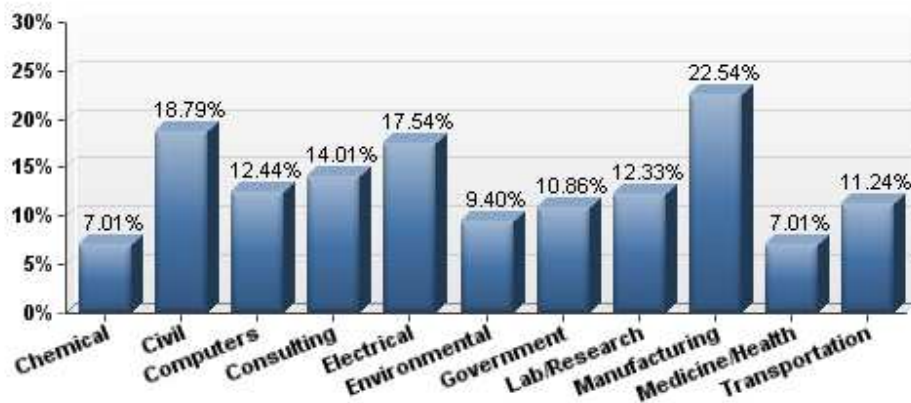


## Survey of Engineering Graduates

How People Learn Engineering – Draft Report March 2012

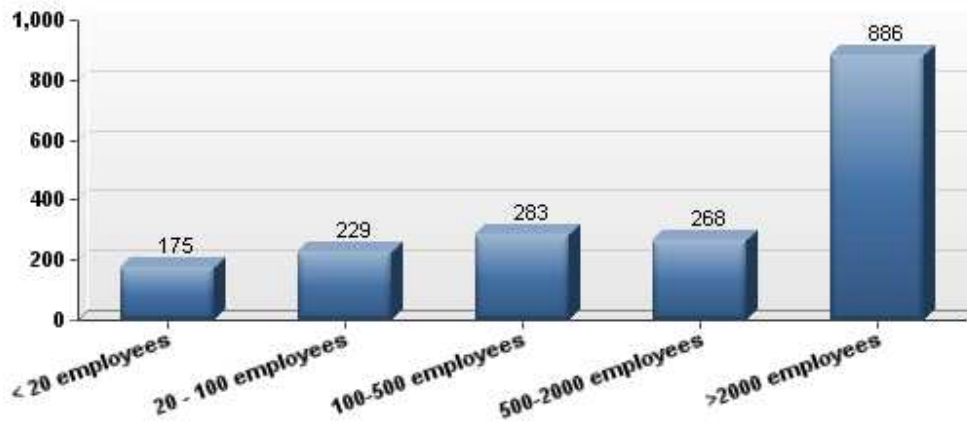
We surveyed college of engineering alumni of a large, research 1, public university, as well as engineers and engineering managers on the mailing list of the university's Engineering Professional Development (EPD) Department. We reviewed the two lists to eliminate any overlap. In the end, we sent the survey to approximately 10,000 university alumni and 4,000 EPD contacts. Only approximately 12% of individuals fully completed the survey (N = 1667), so we plan to send the survey to these populations again to understand possible non-responder bias. Engineering or other degrees were earned by respondents between 1967 and 2010. The following graphs give a basic overview of the survey responses. Future work will include statistically comparing these results by the following subgroups: male, female, ethnicity, year of degree, employment status (manager vs. traditional engineer vs. no longer in engineering career), type of industry, size of company, and type/major of degree held. For each of the questions in the survey, the basic data is provided in the charts and tables below. Quotes from engineers to add depth to these questions are also provided for some key questions. These quotes come from interviews and past surveys of engineering alumni that included open-ended questions.

### 1. Check the type of work that you do (you may select more than one)



## 2. What is the size of your firm? (entire company)

1	< 20 employees		175	10%
2	20 - 100 employees		229	12%
3	100-500 employees		283	15%
4	500-2000 employees		268	15%
5	>2000 employees		886	48%
	Total		1,841	100%



**3. What past positions have you had, beyond undergraduate education? Please use the drop-down menus to indicate how long you were in that position, where applicable.**

1	"Traditional" practicing engineer (may include some project leadership)	162	119	350	275	217	372	1,495	3.92
2	Engineering team leader or manager	441	85	198	157	100	270	1,251	3.16
3	Not engineering related	512	107	178	100	77	177	1,151	2.70
4	Not employed (eg. family leave, medical leave, unemployed)	761	152	67	10	3	1	994	1.34

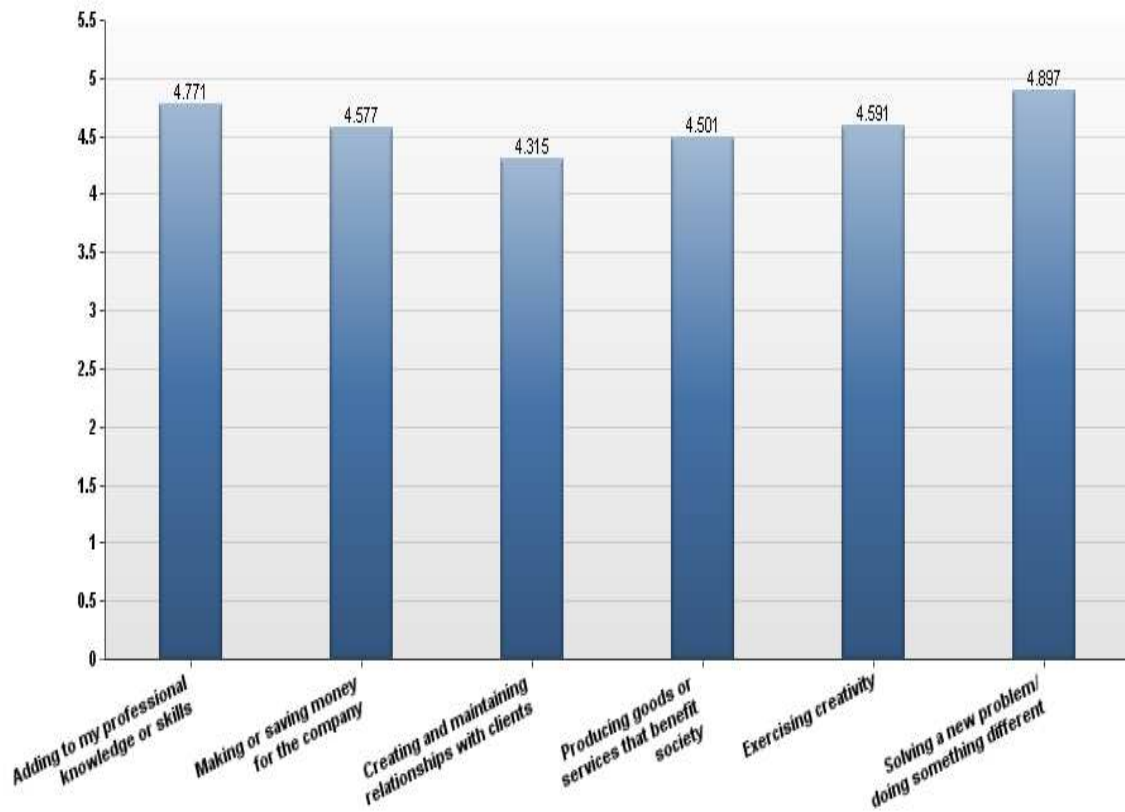
**4. CURRENT position**

1	"Traditional" practicing engineer (may include some project leadership)		849	46%
2	Engineering team leader or manager		532	29%
3	Engineering background, but not in an engineering field		461	25%
	Total		1,842	100%

### 5. How long have you been in your current position?

1	0-3 years		717	42%
2	3-7 years		462	27%
3	7-15 years		301	18%
4	> 15 years		228	13%
	Total		1,708	100%

**6. IF you were able to pick a new project at work, how important would the following reasons be for choosing that project?**



1	Adding to my professional knowledge or skills	14	34	90	433	706	389	1,666	4.77
2	Making or saving money for the company	41	46	160	468	566	385	1,666	4.58
3	Creating and maintaining relationships with clients	58	79	241	488	502	298	1,666	4.32
4	Producing goods or services that benefit society	43	49	171	524	526	353	1,666	4.50
5	Exercising creativity	16	39	134	533	644	300	1,666	4.59
6	Solving a new problem/doing something different	16	15	65	373	756	441	1,666	4.90

Quotes from engineers:

“I feel that I am supporting something I believe in (health care research and provision of care for those that can't afford it). I would be more satisfied if there were ways to learn more skills (database development, research) in my job. I find it very hard to take classes or study outside of work.”

“I am very satisfied with my job because I enjoy my work and I have had the opportunity to grow as an engineer/manager throughout my career. I can honestly state that there has not been one day in my career when I begrudged going to work.”

“I enjoy the problem-solving aspects of the work that I do, such as identifying specific opportunities during the energy audits and defining ways to calculate energy savings from projects.”

**7. Think about your work during the PAST TWO WORK DAYS. How often did you use the following skills?**

1	Teamwork	20	126	286	568	666	1,666	4.04
2	Business understanding	115	317	349	502	383	1,666	3.43
3	Problem solving	8	68	213	637	740	1,666	4.22
4	Communication (eg. writing, presenting, networking)	20	89	178	536	843	1,666	4.26
5	Technical skills	31	167	380	604	484	1,666	3.81
6	Applying foundation knowledge (eg. math, physics)	147	513	410	367	229	1,666	3.01
7	Having a global perspective and cultural awareness	355	471	287	311	242	1,666	2.77
8	Creativity	46	264	449	581	326	1,666	3.53

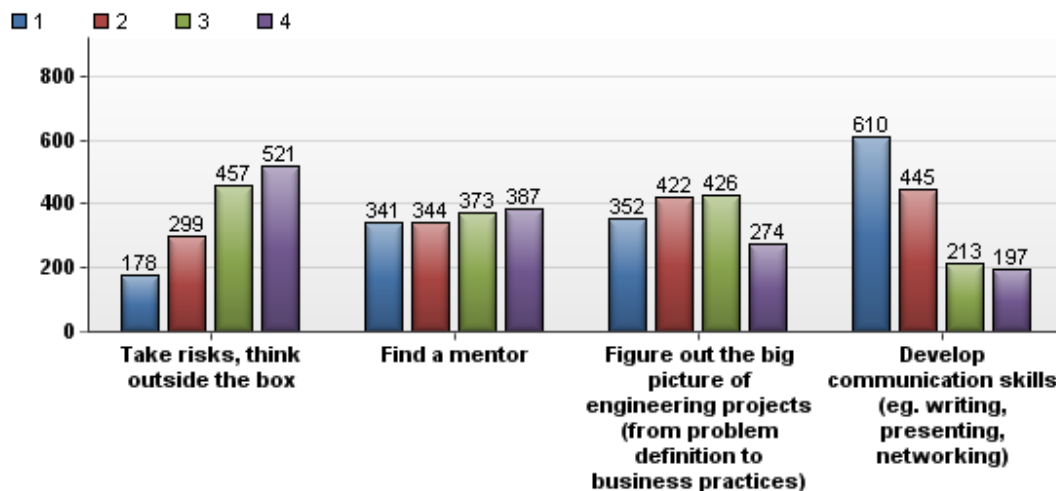
Quote from an engineer:

“When I arrived, they... cut them out and they just [fell] into a dumpster and eventually the dumpster would fill up and someone would have to come along and take it out back and dump it, empty it and replace it. So they wanted something more automatic. There is a problem, looking for an engineer to solve it; make it simpler and make it less manual. That’s a typical engineering project. So we worked with using an air handling system to pull or suck, actually suck the spare waste hauled out from the line and carry them through a duct system with enough air pressure and blow enough static pressure to actually carry them along and take them right to the main dumpster and eliminate someone having to empty smaller units on a regular basis. And there was some bumps

along the road but we created a system that worked and like I said reduced manual labor...It's the epitome of engineering."

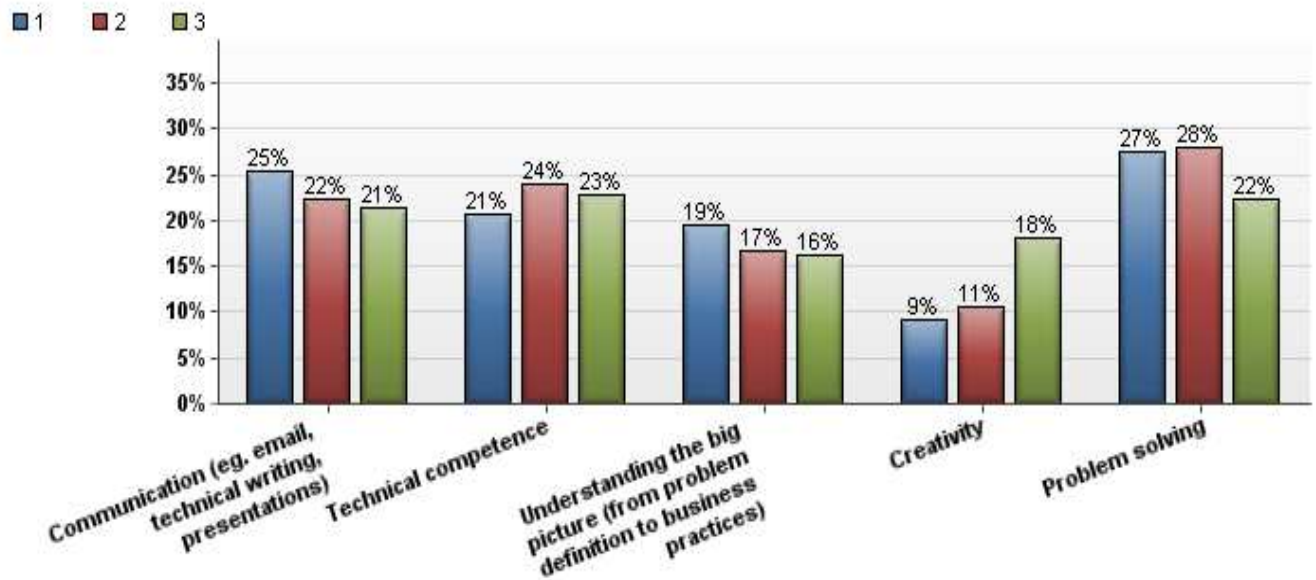
**8. Please rank the following advice for NEW engineers, with 1 being the most important to 4 being the least important.**

1	Take risks, think outside the box	178	299	457	521	1,455
2	Find a mentor	341	344	373	387	1,445
3	Figure out the big picture of engineering projects (from problem definition to business practices)	352	422	426	274	1,474
4	Develop communication skills (eg. writing, presenting, networking)	610	445	213	197	1,465
	Total	1481	1510	1469	1379	-





**9. Please rank the following skills for EFFECTIVE engineers, with 1 being the most important and 5 being the least important.**



1	Communication (eg. email, technical writing, presentations)	387	341	325	267	201	1,521
2	Technical competence	310	362	344	293	199	1,508
3	Understanding the big picture (from problem definition to business practices)	294	252	245	339	379	1,509
4	Creativity	140	160	274	373	563	1,510
5	Problem solving	412	422	334	206	130	1,504
	Total	1543	1537	1522	1478	1472	-

Quote from an engineer:

“Some projects, different engineering firms are hired for different components and once they develop a design they hand it off to contractors to follow through and there is not always that oversight or that communication to kind of watch to see if the contractors are following through with what was intended. I would say as an engineer that is something that they should be trying to not just provide the one thing that the client thinks they need but also to look at the project as a whole to try and provide feedback or suggest to them where else they maybe should be part of the project to review and evaluate what’s going forward.”

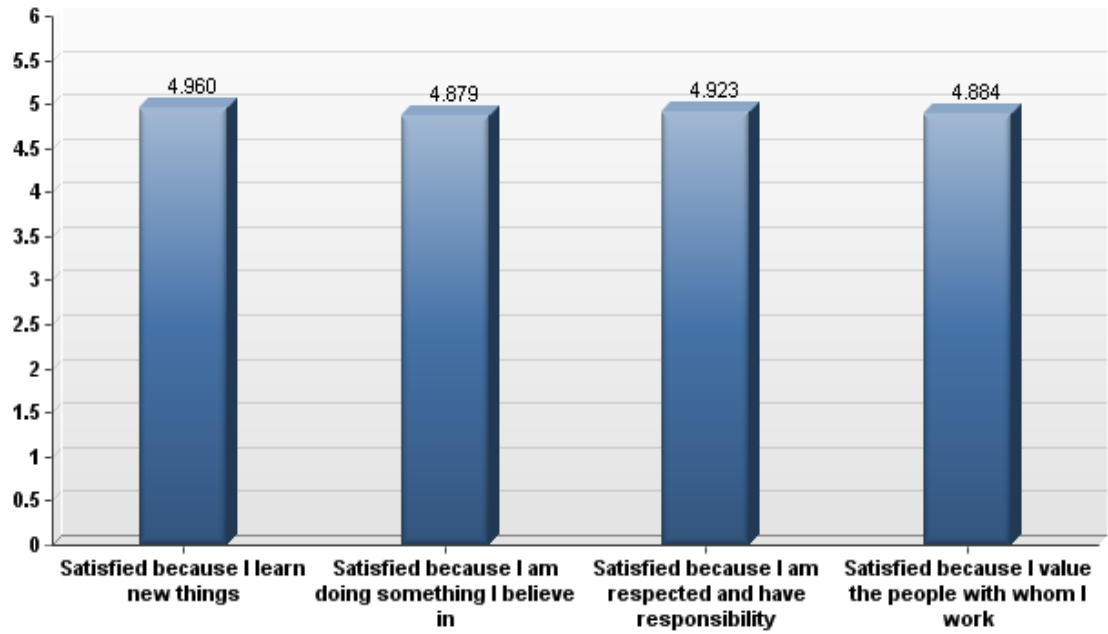
**10. Consider why you are an engineer. Select how much you agree with the statement, "I am an engineer because I ...."**

4	Enjoy designing things	11	42	84	392	645	454	1,628	4.83
3	Enjoy helping people	23	53	121	459	627	345	1,628	4.63
2	Enjoy solving problems	5	4	3	88	557	971	1,628	5.52
1	Enjoy tinkering	25	90	145	476	531	361	1,628	4.52
5	Enjoy work with clients	62	127	216	578	460	185	1,628	4.11

**11. Overall, how satisfied are you with your current job?**

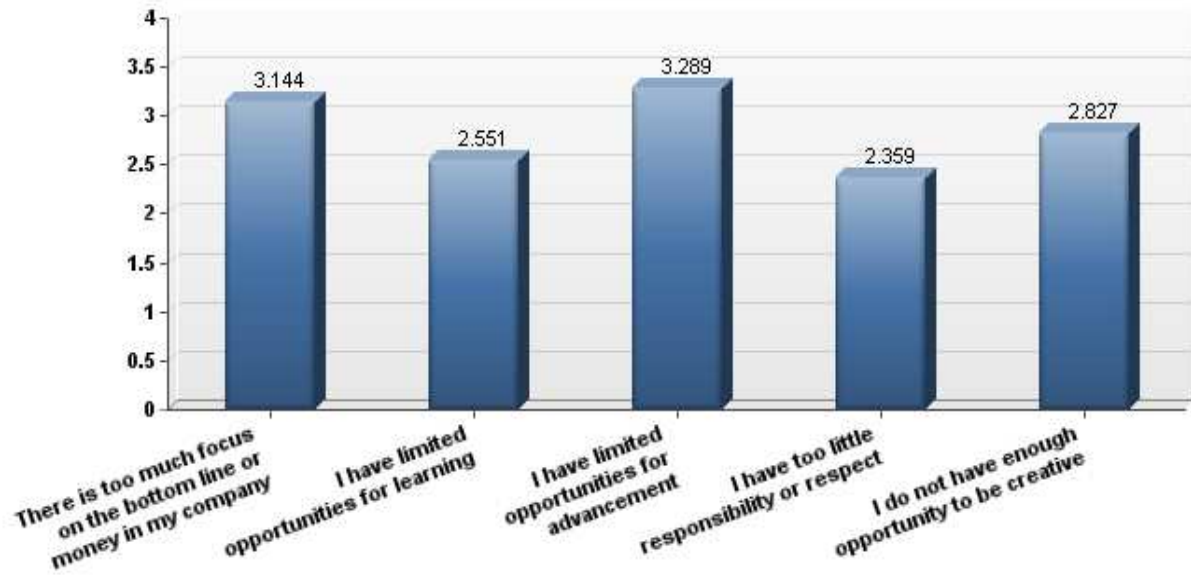
1	Very Dissatisfied		16	1%
2	Dissatisfied		69	4%
3	Neutral		157	10%
4	Satisfied		773	50%
5	Very Satisfied		532	34%
	Total		1,547	100%

**12. To what extent are the following job satisfaction factors true for you?**



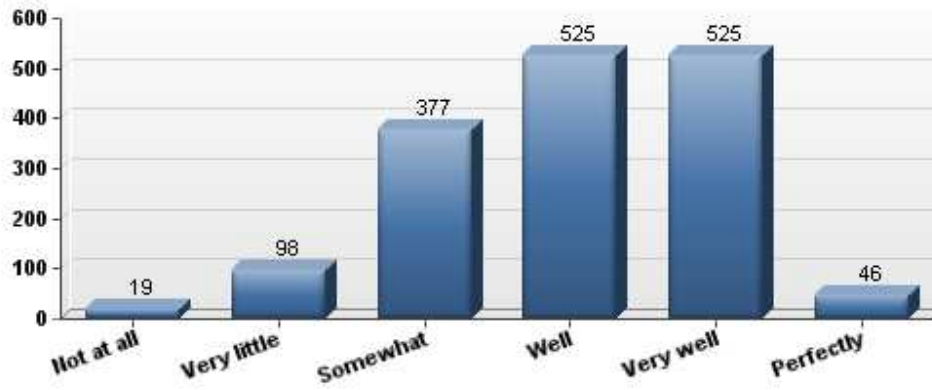
1	Satisfied because I learn new things	15	26	55	367	600	550	1,613	4.96
2	Satisfied because I am doing something I believe in	15	32	97	375	565	530	1,614	4.88
3	Satisfied because I am respected and have responsibility	26	33	58	348	605	543	1,613	4.92
4	Satisfied because I value the people with whom I work	21	20	77	369	646	480	1,613	4.88

**13. To what extent are the following job dissatisfaction factors true for you?**



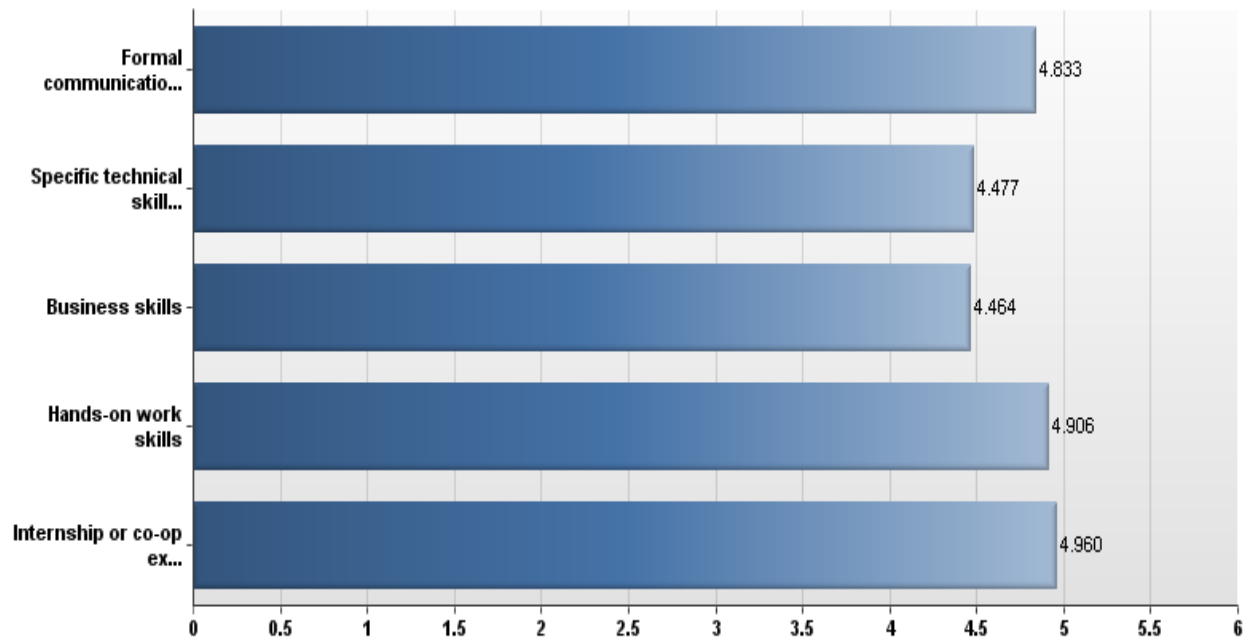
1	There is too much focus on the bottom line or money in my company	207	387	345	414	158	101	1,612	3.14
2	I have limited opportunities for learning	434	489	275	249	115	51	1,613	2.55
3	I have limited opportunities for advancement	266	308	255	414	221	150	1,614	3.29
4	I have too little responsibility or respect	502	540	244	195	84	49	1,614	2.36
5	I do not have enough opportunity to be creative	270	472	381	306	122	61	1,612	2.83

**14. How well did your formal, undergraduate education prepare you for the work you are now doing?**



1	Not at all		19	1%
2	Very little		98	6%
3	Somewhat		377	24%
4	Well		525	33%
5	Very well		525	33%
6	Perfectly		46	3%
	Total		1,590	100%

15. Based on work you have done, select how much you agree with the statement, "I think undergraduate education should include more \_\_\_\_\_."





1	Formal communication skills (eg. technical writing, presenting)	6	31	105	400	586	462	1,590	4.83
2	Informal communication skills (eg. listening, emailing, connecting with the right people, networking)	19	71	155	491	512	342	1,590	4.53
3	Specific technical skills appropriate to your field	9	65	220	440	576	280	1,590	4.48
4	General, broad field, engineering knowledge	12	68	216	550	540	204	1,590	4.35
5	Business skills	9	66	171	529	562	253	1,590	4.46
6	Hands-on work skills	6	29	107	338	597	513	1,590	4.91
7	Internship or co-op experiences	4	29	88	336	582	551	1,590	4.96
8	Global or multicultural learning (eg. study abroad, learning a language)	79	247	322	543	259	140	1,590	3.68
9	Opportunities to be creative	6	62	204	629	501	188	1,590	4.33
10	Liberal arts courses	182	364	440	377	168	59	1,590	3.10

Quote from an engineer:

Interviewer: Where did you learn those skills?

Engineer: "On the job and in school. College is great for teaching theory and problem solving skills but nothing can substitute real world experience."

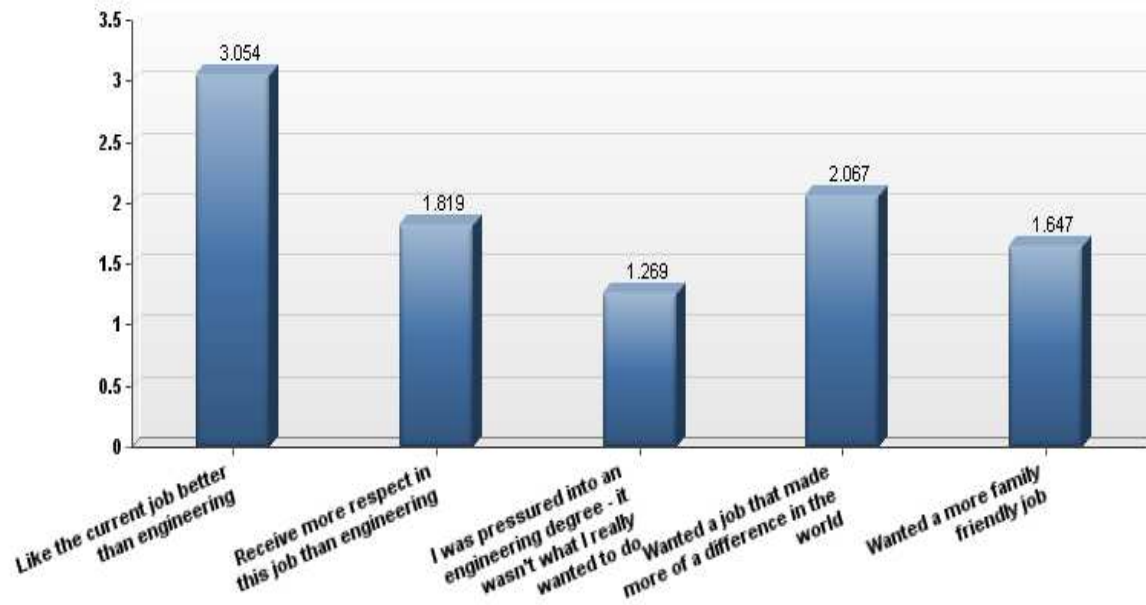
### 16. What is your gender?

1	Male		1,344	85%
2	Female		230	15%
	Total		1,574	100%

### 17. What is your race/ethnicity?

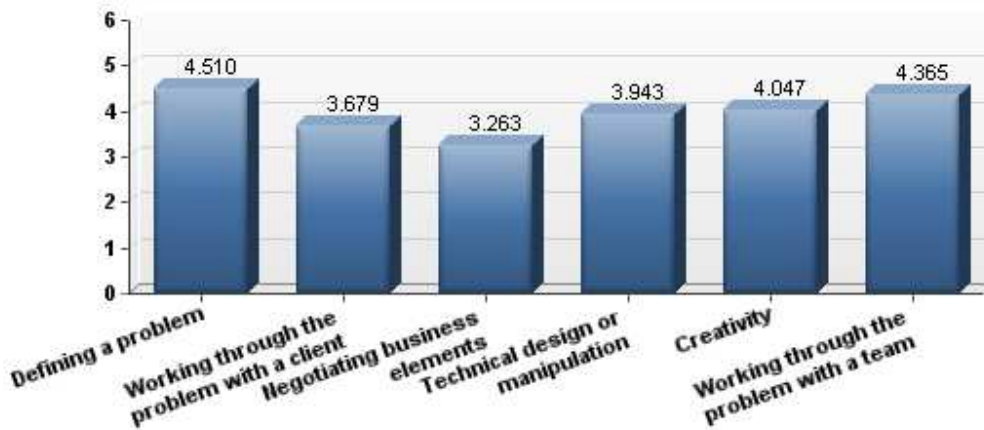
1	American Indian or Alaskan Native		4	0%
2	Asian		129	8%
3	Black or African American		21	1%
4	Hispanic or Latino		37	2%
5	White		1,323	84%
6	Other		54	3%
	Total		1,568	100%

18. For each of the following reasons, select how significant they were in your decision to not be in engineering now.



3	Like the current job better than engineering	105	45	62	109	84	405	3.05
4	Receive more respect in this job than engineering	247	44	61	40	11	403	1.82
5	I was pressured into an engineering degree - it wasn't what I really wanted to do	336	36	21	6	3	402	1.27
2	Wanted a job that made more of a difference in the world	208	61	57	50	26	402	2.07
1	Wanted a more family friendly job	279	42	41	24	16	402	1.65

**19. In your current work, how often are the following involved in your thinking and problem solving?**



1	Defining a problem	7	46	222	536	483	344	1,638	4.51
2	Working through the problem with a client	103	217	395	482	270	171	1,638	3.68
3	Negotiating business elements	167	371	435	325	210	130	1,638	3.26
4	Technical design or manipulation	61	181	330	481	388	197	1,638	3.94
5	Creativity	10	78	433	597	344	176	1,638	4.05
6	Working through the problem with a team	10	61	274	532	498	263	1,638	4.37

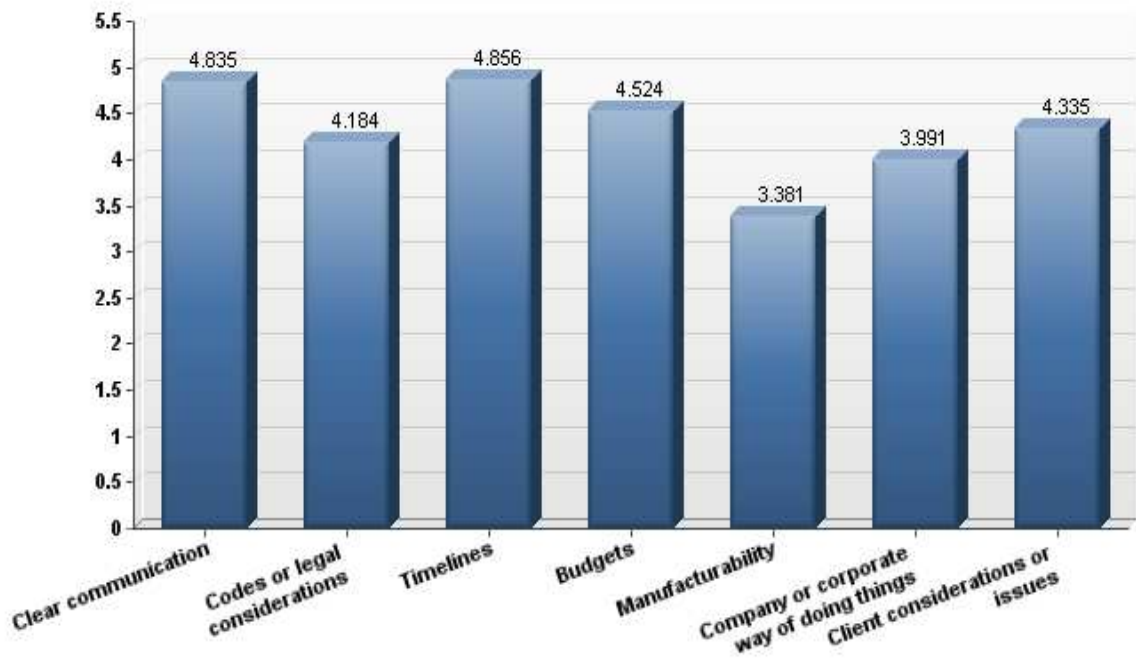
Quotes from engineers:

“So now we’ve got a \_\_\_\_\_ that’s dead back there so I got to drive two guys back there to try to figure out the cause and then work with the team to drive corrective action so that it doesn’t happen anymore.”

Interviewer: “What do you think your major disagreements tend to center around?”

Engineer: “It’s always interesting. Fundamentally, I would [argue] that we are both right. It is usually nothing huge we are disagreeing on something. It’s usually we are disagreeing on the wording that is coming out and describing it. That is why we always draw it—some subtle way how you define something.”

**20. How often are the following constraints involved in your current work?**

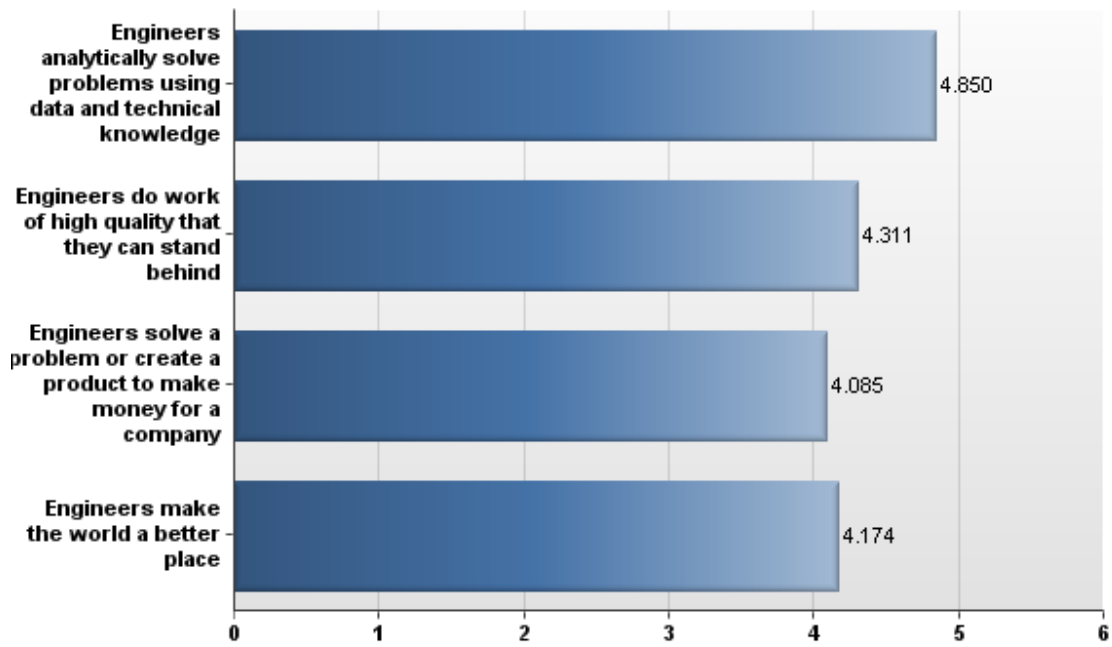


1	Clear communication	7	37	202	313	494	585	1,638	4.83
2	Codes or legal considerations	52	183	346	317	311	429	1,638	4.18
3	Timelines	6	27	132	389	562	522	1,638	4.86
4	Budgets	34	100	225	369	434	476	1,638	4.52
5	Manufacturability	262	313	327	236	275	225	1,638	3.38
6	Company or corporate way of doing things	57	167	345	463	376	230	1,638	3.99
7	Client considerations or issues	42	112	276	383	475	350	1,638	4.34

Quote from an engineer:

“So dealing with a particular contractor and just wanting to please the owner, it ended up being a lot more work for us. The fee originally was to do the \_\_\_\_\_ and done. But when you have them going back to the original fuel system, that’s hours upon hours of extra work and I didn’t know if that fee was built in. It probably wasn’t but I didn’t have a project manager to figure out what we had in our contracts and I didn’t have the time to look into that so. It was a pretty trying. It was a good three weeks of my life that were pretty stressful and I was pulling out my hair and we were getting calls left and right. Trying to figure that out and it was we need it now type of thing.

## 21. How well do these statements describe engineering work?





1	Engineers analytically solve problems using data and technical knowledge	1	25	96	353	774	379	1,628	4.85
2	Engineers do work of high quality that they can stand behind	30	77	219	492	651	159	1,628	4.31
3	Engineers solve a problem or create a product to make money for a company	38	112	330	500	489	159	1,628	4.09
4	Engineers make the world a better place	33	116	299	459	529	192	1,628	4.17

Quotes from engineers:

“Engineering to me represents thinking about what you are doing and options to make it better. The contractor typically locates \_\_\_\_\_ at the maximum distance apart which creates a higher pressure requirement... Using engineering limitations associated with the hydraulic calculations, I was able to work with the contractor to relocate the \_\_\_\_\_ and minimize the pressure required.

This was applying the knowledge of calculations, rather than just running a calculation without thinking about what it means.”

“And I think back to I just think that there are lots of different fields for engineering but I think what relates them all is the whole problem solving. You have a problem and you use your technical information, your math, and your science to help solve the problem whether it is environmental, mechanical or whatever.

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