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# EMPOWERING TIMES



## THINKING ALOUD

Mathemagic Anyone?  
Jay



## PODIUM

Prof. Sudhir R. Ghorpade  
Institute Chair Professor  
Department of Mathematics  
IIT Bombay



## WE RECOMMEND

Magician in the Desert: Story of Meru  
Cabs  
Gaurav Rao



## WONDER WOMEN

Anupama Tilak  
CEO  
Fluent Services Private Limited, Pune



Dear Reader,

December 22 is the birth anniversary of Ramanujan and observed as National Mathematics Day. In recognition of his contribution to the field, the declaration of this day was made by Dr. Manmohan Singh, the former Prime Minister of India, to mark the 125th birth anniversary of Srinivasa Ramanujan in 2012. Dr. Singh emphasised the need to carry forward the legacy of great mathematicians such as Srinivasa Ramanujan, Aryabhata and Brahmagupta so as to nurture the glorious tradition and skills of the country in Mathematics.

Although the initial steps in Mathematics came about as a result of a need by ancient civilisations, its contribution and its power today in our daily lives cannot be undermined. Read the recent hype created around cryptocurrencies whose existence rely on cryptography - the branch of Mathematics related to keeping information secret! Also, the recent explosion in interest on topics such as Big Data, Artificial Intelligence, among other advancements, highlight the importance of Mathematics.

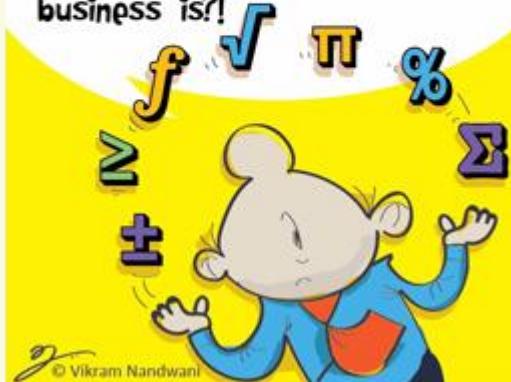
For a country of India's size, despite its large scientific workforce, there is still room for progress in STEM education and research. The latest Economic Survey 2017-2018 has cautioned that the country now needs to gradually move from being a net consumer of knowledge to becoming a net producer. The Survey indicated that this can be achieved by investing in educating its youth in Science and Mathematics and taking a more mission-driven approach towards this stance.

In case you shy away from Mathematics, we hope that this month's ET issue on '**The Magic of Mathematics in Business**' will help you embrace this subject and unravel the magic that lies within!

In the **Thinking Aloud** section, **Jay** tries to convince us that Mathematics is less mysterious than you think! On the **Podium**, IIT Bombay's Chair Professor for Mathematics, **Prof. Sudhir Ghorpade**, will make readers fall in love with

## FIGURES OF SPEECH

Well... Maths is not easy...  
But then... what in  
business is?!



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Mathematics with his crisp answers to questions surrounding STEM, the scope of Mathematics in the sphere of Big Data, AI and other advancements.

In the **We Recommend** segment, **Meeta** reviews Gaurav Rao's book, Magician in the Desert: Story of Meru Cabs and takes you on a journey of how the Founder of the radio taxi company made it big with limited resources. This month in the **Wonder Women** segment, **Anupama Tilak** walks down memory lane and offers some food for thought for women entrepreneurs to chalk a different path. She sets an example through her language translation and training firm, Fluent Services Private Limited.

In **Figures of Speech**, **Vikram**'s toon highlights the complexity of Mathematics and business!

As always, we value your opinion, so do let us know how you liked this issue. To visit our previous issues you can visit the Resources section on the website or simply [Click Here](#). You can also follow us on [Facebook](#), [Twitter](#), [LinkedIn](#) & [Google+](#) - where you can join our community to continue the dialogue with us!

### THINKING ALOUD

Mathemagic anyone?

- Jay

The announcement of the Nobel Prizes annually is highly awaited. But one subject that does not have a Nobel Prize is Mathematics. Did Alfred Nobel dislike the subject much like many other young students? While the reasons are unclear (and, no, he did not dislike Mathematics though there is an apocryphal story in this regard), mathematicians are honoured instead by two major awards - the Fields Medal and the Abel Prize. The Fields Medal is awarded once in 4 years and honours the brightest minds in the field under 40 years; and, the Abel Prize, instituted only as recent as 2001, goes to outstanding contribution in the field of Mathematics.

For a subject that is the underlying element in all subjects (remember even musical notes have a mathematical underlay), it is surprising that the subject creates phobia in youngsters. Compare this with the comment of Maryam Mirzakhani, the only female mathematician to have won the Fields Medal, that "*...the most rewarding part (of doing Mathematics) is the "Aha" moment, the excitement of discovery and enjoyment of understanding something new - the feeling of being on top of a hill and having a clear view.*" Not a view that most people would agree with, I think.

Yet, Indians and Mathematics have an old association. The concepts developed by Aryabhatta (whose work on the place value system indicated an implicit understanding and use of the concept of zero, it is argued) and Brahmagupta are acknowledged as seminal works from the fifth century. And, there are more such masters of yore. And, the contribution in the modern era has come from many other geniuses, most well-known of which is the enigmatic Srinivasa Ramanujam. The tradition has continued and the Fields Medal in 2014 to Manjul Bhargava (based in Princeton University) was welcomed widely in India as he spoke eloquently of his childhood influences of Sanskrit, Mathematics and Indian classical music.

Pure Mathematics, however, is not a glamourous arena. Instead, those accolades go to the inventors of technological products. In this context, it would be interesting to recall a comment from Bhargava who said that '*Mathematics and Science in India, at least in recent times, are being viewed as "tools for Engineering or Medicine" and "not viewed as subjects and careers" in themselves.*'

Can this be changed? The Indian Mathematical Society is over 100 years old, having been established in 1907, and believes that more home-grown mathematicians can be produced, given societal encouragement and recognition, coupled with better teaching at school level where curious and questioning minds ought to be stimulated. Perhaps, using the techniques of Vedic Mathematics could be an answer. After all, the rise of Kumon and UCMAS classes are ample proof that Indian parents need no convincing on the utility of Mathematics in grooming youngsters.

Truly what we need to have is less mystery on the subject and more popularity created by generating enthusiasm for the magic of numbers!

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## PODIUM

# Interview with Prof. Sudhir R. Ghorpade Institute Chair Professor - Department of Mathematics, IIT Bombay



*Prof. Sudhir R. Ghorpade earned his B.Sc. from the University of Bombay in 1982, M.Sc. from IIT Bombay in 1984, and Ph.D. from Purdue University, USA, under the supervision of Prof. Shreeram S. Abhyankar, in 1989. Subsequently, he joined IIT Bombay, where he is currently an Institute Chair Professor in the Department of Mathematics.*

*During December 2012 - December 2015, he was the Head of the Department of Mathematics at IIT Bombay. He has held visiting faculty positions in Denmark, France, Germany and USA, and has given numerous seminar/colloquium talks worldwide. His research interests include algebraic geometry, combinatorics, coding theory and commutative algebra. His research has resulted in enhancing fundamental knowledge and he is widely acknowledged for his contributions. He received an AICTE Career Award for Young Teachers in 1998, IIT Bombay Research Paper Award for 2011 and the Prof. S. C. Bhattacharya Award for Excellence in Pure Sciences from IIT Bombay in March 2014. He is a Fellow of the National Academy of Sciences since 2010, a member of the Apex Committee of the National Center for Mathematics, Mumbai, India since 2013, and has served on the Editorial Board of Resonance during 2003-2011 as well as the International Journal of Information and Coding Theory during 2007-2013.*

*Besides many research publications in reputed international journals, he has co-authored two textbooks on calculus and real analysis with Prof. B.V. Limaye, which have been published in the Undergraduate Texts in Mathematics series by Springer, New York (2006, 2010) and has co-edited two monographs, published by the American Mathematical Society (2005) and the Ramanujan Mathematical Society (2013). He was also a guest editor of a special issue of the Journal of Algebra and its Applications (Vol. 9, 2015) in honour of its founding editor late Prof. Shreeram Abhyankar.*

*Recently, he has been elected as the President of the Indian Mathematical Society for the period April 2018 - March 2019.*

**ET:** You are a Professor at the Indian Institute of Technology, widely considered as one of the foremost educational institutions in the world. In your opinion, does Science, Technology, Engineering & Mathematics (STEM) education get enough attention in India?

**SG:** I think the question does not have simplistic answers. First of all, the question itself can be interpreted in several ways such as whether or not STEM education is getting enough attention in India from (i) people at large, especially parents and the students themselves, and (ii) governments and policymakers. Let me try to address these two stakeholders, leaving aside other possibilities such as industry and media.

I believe most Indian parents are deeply concerned about the education of their children. We often see poor people going through considerable hardships and making sacrifices for their children to get a decent education. Those that are relatively better off are also spending considerable time, energy and resources for providing quality education to their children in India or abroad. These people recognize that Science and Mathematics form an integral component of education. Engineering and Technology are still amongst the top career choices that students and parents consider, even though the sheen may have worn off a bit in the recent past. That said, undue weightage and importance is often given to examinations and marks instead of gaining a thorough understanding of the subject and witnessing the joy of learning.

As for governments and policymakers, at a macro level, I think there is significant support, even though in terms of percentage of GDP, our country seems to spend much less on education than many developed and some developing countries. I am not an expert on this topic, but it is my impression that for pursuing Science, Technology, Engineering and Mathematics at an advanced level, especially at elite institutions such as IITs and CSIR and DRDO laboratories, there is ample funding available. There are generous doctoral and post-doctoral fellowships available for those who can clear some eligibility tests, and for top students wishing to take up studies in Science and Mathematics after 12 years of schooling. There are handsome scholarships available through the INSPIRE programme of the Department of Science & Technology (DST) of the Government of India. On the other hand, funding to universities at large (that are usually supported by state governments) and undergraduate institutions appears to be far from adequate. More than the lack of funds, there has been tremendous bureaucratization, especially in our universities and the bodies that control them such as the UGC

and AICTE. This stifles growth and provides fewer incentives for researchers to truly excel in their chosen fields, or even to convey the excitement about their subject to the students whom they teach and guide. The situation in schools that are fully funded by the local bodies such as municipal corporations is even more dismal, especially in mofussil areas. If one compares the amount of money spent per child in public schools in India as opposed to developed countries such as USA, the difference is quite phenomenal.

In short, while much attention is being given to STEM education in India, there is much that can be done by way of putting in more resources and also directing the resources that are already being put in a better and effective manner.

**ET: What makes Mathematics important in life and how do we make it attractive for students to learn?**

**SG:** While many of us may not realize it, Mathematics is everywhere in our day to day life, and its importance cannot be overemphasized. Let us take the case of numbers, about that we learn at a very young age. Our understanding of the world, in general, and our finances, in particular, would suffer a great deal if it were not for this fundamental concept. It is such a remarkable abstraction! The number 5, for instance, has no caste, creed, and colour, religious, political or sexual preference! We can equally well talk of 5 apples or 5 stones or 5 persons. We can appreciate this notion, and in particular, the number 0 and the place value system, both of which are said to have originated in India, if we try to perform addition or multiplication using roman numerals, or think of the cave man possessing no knowledge of numbers, but trying to ensure that all his sheep that went out for grazing return to the shelter by night. Notions of number and space are among the most basic in Mathematics and pervade many aspects of Science and daily life. Over the years, Mathematics has developed into a remarkable edifice. While developments in Mathematics have sometimes come about due to practical problems, they have also come about due to internal problems concerned with understanding patterns or symmetry and seemingly devoid of any practical use. Some of these have later found significant practical applications. For instance, the credit card numbers, when sent across electronic media, are encrypted for security using what is called the RSA algorithm which uses prime numbers in an essential way. We enter a movie theatre and see a sign such as "digital Dolby music" without pausing to think that the word digital has to do with digits that we learn in Mathematics. Communication by mobile telephone, deciphering the data sent by satellite, rendering of music digitally recorded on CD players are often aided by error correcting codes that use advanced algebra and related areas of Mathematics.

In order to make Mathematics attractive for students to learn, they could be told about some of the uses of Mathematics, but more importantly, students should be encouraged to ask questions, think on their own and develop a clear understanding. Mathematics is one subject that students cannot hope to master by mere memorization or rote learning. Once they understand something well, they are more likely to enjoy the subject and develop a liking for it. There are many books and videos that do an admirable job of explaining the basics of Mathematics and conveying the excitement of learning Mathematics. These can be made available to the students in the school library or pointers could be provided by teachers to some of the nice things about Mathematics available on the Internet.

**ET:** Besides standard accounting, in what parts of business does Mathematics play a central role? And, is this role likely to expand with the emergence of Big Data, Artificial Intelligence, etc.?

**SG:** The areas of human endeavour, in general, and business, in particular, where Mathematics plays a central role are perhaps too numerous to list here. I will just mention a few.

Mathematics and statistics are used in a significant way in data analytics so much so that in recent decades, a whole new branch has emerged, called Financial Mathematics. This uses advanced methods from partial differential equations and stochastic processes that are well beyond what is usually studied in undergraduate courses.

Mathematics of linear programming enters into efficient scheduling of airlines and human resources, and a good algorithm can save the industry millions of Dollars.

Advanced notions and results in linear algebra are used in the algorithm that Google uses to decide the order in which pages relevant to your search are lined up.

One does expect that the role of Mathematics is likely to expand with the advent of big data, AI, etc. Already, questions about efficient storage and retrieval of huge data by companies such as Facebook have led to newer questions and concepts in the theory of error correcting codes to which I alluded to in the answer to the previous question. Some of the keywords here are codes with locality or locally repairable codes. Newer and stronger algorithms for cryptosystems will be required if and when a quantum computer is actually realized. Already many

advanced notions and results from classical areas of Mathematics (for instance, algebraic geometry) are used in relatively recent areas such as cryptography and coding theory. This could well expand in the future. Thus, there are exciting times ahead!

**ET: Shortly you assume the role of the President of the Indian Mathematical Society. In your experience, what are the challenges in encouraging people to pursue a career in Mathematics?**

**SG:** Classically, pursuing a career in Mathematics means either becoming a researcher and making original contributions to the subject, or to focus primarily on teaching Mathematics at a basic level especially at undergraduate institutions. Of course, the two activities can overlap. Each of these is fraught with unique challenges and I will try to convey my personal impressions here.

Those aspiring to do research in Mathematics have an opportunity to create something permanent that can possibly last for generations to come, and leave a definitive footprint on the sand of time. In his charming little book, *A Mathematician's Apology*, G. H. Hardy (the English mathematician who arranged for Ramanujan to go to Cambridge) emphasized the permanence of mathematical achievement by saying "*What we do may be small, but it has a certain character of permanence; and to have produced anything of the slightest permanent interest, whether it be a copy of verses or a geometrical theorem, is to have done something utterly beyond the powers of the vast majority of men....In these days of conflict between ancient and modern studies, there must surely be something to be said for a study which did not begin with Pythagoras, and will not end with Einstein, but is the oldest and the youngest of all.*" Hardy goes on to write "*Archimedes will be remembered when Aeschylus is forgotten, because languages die and mathematical ideas do not. 'Immortality' may be a silly word, but probably a mathematician has the best chance of whatever it may mean.*" I could be digressing here and indulging in some rhetoric, but the point is that for a young person genuinely interested in Mathematics, there is no dearth of motivation to pursue a career in Mathematics as a professional researcher.

But let us turn to some pragmatic considerations. The challenges that I see, especially in the Indian scenario, is the shortage of role models - researchers working at a sufficiently high level that can personally guide young students to do world class research and have a meaningful career. For a variety of reasons, mediocrity has set in and there is a tendency to pay scant regard to quality. Hiring and promotions at many institutions are decided merely on the basis of numerical indicators of academic performance and this, in turn, has led to a spurt of spurious journals where it is possible to publish just about anything provided one is willing to pay. What is

particularly sad is that our young doctoral students may get the wrong ideas about how research is done. Of course, the situation is better at the so-called elite institutions. But for India to grow and be counted as a scientific powerhouse to reckon with, our universities at large have to prosper and be seen as places where vibrant and high quality research thrives. However, I do see some silver linings as well. There are isolated instances of top class researchers in some universities. The ATM (Advanced Training in Mathematics) schools organized by the National Centre for Mathematics (NCM) are attempting to ensure that doctoral students across the country have a strong foundation in the basic areas of Mathematics and a good exposure to some advanced topics. The MATRICS (Mathematical Research Impact-Centric Support) scheme of DST now provides for a modest, but useful and flexible, support to a large number of researchers in a manner that is free from bureaucratic impediments. Thus there is hope!

Those who are teaching Mathematics in colleges and predominantly undergraduate institutions have an invaluable opportunity to shape the minds of young students, and they have a very important role to play. In my younger days, I was blessed to have some dedicated teachers in my college who aroused my curiosity, helped to develop a good understanding of the subject, and encouraged me to take up higher studies. Perhaps they did not earn a whole lot of money, but were highly respected for their dedication and knowledge. Today, the salaries of college teachers are quite good, but for their professional growth, they are expected to do research. This seems a little unfair to me given the amount of teaching they do. A narrow-minded insistence on all college teachers to do research is inevitably leading to many of them adopting unsavoury means to satisfy the requirement, at least on paper, and thereby losing focus on the scholastic abilities that can make them effective and inspiring teachers. This is also a challenge, in my opinion, especially since systemic changes are not easy to make.

**ET: What is your advice to professionals who are overwhelmed by the fear of numbers?**

**SG:** Fear is often a result of improper understanding of the relevant matter. As was mentioned earlier, numbers are important to our day-to-day living and in fact, it is difficult to imagine life without numbers. Mathematics is a peculiar subject in that it evokes extreme emotions among people at large. Often, when I meet people in other walks of life and tell them what I do, they respond by telling how they hated Mathematics (and sometimes, how they loved it and were particularly good at it in school). There seems to be nothing in-between. I mean, one doesn't usually tell a musician or a painter how we hated music or painting (even if we were not particularly good at it). Perhaps this has a lot to do with personal experiences and the kind of teachers one has had at a young age. For those interested in overcoming their fear of numbers and learning something about Mathematics, there is a

wealth of resources available in a good library or perhaps more easily, on the internet. They just need to look up! And of course not everyone has to become a Mathematician!

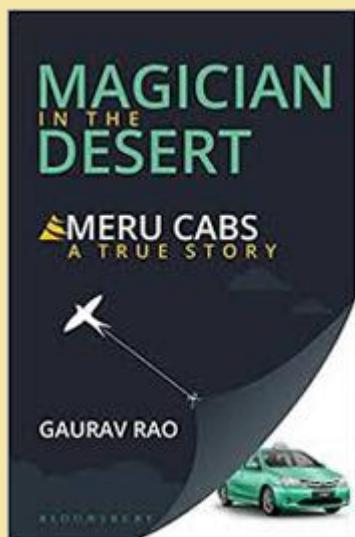
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### WE RECOMMEND

#### Magician in the Desert: Story of Meru Cabs

- Gaurav Rao

- Reviewed by Meeta Lee



"Magician in the Desert" by Gaurav Rao is the interesting story of Meru Cabs and a journey inside the mind of Neeraj Gupta, the Managing Director of India's first and the then largest owned radio taxi company. This book is a must read for every entrepreneur who wants to venture into a business with limited resources and yet achieve success. Gaurav has decoded Gupta's thoughts, actions and viewpoints in layers which will be very helpful for entrepreneurs to understand the business model behind the success of Meru Cabs.

Neeraj Gupta, a very simple, down to earth man, believes in starting conservative yet thinking big as he feels that thinking conservatively compels you to become innovative. Armed with a basic commerce degree, and married without a job in hand, he decided to tread on the untouched ground of the transportation service in India. In 1997, he opened a garage with the borrowed seed capital of Rs. 50,000, and by 2011, had created an empire valued at Rs. 2,000 crores.

The first part of the book focuses on Neeraj Gupta's personality, his values and his approach to life. There are

some interesting anecdotes on his social gathering and his initial encounters with his wife before he got married. It also details all the efforts taken by Neeraj to develop his business and the challenges that he faced initially. How he juggled between two businesses - one was Blue Steel - the furniture outlet, which was managed by his father, and the other Meru Cabs.

The second part of the book focuses on Neeraj Gupta as a visionary. It showcases Neeraj's qualities of building and maintaining relationships, risk taking, logical thinking, resilience and change. An interesting conversation is highlighted in the book when Gaurav asked Neeraj whether it was awkward to check restaurant bills before paying them even though he was the Managing Director of a company. Neeraj's reply that his preference to nurture a good habit and the tone used to give the reply reflected humility and a deep understanding of the human mind, according to Gaurav.

The last part of the book which is titled as Strength to Strength details Neeraj's various challenges including regulatory challenges of private taxi licenses, an extortion threat which led to a close shave, the Human Resources Management of Meru Cabs, the expansion of Meru cabs and the launch of Motor Works - a workstation facility for the entire fleet of 200 cabs which was Neeraj's brain child.

Gaurav Rao specializes in developing and implementing marketing programs based on image building and branding in the public and private sector. He is an adviser on business strategy, planning and development in media management business. In this book, he has put together an overwhelming story of struggle and achievement in business while studying the functioning of the man behind the machine and how practicality goes a long way to fulfil any individual's dreams.

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## WONDER WOMEN

### Anupama Tilak

#### CEO - Fluent Services Private Limited, Pune



Anupama Tilak is the CEO and Co-Founder of Pune based Fluent Services Private Limited, which was founded in 2004. An electronics engineering graduate from Pune University she has worked in Japan and Australia. Anupama has been associated with various assignments related to the Japanese language since 1999. She visited Japan on a scholarship from the Japanese Government and has been teaching Japanese at various institutes in Pune.

After returning to India, she was at the crossroads of choosing a path between switching to software or exploring options with the newly acquired Japanese language skills, since MNCs were coming to India in a big way then. Choosing the option to explore opportunities in Japanese, she continued with strengthening her language skills at the Indo Japanese Association, Pune. This was where she met her future partner in business, Mugdha Chandakkar. Together they decided to take up Japanese language translations which gave birth to Fluent Services.

Starting with a two people team, offering only Japanese language translations, Fluent Services now has an all-women team of more than 25. Her company offers not only translations in almost all foreign and Indian regional languages but also corporate language training, interpretation services and spoken language training.

In recognition of their efforts, both directors were honoured with various awards like the Sakaal-Mitcon Maharashtra Udyogini gold medal in 2009, the Maratha Chamber of Commerce Industries and Agriculture (MCCIA) - "Ramabai Joshi" Award for women entrepreneur 2012, along with other nominations. Anupama has successfully completed the "Certificate program in Management for Women Entrepreneurs" conducted by the prestigious Indian School of Business (ISB), Hyderabad.

Being a first generation entrepreneur, all aspects of doing business were very new to Anupama. Right from business planning to execution, technical aspects, financial aspects, customer interaction, business expansion and other matters were all challenges. Every day was a day of learning! The early days also involved operational fights right from getting permissions, bad net connectivity, power outages and so on.

According to Anupama, when you embark upon your journey as an entrepreneur, it can get challenging. The support from your family proves to be a very important aspect at this time. Over the years, the attitude of the society in general towards working women has become positive. But more than anyone else, women themselves want to 'be perfect' at all roles, whether that of a homemaker or and that of an entrepreneur which can be a tightrope walk. For working women, though there is no reason for it, there is somehow a feeling of guilt for not being physically present at all times be it at the workplace or home. It is important to try and get over this feeling since you are not ignoring any of your duties.

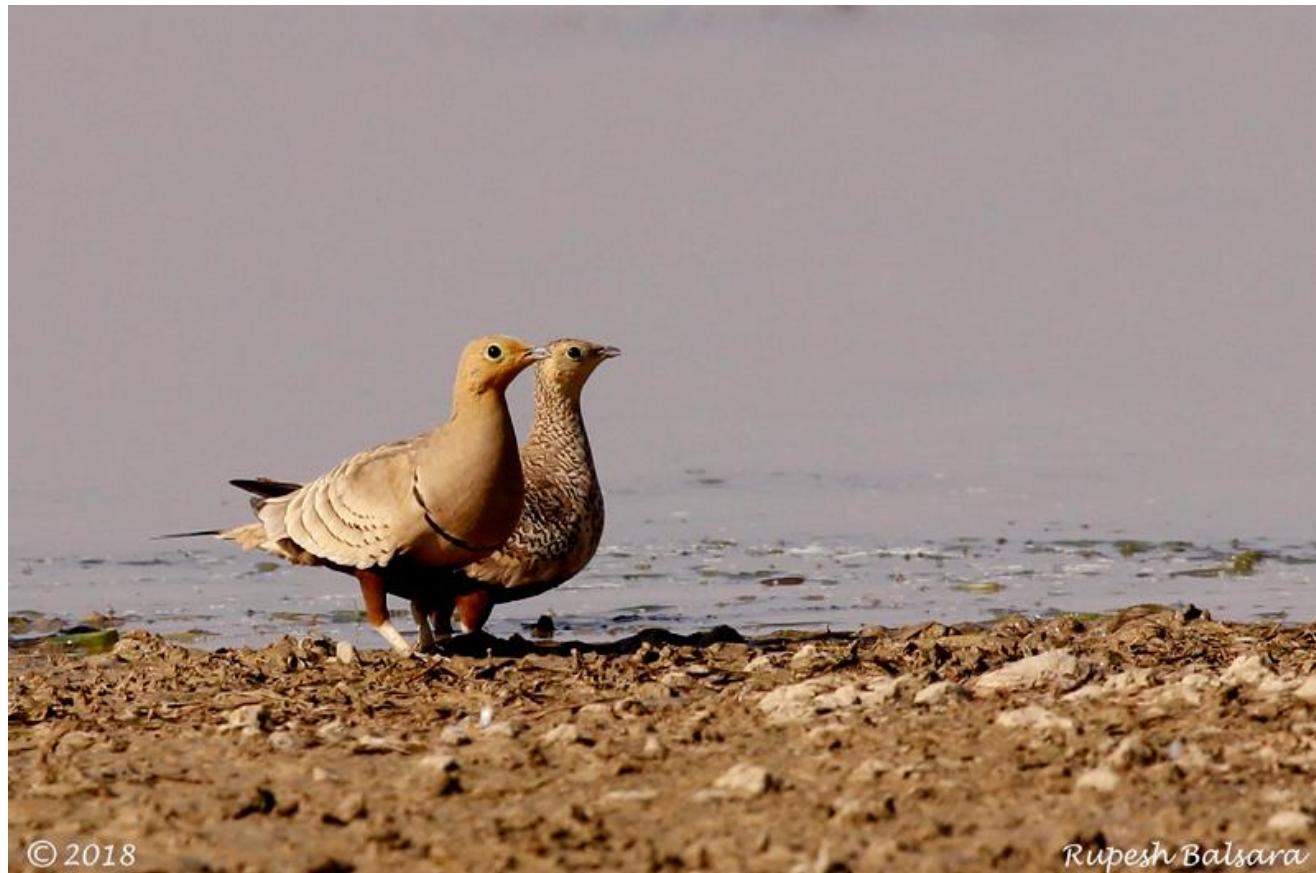
Anupama is an avid traveler and feels that this has broadened her outlook towards life. She has a tilt towards fitness and enjoys running, cycling and going to the gym. The much needed 'me' time helps her to contemplate upon issues and find solutions. With a firm belief in the adage, 'healthy body, healthy mind,' she and her partner promote various events related to fitness.

Since she chose a career path that was different from her basic engineering studies and has made it a success, Anupama feels that if you believe in yourself and are willing to move out of your comfort zone, nothing is impossible. She dreams of empowering more women by this different career option and also helps by providing them an opportunity to work flexible hours. Many Japanese companies are establishing their foothold in India and with the Make in India initiative, she looks forward to expanding her business horizons.

To know more, please visit Anupama's website, <http://www.fluentindia.com>

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## THROUGH THE LENS



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*Rupesh Balsara*

Wildlife and avid bird photographer **Rupesh Balsara** spots the Chestnut Bellied Sand Grouse at Rajasthan's Desert National Park. These birds are found in sparse, bushy, arid regions and are common in central and northern Africa and southern Asia. This species is known to travel up to 80 kms a day in search of water.

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