

# My Transition to Entrepreneurship

*A Different Way to Perceive Work and Risk*

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Why did I become a power systems engineer?

Why did YOU become a power systems engineer?



# I became a power systems engineer because...

- My original goals from early teens were to use all available resources to →
  - Obtain good, stable employment
  - Establish a level of solvency so that my relationships were not defined by financial strain
  - Fall in love and get married 😊
  - Have a clean, comfortable, functional home
- Power Systems was a solution because it was the least risky path to the lifestyle I desired →
  - Engineering disciplines in general tend to be well paid and in demand
  - Electric power industry is fundamental to economy and tends to be stable
  - Electric power industry suffers from age disparity



# How did that go?

- 2005 (18) → First Day at Virginia Tech
- 2008 (21) → Blue Ridge Electric Internship
- 2009 (22) → BSEE, ExxonMobil Internship
- 2010 (23) → ExxonMobil Internship, Fell in love with Tania
- 2011 (24) → MSEE
- 2012 (25) → Dominion Internship, Married Tania
- 2013 (26) → PHD EE, Engineer III @ Dominion, 3 $\Phi$ LSE
- 2014 (27) → First side gigs for LSE
- 2015 (28) → Built a new (first) home
- 2017 (30) → Started Grid Widget Labs, Consulting Engineer @ Dominion



Life is good. But...

I miscalculated...



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# First Observation on Risk

"If I don't eat and drink, I will die. Therefore, I cannot dedicate my focus to other pursuits (synchronophasors!) I may not be able to eat and drink and will then die."

*But what is the probability that you won't be able to eat?*

"If I take a riskier job or start a company to dedicate myself to other pursuits and if I lose my job or the company fails I may lose money/lose reputation/lose friends/etc."

*But what is the probably that you won't rebound into a job that is just as stable as your first one? Especially in this industry? Or that through your misadventure wont stumble onto an even better job?*





But if life is good...

Why take any additional risks at all?





# Maslow's Hierarchy of Needs





I won't live without this

I will die without this



# Second Observation on Risk

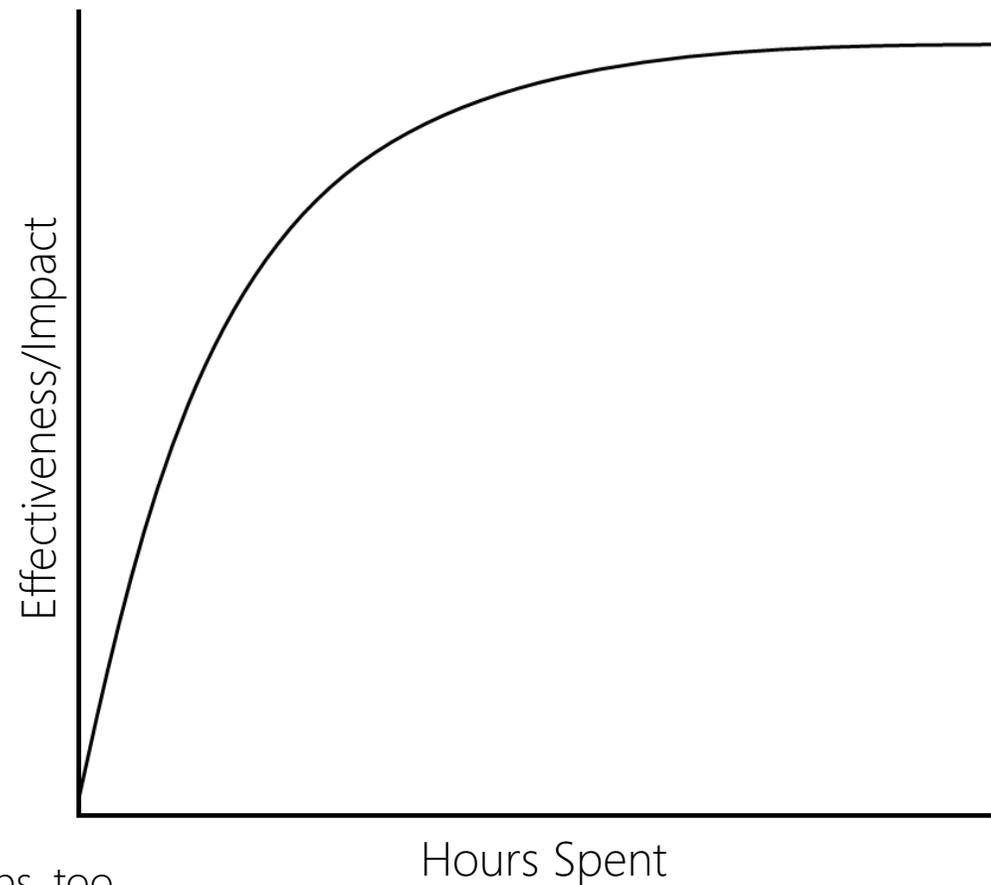


- There is potential loss at either end of the continuum
- In power system protection, you understand this as the “Security-Dependability”
- Colloquially, “You’ll never know if you don’t try.”



# What I Did First

- I put all of my time and energy into my FT job<sup>†</sup>.
- However:
  - There are diminishing returns within a single pursuit.
  - The scope of your impact is approximately limited to the scope of the job<sup>†</sup>.
  - You're overall effectiveness is diminished on creative pursuits after a certain amount of time spent.



<sup>†</sup> Don't get me wrong. There are many, many good things about FT jobs, too.



# How Much Time is Available Weekly?

## Periodic Sinks

(Nominally ~126 hours)

- Sleep
- Exercise
- Hygiene
- Commute(s)
- FT Job
- Food Prep and Eating

## Aperiodic Sinks

(Remaining ~42 hours)

- Clean the house/apartment
- Laundry
- Family/Friends
- Lawncare
- Grocery shopping
- Home improvement projects
- Doctor
- Kids
- Time on your phone
- Entertainment
- Other errands
- Driving to facilitate other activities



# The Incremental Hour in Creative Pursuits

- Began with a simple observation of how I was spending my time.
- After you've met the minimum time responsibility for a given period (generally 40 hours) what do you do with the 41<sup>st</sup> hour? The 42<sup>nd</sup>? The 43<sup>rd</sup>?
- This iterative reevaluation will help you know when to stop and work on something else!
- Counting your time begs the question: What is "Work"?



# What is “Work”?

- We’re surrounded by a culture that perceives “work” through an industrial lens. However...
- You are a “knowledge worker” in a “knowledge economy”



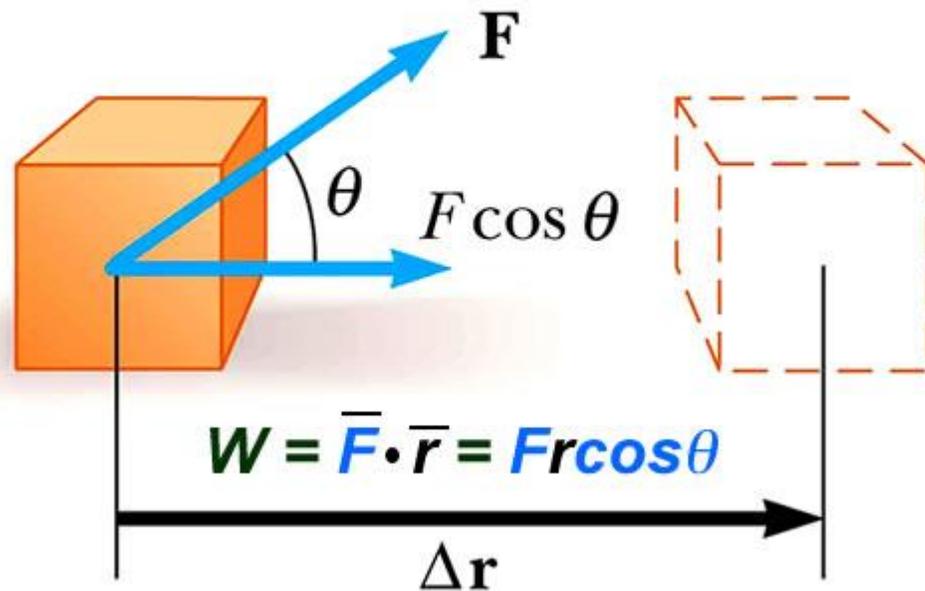
# What is “Work”?

- What is hard work?
- Who is a hard worker?
- If a knowledge worker does not have bounded hours, what is the role of sleep, hygiene, relaxation, in the context of work?



# What is "Work"?

**Work = Force  $\times$  Displacement**



- Work is sequence of directed actions by an individual or a team that results in an orchestrated "change of state" that is in line with the goals of the individual or team.



# Third Observation on Risk

- With an FT job<sup>†</sup>, all revenue is from a single source and not necessarily linked to your performance.
- Your FT job<sup>†</sup> determines most of the people that you interact with
- Your FT job<sup>†</sup> determines how, when, and where you spend your time.
- All of these things:
  - Affect your potential for impact
  - Influence who you become



<sup>†</sup> Don't get me wrong. There are many, many good things about FT jobs, too.



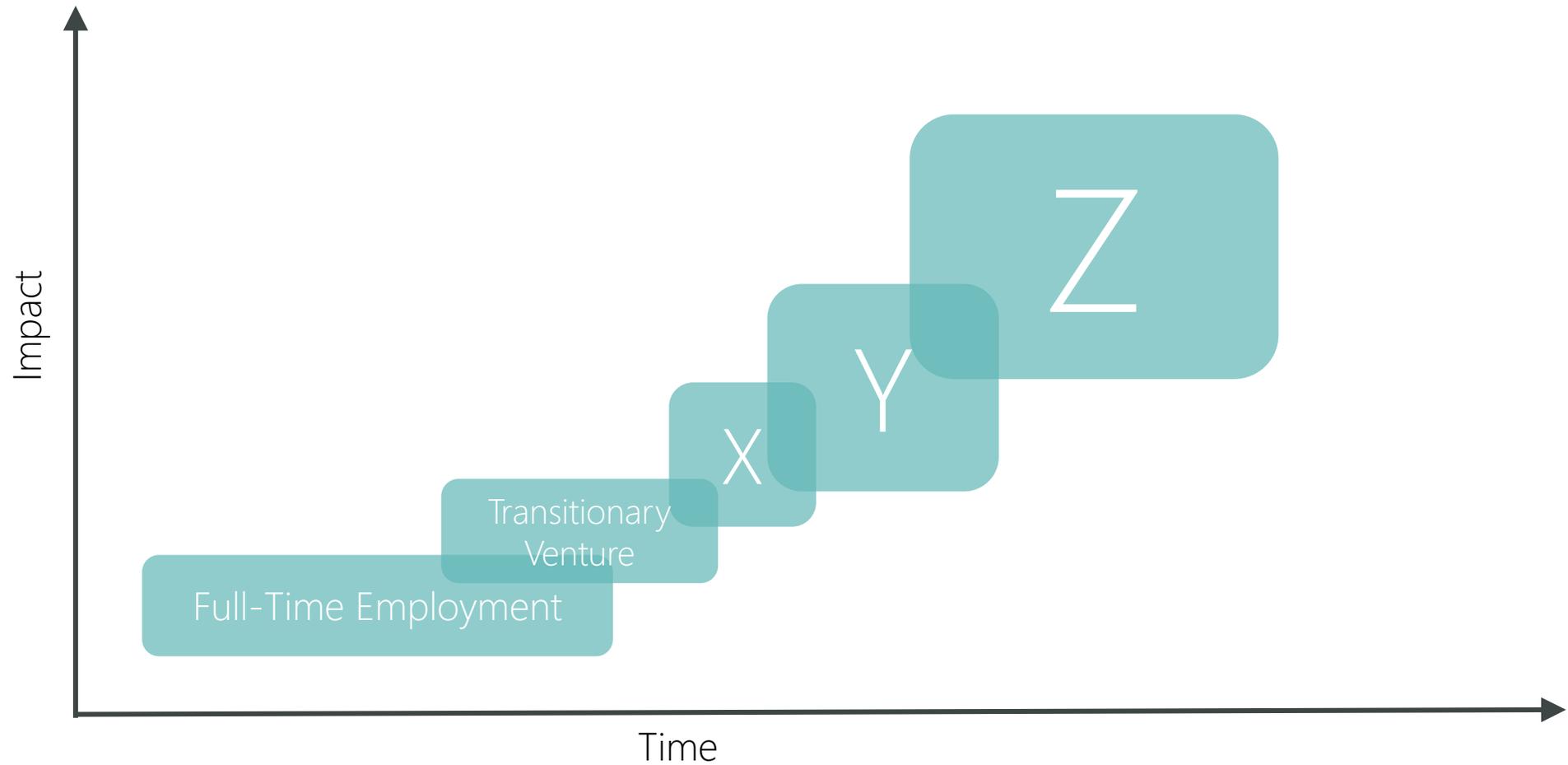
# Think of Yourself as a Business or an Investment

- Diversification of skills, networks, relationships, perspectives
- Jobs, roles, skills as revenue streams
- Each revenue stream has a capacity and a risk associated with it.

```
class Person(Business):  
  
    def __init__(self):  
        self.revenue_streams = []  
        self.operating_expenses = []  
        self.resources = []  
        self.products = []  
        self.services = []
```



# Back-Calculating an Impact Trajectory

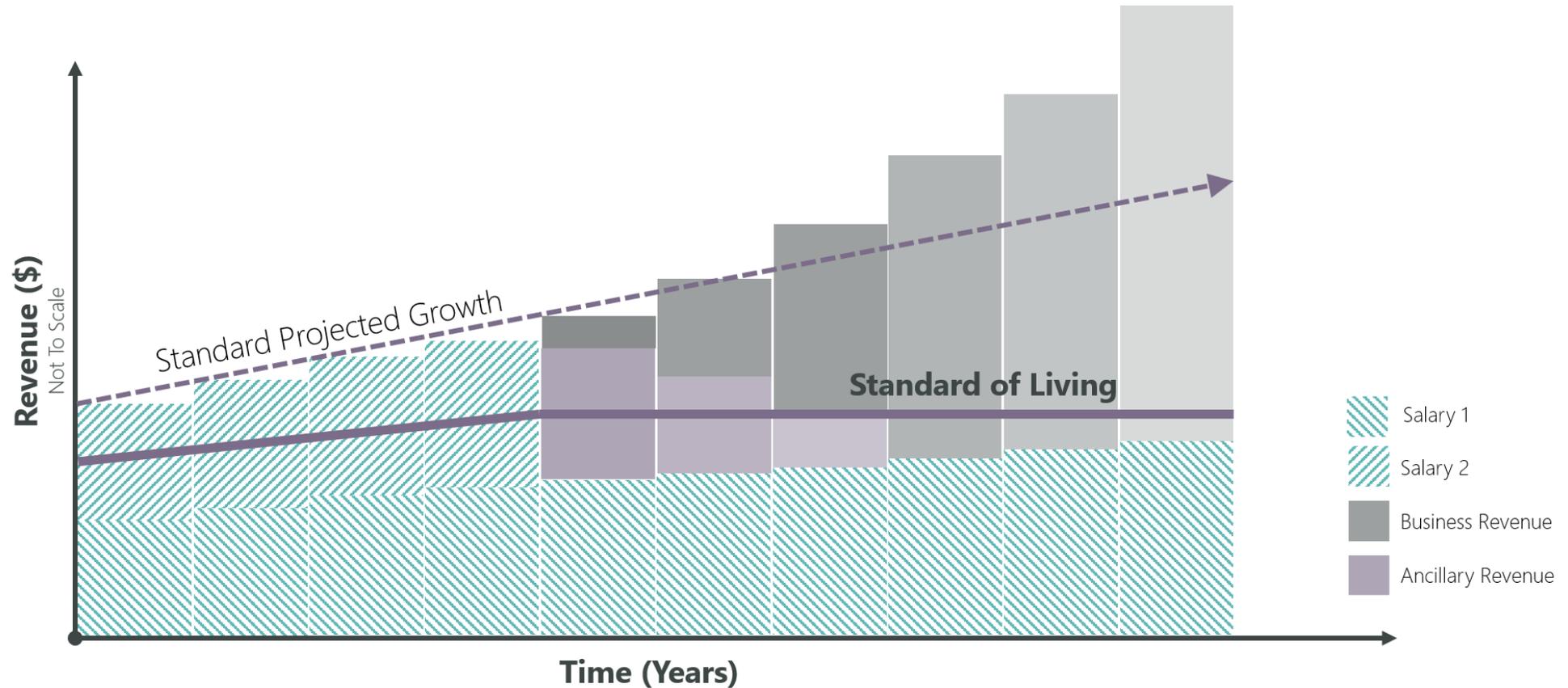


# The Purpose of Starting this Business

- Creating a secondary (eventually primary) revenue
- Increase revenue/time ratio to enable exploration
- Learn new skills through practice (i.e. how to build a business)
- Meet new and interesting people
- *Increase control over the influences in my life to optimize impact:*
  - *Who I work with, when I work, where I work*
  - *What skills I learn, what problems I work on*



# Everything Still Has to Add Up



# Calculating the Cash Equivalent Value of Your Time

*total cash equivalent = salary + bonus + benefits(healthcare, retirement, etc)*

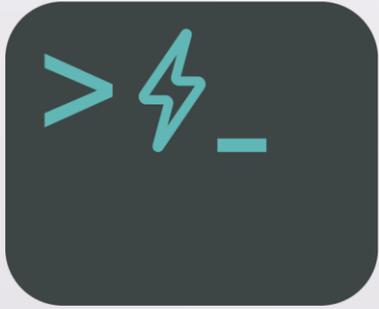
*total available hours = 40 \* (52 - number of weeks off)*

*ancillary revenue hours = total available hours - business hours*

*required hourly rate =  $\frac{\text{total cash equivalent}}{\text{ancillary revenue hours}}$*

Compare this value to contractor rates and other forms of income





# My Transitionary Venture

How Am I Making This Work?

# About Grid Widget Labs

**Grid Widget Laboratories, LLC** is software startup company located in Glen Allen, VA that makes software development tools for power systems engineering. Our first product is a software development kit (SDK) for writing software that interfaces with the electric transmission-grid simulator, PSS®E. The SDK is designed to improve the simulators' usability, save time for the coders, improve code manageability, and help customers extract more value from their simulators by lowering the difficulty level of programmatic analysis of transmission grids.

*Our Mission: The mission of **Grid Widget Labs** is to create and foster a culture of software professionalism and clean coding in the electric power industry by providing valuable, high quality developer tools and learning resources to its customers.*



What does it mean to be a power systems engineer?



What skills define a great power systems engineer?



# The Power Systems Engineer 1.0

- The *"Fundamentalist"* - Characterized by (often heuristic) expert knowledge of power system fundamentals
  - Three phase power and symmetrical components
  - Electric machines: transformers, synchronous and induction motors and generators, voltage regulators, etc.
  - Power system relaying, particularly mechanical relays.
  - Traditional system analysis (power-flow, transient stability, etc.)

**Power Systems**  
**Engineer 1.0** 



# The Power Systems Engineer 1.5

- The *"Jack-of-All-Trades"* – Characterized by strong grasp of cross-cutting fundamentals plus key, applied, ancillary skills such as:
  - Communications, networking, protocols
  - Electronics, power electronics
  - Embedded systems, computing
  - Controls
  - Mathematics, optimization

**Power Systems  
Engineer 1.0**



**Power Systems  
Engineer 1.5**



# The Power Systems Engineer 2.0

- The *"Abstractionist"* – Characterized by strong grasp of cross-cutting fundamentals plus deep expertise and experience with one or more applied, ancillary skills plus *the ability to express this knowledge and work product in software.*

**Power Systems  
Engineer 1.0**



**Power Systems  
Engineer 1.5**



**Power Systems  
Engineer 2.0**



# Why I Take This Seriously

- **The Story**

- Graduate school at Virginia Tech
- Original development of the linear state estimator in DOE Project
- Technology transfer of linear state estimator
- On the job experience

- **The Outcome**

- The technologies that I created have a life of their own
- A skill I didn't want or seek out has been a key differentiator for me throughout my career and has opened doors into new subdomains



# The Power Systems Engineer Skill Gap

- Increased demand for software talent in the electric utility industry
- The rise of the “User-Developer”
- Is it realistic to try to recruit the best software talent? **Probably, not.**
- Is it realistic to think that we can train all power systems engineers to be professional-quality software developers? **Sometimes, yes.**
- Is it realistic to think that we can create technologies to bridge this gap? **Yes! And there are examples of this in other industries.**



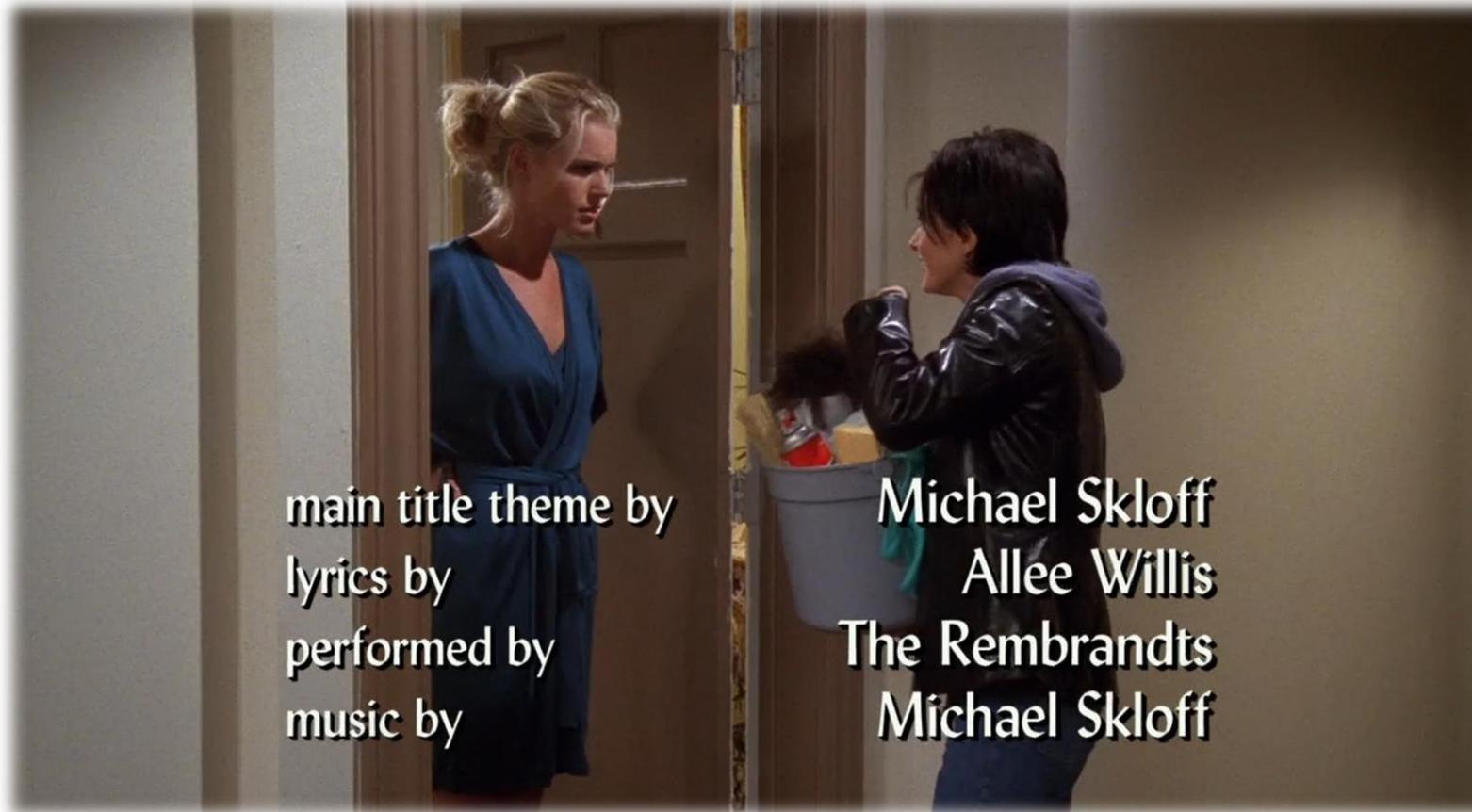
# Most of Our Code.... (Why Does the Skill Gap Matter?)



"Friends" – Season 4 Episode 6 – "The One with the Dirty Girl"



# We Should All Be More Like Monica!



main title theme by  
lyrics by  
performed by  
music by

Michael Skloff  
Allee Willis  
The Rembrandts  
Michael Skloff

"Friends" – Season 4 Episode 6 – "The One with the Dirty Girl"



# A Problem and an Opportunity

Everyday thousands of engineers, researchers, consultants, analysts, students, and developers use PSS®E to solve problems in their jobs. For any use case of scale or complexity, these users take advantage of PSS®E's Python API which means they need to read, write, maintain, and update the Python scripts (and larger programs and libraries). But...



# The Problem with the API

- Utilizing PSS®E at scale is done through its Python API. But...
  - **Its UGLY** – The API is not structurally or idiomatically aligned with its target language or purpose
  - **Its HARD TO USE** – The API calls are cryptic and require intimate knowledge of hundreds of functions and their unique signatures, often with several dozen options each.
  - **Its INTIMIDATING** – The API is a hurdle for many users that alienates them and prevents them from extracting the maximum value from their usage of PSS®E
  - **Its HARD TO LEARN** – For those that are brave enough to try, the learning curve is still incredibly steep.



# The Problem with the API

- Utilizing PSS®E at scale is done through its Python API. But...
  - **Development is TIME CONSUMING** – While documentation is comprehensive, a typical user spends a great deal of time searching for just the right function call and input parameters in the documentation. (repeatedly, because they are so difficult to remember)
  - **Resulting Code is LESS MANAGEABLE** – Many users *attempt* to create their own 'toolbox' to make development easier but these not comprehensive and result in code-bases that are not dependent on a single API because everyone tries to write their own. They are also undocumented and not shared across a community.



# The Opportunity

- The *Endurance SDK* aims to minimize the burdens of working directly with the PSS®E API by providing a professionally architected, programmatic interface and easy to understand documentation.
- The value of this approach is:
  - Make writing Python apps for PSS®E faster, simpler, and more interoperable
  - Reduce cognitive burden on the user with easier to find/read/write commands
  - Lower the bar of required skills to use Python with PSSE while simultaneously empowering the super users.

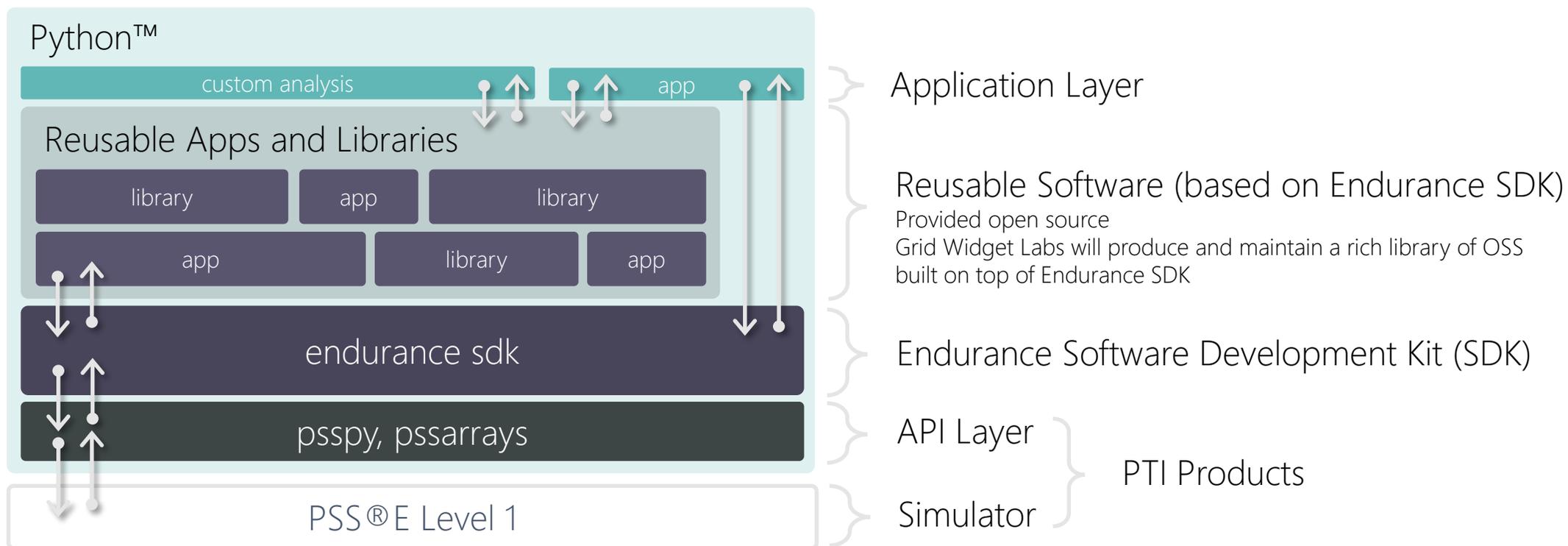


# Products and Services

- *Our First Product*: The **Endurance SDK** for use with PSS® E Base Modules: <http://www.gridwidgetlabs.com/products/endurance-sdk/>
  - Offered through subscriptions
    - All tiers (Industry and Univ.) → Library, docs, basic email and forum support
    - Extended tier (Industry) → Extended support
    - Premium tier (Industry) → Included custom dev. Hours and additional dev at reduced rate.
- *Services* - <http://www.gridwidgetlabs.com/services/>
  - *Code Migration* – migrate legacy code targeting the native API to utilize the Endurance SDK. Options include direct translation or refactored translation.
  - *Code-Along Training* – 1-on-1 training tailored to the individual needs of the user and his/her skill set and experience
  - *Custom Development*



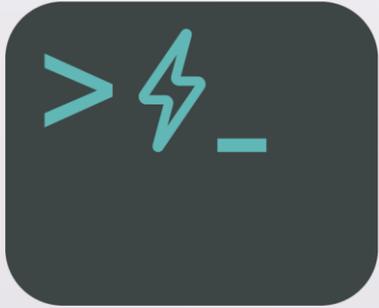
# Our Place in Your Stack



# How to Get Started with Endurance SDK

- <http://www.gridwidgetlabs.com/gettingstarted/>
- **Endurance SDK is now in Beta (RC1 Imminent)**
- Reaching Out
  - <http://www.gridwidgetlabs.com/contact/>
  - [reach.us@gridwidgetlabs.com](mailto:reach.us@gridwidgetlabs.com)
- Signup on Our Website
  - <http://www.gridwidgetlabs.com/accounts/register/>
- Get Validated
  - We find out if you are a student or a member of industry
- Trials
  - We offer full featured trial versions of the software





# If I Was a Student Again...

Some thoughts on the opportunities available as a student in CURENT

# Some Perspectives That I Wish I Had as a Student

*(Things you are working toward are more certain than you probably anticipate. This is not meant to discourage you from working on them but to merely make you understand your true tolerance for risk)*

- The probability of getting a good job with a good salary and good benefits is very high
- The probability of finding love and getting married is very high
- The probability of an upper-middle class lifestyle is very high
- The probability of creating a comfortable home is very high

*Essentially, there is margin for error and room for risk-taking*



# The Opportunity You Have in CURENT

At CURENT, the entrepreneurial equation is different

- Your focus can be on creation, not production
- You have fewer social and financial responsibilities
- You are surrounded by smart people everyday
- You have more control over your schedule
- You have direct access to a network of universities, students, researchers, mentors, industry partners, and government organizations
- You have access to entrepreneurial resources through UTK



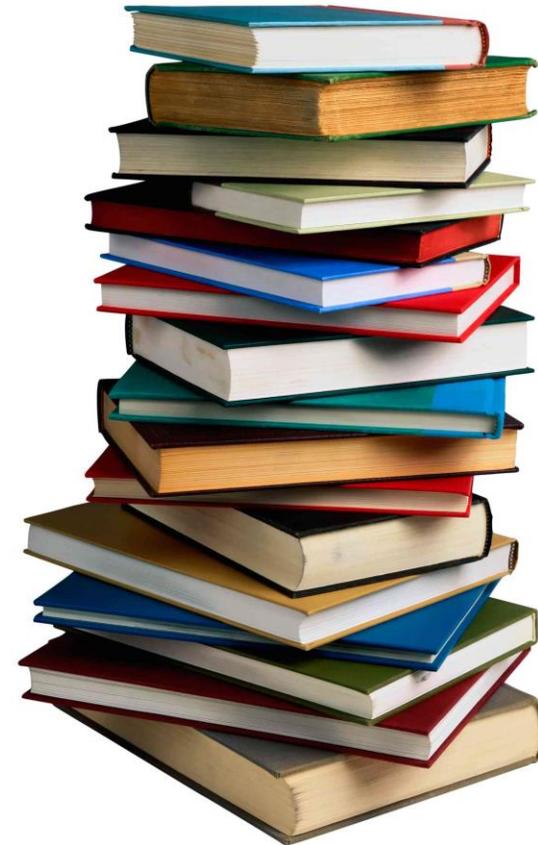
# Seeking Mentors

- You should have at least 3 mentors
  - 3-5 years senior
  - 10-15 years senior
  - Someone nearing the end of their career
- You can't always rely on your environment to provide these relationships. You have to seek out people and advice.



# (Critically) Read as Much as You Can

- Read as much as you can but read everything critically.
- Read anything on the internet doubly critically.
  - Bloggers aren't generally writing to you as an audience and are generally not SMEs.
- Use the Internet to narrow your search.
- Most of what you can learn through an average MBA program you can find good literature for.
- Reading can double as a relaxing activity (i.e. to promote creativity) but can also be functionally valuable from the perspective of work.



# Don't Reinvent the Wheel

- Outsource as much as possible
  - Most services you need to run your business:
    - Have already been created
    - Can be found online
    - Are remarkably affordable
- Don't be afraid to pay for good tools or services
- Grid Widget Labs  
Total operating expenses = ~\$120/mo



# Bringing It All Together

- You have chosen the electric power delivery domain within the energy sector
- The skills that will define high-performing individuals will continue to diversify and cross-pollinate with other industries (we talked about software craftsmanship today)
- The things that you seek, the things that you fear, and way you perceive risk will change as you age and progress through your career.



# Bringing It All Together

- Just as there are advantages to a diversified (but honed) skill-set, there are advantages to diversified revenue streams. The world is changing such that this will be the norm.
- Don't underestimate the likelihood of your success.
- You're in a great position in CURENT to expand your horizons into more "risky" activities without exposing yourself to much real risk.

