ETHICS FOR ENGINEERS

Kate Golden,
Vice President, Associate General Counsel
M. A. Mortenson Company
(Also licensed as a Professional Engineer in Minnesota)
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### Most Ethical Profession

<table>
<thead>
<tr>
<th>Profession</th>
<th>% Very high/High</th>
<th>% Average</th>
<th>% Low/Very low</th>
<th>% No opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurses</td>
<td>84</td>
<td>25</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Medical doctors</td>
<td>67</td>
<td>25</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Pharmacists</td>
<td>66</td>
<td>28</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>High school teachers</td>
<td>60</td>
<td>29</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Police officers</td>
<td>54</td>
<td>32</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Accountants</td>
<td>42</td>
<td>48</td>
<td>7</td>
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<tr>
<td>Funeral directors</td>
<td>39</td>
<td>42</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Clergy</td>
<td>37</td>
<td>43</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Journalists</td>
<td>33</td>
<td>31</td>
<td>34</td>
<td>10</td>
</tr>
<tr>
<td>Building contractors</td>
<td>29</td>
<td>49</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Bankers</td>
<td>27</td>
<td>50</td>
<td>21</td>
<td>10</td>
</tr>
<tr>
<td>Real estate agents</td>
<td>26</td>
<td>54</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>Labor union leaders</td>
<td>21</td>
<td>42</td>
<td>31</td>
<td>10</td>
</tr>
<tr>
<td>Lawyers</td>
<td>19</td>
<td>51</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>Business executives</td>
<td>17</td>
<td>49</td>
<td>32</td>
<td>10</td>
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<tr>
<td>Stockbrokers</td>
<td>14</td>
<td>48</td>
<td>32</td>
<td>10</td>
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<tr>
<td>Advertising practitioners</td>
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<td>46</td>
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<td>Telemarketers</td>
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<td>32</td>
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<td>Car salespeople</td>
<td>8</td>
<td>47</td>
<td>44</td>
<td>10</td>
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<tr>
<td>Members of Congress</td>
<td>8</td>
<td>32</td>
<td>50</td>
<td>10</td>
</tr>
</tbody>
</table>

**Engineers -- 65% (2016)**

**Lawyers -- 19%**

Why do bad things happen to good people (despite their best intentions)?
Why do good people do bad things?
Assume only “bad” people engage in unethical behavior…. That’s not me
Really... are you sure?
Small ethical lapses can lead to bigger ethical missteps...
737 Max Challenges

How the new Max flight-control system (MCAS) operates to prevent a stall

The angle of attack—the angle between the wing and the airflow—is fed into the flight computer. If this angle rises too high, suggesting an imminent stall, the MCAS activates.

The antistall system depended crucially on sensors that are installed on each side of the airliner—but the system consulted only the sensor on one side.

Illustration: Norebbo.com
What might be the ethical dilemmas or issues?
“In the 737 Max, the engine nacelles themselves can, at high angles of attack, work as a wing and produce lift. And the lift they produce is well ahead of the wing’s center of lift, meaning the nacelles will cause the 737 Max at a high angle of attack to go to a higher angle of attack. This is aerodynamic malpractice of the worst kind.”
Software relied on a single sensor & not easy to override

• If error: inexperience? QA/QC?
• Culture of routinely pushing out software fixes?
• Failing to inform of software
FAA certification process using Boeing personnel

Was self-certifying conflict of interest?
Model left in service after first accident

- FAA determined “underlying risks from the MCAS design were unacceptably high without at least some FAA action, that they exceeded internal FAA safety standards and that the likelihood of another emergency or even accident “was over our threshold’.”
But why?
Failing recognize conflicting or irreconcilable goals?
Excessive pressure to reach unrealistic performance targets?
Framing decision as business as a management or business decision – not an ethical decision / dilemma

Is it acceptable for an engineer to point out risks but leave the decision up to management or others?
February 29, 2018 photos of cracks
Pictures taken March 14, 2018
### NTSB Report Synopsis (10/19)

**Probable cause:** Design deficient – underestimated demand, overestimated capacity

### OSHA Conclusions (7/19)

- Structural **design deficient**

### EOR Conclusions (9/19)

- Construction deviated from plans and specs (construction joint not roughened)

### Third party review

- Firm not qualified
- **EOR failed** to recognize danger of collapse; should have had peer review
- Twisting during **bridge move** exceed limits (but not disclosed until later)

### Third party review insufficient/incomplete

- **Third-party design review** insufficient
- Info received by EOR about cracks incomplete

### EOR/contractor/on-site inspector/owner/FDOT should have

- Shored bridge, closed street
- On-site inspector/contractor failed to exercise independent judgment to close street, shore bridge
- Others should have acted to close street
What might be the ethical dilemmas or issues?
What are possible ethical dilemmas?

<table>
<thead>
<tr>
<th>Communications among team</th>
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</thead>
<tbody>
<tr>
<td>Sufficiency of third-party design review</td>
</tr>
<tr>
<td>Failure to obtain independent review of cracking</td>
</tr>
<tr>
<td>Failure to close highway</td>
</tr>
</tbody>
</table>
Why didn’t they stop traffic?

“The bridge was talking to them. It wasn’t just talking — it was screaming that there was something definitely wrong with this bridge. Yet no one was listening.”

-- Robert L. Sumwalt, NTSB chairman
Failing recognize conflicting or irreconcilable goals?

• Don’t close the highway
• (\$\$ / Time)
• Safety
Psychologically unsafe to speak up?
Attempting to correct own error?
Why do good people do bad things?
What to do?

Reflect
Review standards
Make a list

Learn
Attend trainings, but beware...

Get advice
“Phone a friend”
Also supervisor, compliance hotline, professional organization resources

Take action
Discuss, confront, report

Analyze “why”
THANK YOU!

Kate Golden
Vice President, Associate General Counsel
M. A. Mortenson Company
kate.golden@mortenson.com
Engineers in the fulfillment of their professional duties shall:
1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully, so as to enhance the honor, reputation, and usefulness of the profession.