance offers several discounts for homeowners with smart-home devices, with discounts as high as 10 percent of the homeowner's insurance premium.<sup>144</sup>

Some resilience features like roll down hurricane shutters have been automated for more than a decade, but it is not clear whether the insurance discount for shutters is higher for those with remote automation.

## What are Vulnerabilities of a Smart Home?

Major concerns regarding smart home technology are those of security<sup>145</sup> and data privacy, and these issues must be addressed to assuage consumer fears. One question is whether different demographic age groups will embrace smart homes with varying levels of enthusiasm. The so-called millennial generation appears to accept tech more readily, but even that differentiator is breaking down as consumers of all ages connect with Facebook and other newer technologies that reveal personal details.

In the post-Facebook culture, are consumers more comfortable with sharing information about their location, habits, and even home temperature settings?

Another concern is that smart homes must be usable. Systems designers must keep ease at the forefront by making systems intuitive and adaptable to a range of users (e.g., children and babysitters).<sup>146</sup>

There are also sustainability concerns, for example concerns that smart home technology materials are often hard-to-reuse, are high energy consumers, and demand constant upkeep.<sup>147</sup>

And, what about the quality of data? We will address the potential of data vulnerability in smart homes and telematics technology in a later section on the *Challenges of Insurance, IoT, and Insurance*.

### **Related Concept: Smart Cities**

A related concept to smart homes is that of smart cities. This term is used in different ways, beyond individual buildings.<sup>148</sup> It includes cities with a high number of advanced sensors and superior monitoring, or more broadly, cities that use new technologies for increased efficiency and improved quality of life—for example advanced building materials (e.g., self-cleaning surfaces) or using existing data without additional sensors (e.g., mobile-phone location data).<sup>149</sup>

Potential benefits of smart cities include improved public services through participatory sensing through smartphones.<sup>150</sup> For example, apps could allow drivers to report potholes to their local government.<sup>151</sup> Other ideas being explored include in-ground sensors to monitor whether parking spaces are used, which could tell drivers where spaces are available.<sup>152</sup>

One article called, *Smart Homes Lead to Smart Cities Which Lead the IoT* discusses exactly what its title suggests—that smart homes are a step towards smart cities.<sup>153</sup>

There are differing opinions on the overlap of IoT and smart cities in the future. One article discussed how Gartner and IBM disagree over the integration of IoT devices into smart cities by the end of 2015, with Gartner estimating that smart cities will house 1.1 billion connected things in 2015, and 9.7 billion IoT devices by 2020;<sup>154</sup> and IBM finding that while IoT and smart cities are close, they will remain separate for now.<sup>155</sup>

Songdo, South Korea is an example of a city built with technology in mind, including a pneumatic waste disposal system using pipes to transport trash from homes to processing centers that automatically sort and recycle.<sup>156</sup> Songdo also has sensors to control traffic and public transportation systems.<sup>157</sup>

Smart cities have also incorporated disaster-safety and resilience. One article discussed how Fujisawa Japan, once Panasonic's industrial complex, is becoming a residential zone with smart homes.<sup>158</sup> Panasonic conceived the idea of the Fujisawa Sustainable Smart Town while thinking of how this location could be repurposed and contribute to

society.<sup>159</sup> Features include houses built using earthquake-resistant materials as well as community solar panels that can be used during emergencies.<sup>160</sup>

The concept of smart cities that support and consist of smart homes, commercial structures, and infrastructure can support resilience in a transformative way. Instant knowledge transfer, automated safety features, and self-executing mitigation features can remove the necessity for individual action when individuals are incapacitated, absent, or unable to perform protective actions.

## Insurance and the IoT



We have now discussed the concept of the IoT, as well as smart homes to make the case that opportunities for the insurance industry to leverage this type of technology are abundant. The IoT creates data about myriad of different activities, and this can provide insight for insurers to better assess risk. In turn, insurance incentives can drive behavior change toward more disaster-resilient practices.

Research on the potential for innovation and transformation through this technology indicated that 74% of the respondents said that the IoT will be a major disruptive force within five years, and 54% believed that it will occur in three years.<sup>161</sup>

For our part, we would like to see convergence of the resilience movement and the many potential opportunities through the IoT.

The capabilities and usefulness of the IoT for insurers, includes that data from the IoT has the capacity to provide an accurate portrayal of the exposures, hazards, and risks.<sup>162</sup> Such data can create better products, pricing, and underwriting guidelines.<sup>163</sup> Other opportunities for IoT technology for insurers includes better risk management and mitigation and closer customer relationship from increased and focused interactions.<sup>164</sup>

This enthusiasm for the potential of the IoT for insurers is measurable.

With all of these opportunities, insurers should first fully understand the issues facing the market.<sup>165</sup> And the insurance industry should continue to partner with providers and makers of smart home technology and others to meet consumer demand.<sup>166</sup>

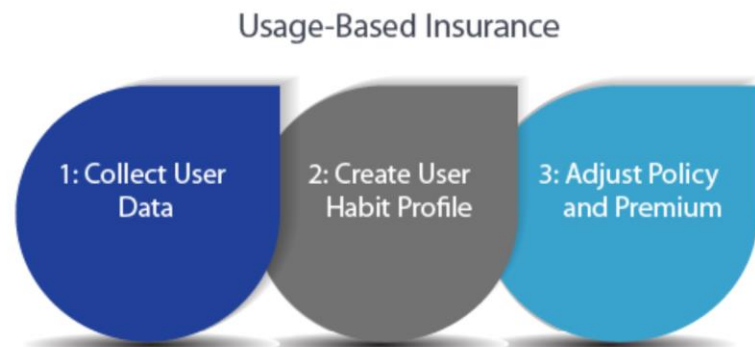
Leveraging the IoT for insurers has already begun, namely through telematics. Telematics returns us to the realm of big data—taking the data generated from the IoT and using it to benefit the insurance sector, and society through a better understanding of risk.

## Telematics

Telematics is defined as “the use of wireless devices and “black box” technologies to transmit data in real time back to an organization.”<sup>167</sup> Currently telematics is most often associated with automobiles.<sup>168</sup> However, smart home systems provide opportunities for customer discounts, as well as telemetry-based underwriting or loss control.<sup>169</sup>

Usage-based insurance (UBI) uses systems that collect data about the user (e.g., speed, braking), which then transmits that information to insurers to profile the user’s habits (driving habits). The user’s insurance policy is adjusted accordingly.<sup>170</sup>

The terms telematics and UBI are frequently used interchangeably, but one paper explains that they are separate concepts: UBI being a broader concept that is then broken down into self-reporting<sup>171</sup> and telematics-based policies.<sup>172</sup> Two main kinds of telematics-based insurance products are pay-as-you-drive and pay-how-you-drive.<sup>173</sup>



One article discussed the potential for telematics in the home automation realm, noting that it could take shape in a comparable manner to Progressive’s Snapshot auto insurance offering where discounts are designed to incentivize safe driving.<sup>174</sup> Similarly, home telematics can inform and assist insurers as they adjust rates based on information from the behavior of the homeowner, including whether an individual is at home during the day to discourage break-ins, notice water leaks, etc.<sup>175</sup>

And, as with underwriting using auto telematics, underwriting using home telematics provides the ability to evaluate homeowner’s behavior and loss drivers in an unprecedented manner.<sup>176</sup> Home telematics have the potential to profoundly change property insurance underwriting. Further, an important difference between auto and home telematics is that home telematics involve more devices, brands, and metrics.<sup>177</sup>

The advent of home telematics may be closer than we realize. One article from December 2013 notes that at least one insurer has filed for a patent on a home telematics device.<sup>178</sup>

In the U.S., Progressive was first successful with UBI with its Snapshot technology (2010), and by the end of 2013 nearly 35% of its auto customers were signed up.<sup>179</sup> Other large U.S. insurers participating include Allstate and State Farm.<sup>180</sup>

UBI is also offered in Europe, with some legislation helping to drive UBI adoption.<sup>181</sup> One study found UBI programs in “the UK, Ireland, France, Germany, Spain, Italy, Belgium, Netherlands, Denmark, Finland and Sweden involving well over 50 insurers.”<sup>182</sup>

Another finding from a July 2015 publication is that in the motor insurance space, 165 deployments are currently in place across 35 countries, denoting approximately 5 million policies.<sup>183</sup>

### **Challenges of Insurance, the IoT, and Telematics**

There are several challenges regarding the potential for the insurance industry to leverage the IoT. As this paper discusses disaster resilience and property insurance, our examination is focused on potential challenges with the smart home concept.

#### **Interoperability**

Interoperability should be a focus for making smart home devices meet the needs of consumers. Smart home technology uses various wireless communications protocols, including Wi-Fi and Bluetooth, and more direction on the best method should be developed.<sup>184</sup> Today’s consumers want to move speedily and seamlessly between platforms, and this includes smart home technology.

#### **Security**

Cyber-attacks on devices and controllers must be considered in smart home technology, and the IoT more generally.<sup>185</sup> The issue of potential fraud in creation of data that is then leveraged for uses like UBI, etc., is another important consideration. Confidence in security protection will be a major driver of take-up of this technology.

#### **Data Privacy**

Most panelists at the CES agreed that data from connected home devices is the consumer’s property.<sup>186</sup> Guidelines and limits on the types of data collected could provide increased confidence in consumer privacy.<sup>187</sup> One insurance industry panel on smart home technology discussed how reluctant or willing consumers will be to share smart home data with insurance companies for incentives.<sup>188</sup> On this panel, opinions expressed included that there will be increased comfort in sharing data; data sharing already facilitated when a service is accessed like Facebook—even if consumers don’t really want to share data; and the importance of how requests for access are accommodated, or how the permission is asked and value is explained.<sup>189</sup>



This is an interesting point in the context of our earlier discussion of insurance incentives in Florida for wind-resistant features. We pointed out then that consumers and regulators were swift to accept the discounts for superior homes, but surcharges for subpar homes were never implemented. This experience should serve as a reminder to build in equity as insurers design policies and incentive programs for smart homes.

Mostly importantly, transparency must be the guide from the outset when designing how data will be used to exactly with whom it will be shared. Strict adherence to established guidelines are basic, yet crucial, foundations for trust and engagement with smart home technology.

### **Managing the Volume of Data in the IoT (Big Data Problems)**

One participant on an insurance roundtable for smart home technology stated his perception that the “[t]he number one challenge is the volume of the data and its lack of uniformity.”<sup>190</sup> This issue was also expanded into a discussion of who potential, reliable partners will be, as well as the issue of potential nontraditional competition in the insurance business.<sup>191</sup> We believe that the insurance industry has the requisite experience and skill to identify appropriate, trusted stakeholders and establish a uniform system for this technology. This is the point at which they can also include and automate resilience metrics in the overall design.

### **Challenge of Take-Up in the Market**

The current market for connected, or smart homes is very young. In fact, U.S. market penetration is estimated at 1 percent.<sup>192</sup>

Global UBI market penetration is cited at less than one percent, but market penetration in Europe, Asia, and America is expected to reach 15 percent in 2020.<sup>193</sup> However, global insurance telematics users are expected to increase at a 90 percent compounded annual growth rate, to reach 89 million in 2017.<sup>194</sup> Different regions of the globe are taking up telematics insurance products at different rates, with Europe as a leader.<sup>195</sup>

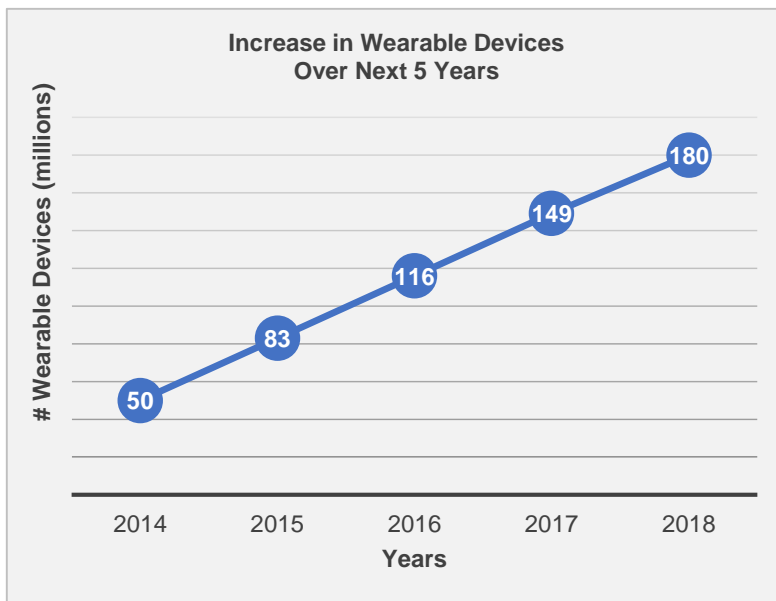
Striking the right timing for any new product, technology or system is a perennial challenge for leaders across all industries. There are risks for those who adopt first, and costs for those who come in last. According to Bain and Company in their June 2014 report, *Leading a Digital® Transformation*, “...the big change taking place in business today is the combination of digital and physical elements to create wholly new sources of value.” Bain describes the transformation as not the replacement of the physical world with the digital, but rather the marriage of the two.<sup>196</sup> They apply this dictum to all industries, and in a separate report, detail insurance digital transformation, citing how the industry is lagging behind.

Bain cites Disney as an expert in the Digital revolution, noting their Imagineering unit’s combination of digital and physical experiences.<sup>197</sup> Since 2008, FLASH has had the

privilege of working with Disney to present [StormStruck: A Tale of Two Homes®](#), an edutainment experience designed to entertain and educate visitors about how they can prepare their homes for a storm. Interactivity and the ability to send a postcard to friends and family about the experience are features of the attraction.

## Potential for Wearables and Smart Homes

One aspect to this movement that has already taken off is wearable technology. Wearable technology consists of miniature electronic devices on the body, or over or within clothing that can collect data on habits and behavior of the individual and transmit data to third parties.<sup>198</sup>



An example is FitBit, a wristband or necklace device that tracks the wearers' steps each day as well as sleep quality to motivate activity and physical health.

One figure estimates that approximately 50 million wearable devices were sold in 2014, and in 2018 more than 180 million are predicted to sell.<sup>199</sup>

Source: Palermo, Frank. *A New Frontier for CRM: The Internet of Things*. May 8, 2015.  
Available: <http://www.cmswire.com/cms/internet-of-things/a-new-frontier-for-crm-the-internet-of-things-029120.php>.

According to a 2014 survey, the insurance industry is aware of this trend, with approximately three percent of insurers using wearable devices currently, three percent experimenting with the technology, and 22 percent developing a strategy for their use.<sup>200</sup>

One article discusses that the real secret in wearables lies in the data, and that the true success of wearables depends on the relevance of the messages being sent.<sup>201</sup>

Potential uses of wearables for the insurance industry include "marketing, underwriting, risk management, new product development, workers' compensation and personal auto injury claims management."<sup>202</sup>

Wearable devices can connect to smart home systems to control such systems remotely. Another use of wearables within the resiliency movement could include transmitting information from communities hit by disaster to devise solutions.<sup>203</sup> There

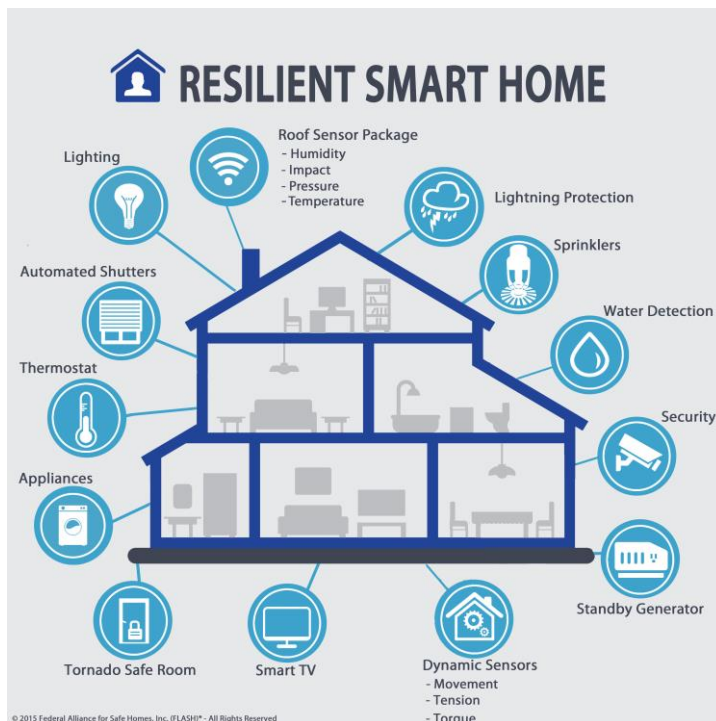
are also current and new applications that could be adapted to wearable technology for disaster safety and home protection. Severe weather warnings or seismic warning systems with “follow me” features can provide advance notice and enhance situational awareness for homeowners.

One of our apps, *FLASH Weather Alerts*, provides fast, precise, text-to-speech warnings with more than 80 opt-in choices, including ash fall, flood, freeze, heat, hurricane, ice, snow, tsunami, wildfire and more. Insurers are increasingly providing this type of technology to customers as a service and to drive good, risk-averse behavior like pulling a vehicle into a garage to avoid hail damage, etc.

## Resilient Smart Homes

In an environment of rising disaster costs and rapidly developing technology, we see a major opportunity for resilient smart homes that not only make homeowners’ lives more convenient, but that make them safer as well. But, this technology should also protect families as well as their largest investment—their home.

So, as there are already important smart home concepts, like remote control of smoke alarms and carbon monoxide detectors, where do we see other potential innovations waiting to be developed?



Insurers have begun discussing this concept with the following ideas:

“[S]tructural stress assessment: once devices exist and are built into houses that monitor conditions the home is exposed to, e.g. temperature, wind speed, humidity and mechanical vibrations, then risk to the exterior fabric of the home can be assessed more accurately.”<sup>204</sup>

“[I]nsurers can offer a data recorder to be installed in the home (similar to those now available in vehicles) to track temperature, humidity, wind speed and mechanical vibrations as they affect the house. This

information can be wirelessly sent to homeowners’ mobile devices so they can act quickly to major changes in status.... This is a simple example that some insurers are already doing....”<sup>205</sup>

The potential reach for these ideas is tremendous. Consider that IoT data from the connected home could be captured for future development of building codes and standards. Sensor packages, like those currently embedded in bridges, could be integrated into homes and give off signals for moisture, pressure, heat or ice. Any or all of those signals could trigger deployment of protective measures, with or without homeowner presence. The idea really isn't unprecedented when we think about fire sprinklers and automatic plumbing backflow valves. It is that the capability to deliver on the ideas is now emerging.

The *Smart House* (Tables 1 – 5) relate how smart home characteristics might be applied and further developed to enhance the resilience from natural perils and mitigate insurance losses.

Peril	Measurement	Resilient Use	Resilient Benefits	Energy/Security/Other	Other Benefits
High Wind	Pressure (pressure transducer)	Pressure from wind on house covering and roof	Automatically close shutters, brace doors	Used to monitor leaks in furnace	Save on heating/cooling Security benefits
	Temperature (thermometer)	Monitor roof/wall covering temperature	Extend life of roof/wall covering with maintenance	Automatically adjust heating/cooling in the house	Save on heating/cooling
	Humidity or Water Sensor (hygrometer)	Monitor moisture content of the roof covering, wall covering, roof decking, and window seals	Extend life of roof/wall covering with maintenance, pinpoint leaks	Used to track leaks in the house	
	Tension/Torque (Load cell)	Monitor connection points in the house	Alert that connections are weakening		
	Movement (Accelerometer)	Monitor movement of roof covering Use sensors on outdoor furniture, etc. to alert user to secure items in high-wind events	Extend life of roof/wall covering with maintenance	Used on doors, etc. to monitor security, turn on room lights, etc.	Security
	Wind Speed (Anemometer)	Monitor wind speed at various points of the house	Extend life of roof/wall covering with maintenance, automatically close shutter or brace doors		
	Rain (Rain Gauge)	Monitor rainfall, correlate with moisture sensor for roof covering, wall covering, roof decking, window seals	Extend life of roof/wall covering with maintenance, pinpoint leaks		

Table 1

Peril	Measurement	Resilient Use	Resilient Benefits	Energy/Security/Other	Other Benefits
Flood	Pressure			Used to monitor leaks in furnace	Save on heating/cooling
	Temperature (thermometer)	Monitor roof temperatures	Water penetration causes significant temperature changes and could indicate a leak	Automatically adjust heating/cooling in the house	Save on heating/cooling
	Humidity or Water Sensor (hygrometer)	Monitor roof and wall moisture	Water penetration causes moisture in places where non should exist and indicate a leak	Used to track leaks in the house	
	Movement (Accelerometer)			Used on doors, etc. to monitor security, turn on room lights, etc.	Security

Table 2

Peril	Measurement	Resilient Use	Resilient Benefits	Energy/Security/Other	Other Benefits
Earthquake	Pressure (pressure transducer)			Used to monitor leaks in furnace	Save on heating/cooling
	Temperature (thermometer)			Automatically adjust heating/cooling in the house	Save on heating/cooling
	Humidity or Water Sensor (hygrometer)			Used to track leaks in the house	
	Tension/Torque (Load cell)	Monitor connection points in the house (continuous load path)	Alert that connections are weakening		
	Movement (Accelerometer)	Monitor movement of roof, walls, chimney	Alert homeowner and other nearby areas to earthquake	Used on doors, etc. to monitor security, turn on room lights, etc.	Security

Table 3

Peril	Measurement	Resilient Use	Resilient Benefits	Energy/Security/Other	Other Benefits
Wildfire	Pressure (pressure transducer)	Pressure from wind on house covering, roof	Automatically close shutters, brace doors	Used to monitor leaks in furnace	Save on heating/cooling
	Temperature (thermometer)	Monitor roof/wall covering temperature	Extend life of roof/wall covering with maintenance, deploy shutters	Automatically adjust heating/cooling in the house	Save on heating/cooling
	Humidity or Water Sensor (hygrometer)			Used to track leaks in the house	
	Movement (Accelerometer)			Used on doors, etc. to monitor security, turn on room lights, etc.	Security
	Wind Speed (Anemometer)	Monitor wind speed at various points of the house	Extend life of roof/wall covering with maintenance, deploy shutter or brace doors		
	Wind Direction (Vane)	Monitor wind direction for wildfire spread	Alert to favorable winds for wildfire		

Table 4

Peril	Measurement	Resilient Use	Resilient Benefits	Energy/Security/Other	Other Benefits
Hail	Pressure (pressure transducer)	Pressure from wind on house covering, roof	Automatically close shutters, brace doors	Used to monitor leaks in furnace	Save on heating/cooling
	Temperature (thermometer)	Monitor roof/wall covering temperature	Extend life of roof/wall covering with maintenance	Automatically adjust heating/cooling in the house	Save on heating/cooling
	Humidity or Water Sensor (hygrometer)	Monitor moisture content of the roof covering, wall covering, roof decking, window seals	Extend life of roof/wall covering with maintenance, pinpoint leaks	Used to track leaks in the house	
	Tension/Torque (Load cell)	Monitor connection points in the house	Alert that connections are weakening		
	Movement (Accelerometer)	Monitor movement of roof covering	Extend life of roof/wall covering with maintenance	Used on doors, etc. to monitor security, turn on room lights, etc.	Security
	Wind Speed (Anemometer)	Monitor wind speed at various points of the house	Extend life of roof/wall covering with maintenance, automatically close shutter or brace doors		
	Rain (Rain Gauge)	Monitor rainfall, correlate with moisture sensor for roof covering, wall covering, roof decking, window seals	Extend life of roof/wall covering with maintenance, pinpoint leaks		
Power Outage			Battery backup systems/generator backup systems		

Table 5

### Resilient Smart Home Considerations

When considering the range of innovation that could prevent or lessen the impact of natural disasters on homes,<sup>206</sup> an important concept should be raised. Natural disaster impacts on residential buildings are intensified when underlying construction workmanship deficiencies exist, and/or when buildings are improperly maintained. Addressing construction defects, deferred maintenance, and deterioration in existing buildings can go a long way in increasing a home’s resilience.

As we promote investment in smart and resilient homes, it is important to point out that the return on investment in this technology can be realized with or without occurrence of a catastrophic event. This is because costly insurance losses most often flow from non-catastrophic water losses or other building or system failures driven by poor construction or poor/incomplete home maintenance.

Those same sensors forecasting a disaster and specifying protective actions will also continuously transmit data that can be used to let the house “know” when maintenance is due. The house can communicate the need to the homeowner, or even directly to the service vendor. Washing machine hoses, air conditioning filters, and window flashing replacements can be kept current, and these are all inexpensive maintenance items that can cause expensive losses if overlooked.

So this smart, resilient home can let insurers and homeowners win on two fronts by using technology to sustain building durability and performance over time as well as deliver superior performance in acute situations when stressed by severe weather or other natural hazards.

### **Envisioning the Resilient Home of the Future**

We must imagine the home of the future as we move to integrate big data and the IoT to enhance building performance, insurability, and survivability from ordinary and catastrophic losses.

This home will be “smart” with a computerized brain center containing a database of basic construction disclosures, e.g. year built, construction type, building code applied, builder name and license number, inspector name and license number. All appliances and systems will be listed along with life expectancy, maintenance protocols, and service intervals.

A network of sensors will be incorporated throughout every element and system. Foundation sensors will monitor moisture levels, wall sensors will convey changes in loads, and embedded roofing sensors will indicate degradation rates of roof shingles. Appliances will automatically reorder standard maintenance parts such as washing machine hoses or air conditioning filters.

Underwriters will use big data to leverage thousands of information points including fire-resistance of exterior cladding, flammability of furniture, plumbing and wiring conditions, and much more. After catastrophes, insurance adjusters will be able to fly a drone past the insured structures, gather data from the sensors, and perform a whole home analysis to detect damage, determine failure sources, and analyze failure severity. It is likely that they will even be able to discern between wind and water damage.

The home systems and structure will be connected with sensors that deliver data on air quality, heat, ice, moisture, motion, stress, and more. And all homes will include safety features and warning functionality, including carbon monoxide detectors, earthquake warning systems, fire sprinklers, security alarms, smoke alarms, and severe weather alerts.

All of this data will serve to revolutionize property underwriting from using only age, location, and construction type to risk profiles with fifty or more data points.

## A Sense of Urgency

Big data and the IoT are already bringing changes to the way we live in ordinary times as well as the way we bounce back after disasters. The implications for the future are not only disruptive, but transformational. It is imperative that we meet the challenge swiftly.

This Bain and Company profile of Climate Corporation presents a strong case for urgency.

Software engineers and data scientists who had previously worked at Google and other Silicon Valley firms started the Climate Corporation eight years ago. Since then it has upended the US crop insurance market, reducing farmers' financial risks by crossing agriculture with Big Data analytics. The company collects information on weather patterns, climate trends and soil characteristics, then crunches the data down to a farmer's field in, say, Iowa. Using these insights, it offers policies against damage from weather events. Farmers can work with independent local agents or directly interact through the Climate Corporation's website. Its payouts complement federal crop insurance, which provides only limited coverage. In contrast to government schemes, payouts are triggered automatically without paperwork when the company's data shows that a weather event has caused damage.

The Climate Corporation has generated strong revenue growth in both insurance and advisory services to farmers about how to raise crop yields. Now it sees potential to take its weather analytics to other countries and possibly to other industries affected by climate change. With its applied Big Data expertise, convenient interface for customers, innovative claims process and proven track record, the company would have seemed an attractive acquisition for a major insurance company. In fact, its model had been presented to insurers by the Anthem Group, an early funder and adviser that specializes in financial services start-ups. Yet late last year, Monsanto acquired the Climate Corporation for \$930 million.

Climate Corporation leveraged big data and weather analytics to reinvent and forever alter an insurance business model. In the end, they were acquired not by an insurer but by an agriculture company. Technology companies understand the intersection of big data and resilience as evidenced by the Climate Corporation example. Insurers and reinsurers need to act swiftly or risk losing ground to competition by traditional technology companies.

## Conclusion

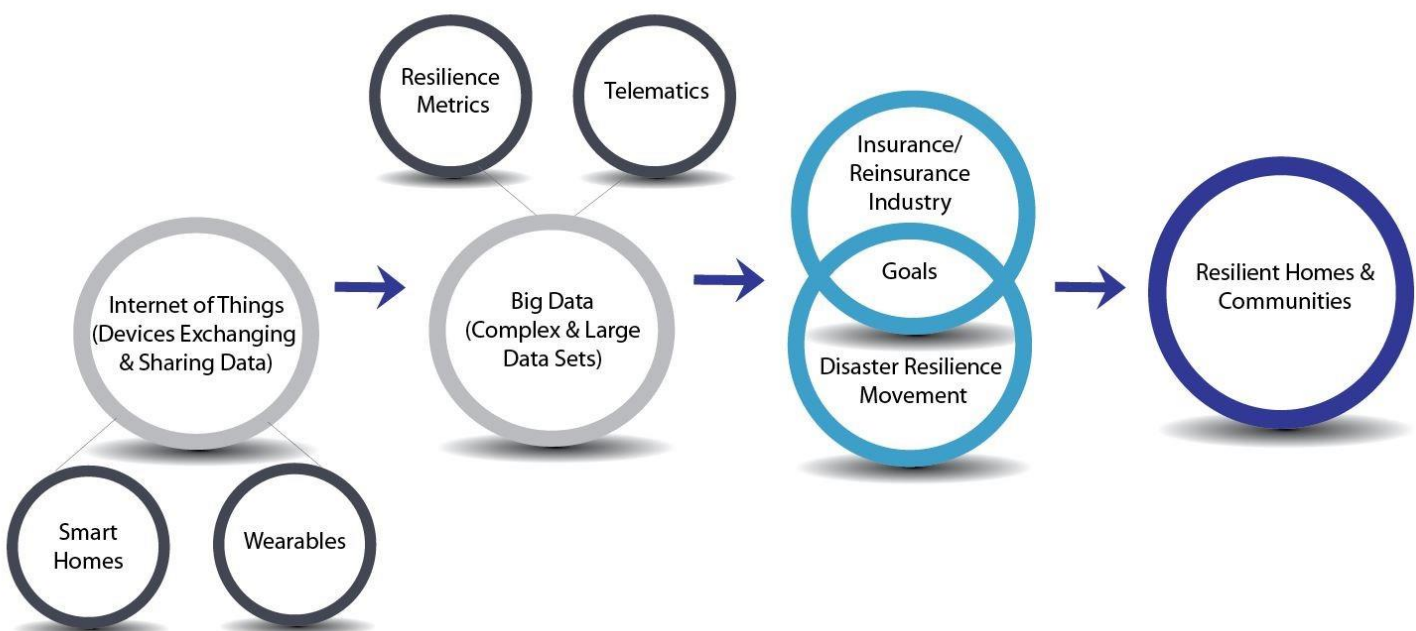
Is there a collaborative intersection between societal and insurers and reinsurers' interests that can advance the disaster resilience movement while creating shared value



through safer communities and stronger markets? The answer is emphatically yes, and a few visionary companies are already leading the way.

The insurance industry is accustomed to using data to drive decisions, and the rise of big data and the IoT presents unprecedented opportunities for reinvention. Each insurance company will eventually determine how they can leverage big data and the IoT. However, no matter the strategy or tactic, collaboration with resilience advocates is essential for success.

When that occurs, the possibilities for this transformation will be endless. And we will have landed squarely at the intersection of shared value.



## END NOTES

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