

Market Expansion Strategy for Teleradiology Services into Resource-Poor Healthcare Set-ups

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Abstract

Healthcare sector is facing healthcare resource shortage globally and an acute doctor shortage in India is having a detrimental effect on healthcare outcomes. Resource-poor hospitals specifically struggle in this phenomenon on account of 4 reasons: not being able to hire enough doctors, poor infrastructure, cost of care and finally the compromised quality. Radiology is one such specialty which is very vital, scarce and is facing all above-mentioned challenges. Developing countries being resource-poor, specifically India which is the 2nd largest populated country in the world, is constantly struggling to provide quality care at low cost and improve healthcare outcomes. There is a need to innovate healthcare solutions to effectively deliver care in resource-poor set-ups. Specially getting radiology services everywhere as it's the backbone of diagnosis process in treatment and hence has a direct impact on healthcare outcomes. And telemedicine is an effective IT solution in getting excellent diagnostic expertise to resource-poor and remote hospitals & diagnostic centers; and hence making treatment outcomes better. 5C Network is one of a kind social enterprise trying to provide quality and cost effective teleradiology solution to resource-poor set-ups predominantly in the southern states of India and aspires to take their services to other states of India as well.

The aim of the study is to propose a market expansion strategy for 5C Network to be able to take their services effectively to the Indian states of Maharashtra and Madhya Pradesh. The research questions will try to find out the current state of the service and how can it be made better in quality and usability for the end users (radiologists and radio-technicians). The study would further explore the bigger picture of ICT, other good practices around the world in teleradiology and make recommendation to the organization under consideration i.e. 5C Network.

The marketing strategy will be devised using 5C analysis, 5M strategy, Segmentation, targeting and positioning recommendations and finally specific recommends will be made using 4P marketing. Further research is needed to find out other best practices, influencing factors and best technology solutions which can help teleradiology service platforms to list up to next level in service quality.

Index Terms— Teleradiology, Market Expansion Strategy, reporting quality, 5C Analysis, 5M Strategy, 4P Marketing

1 INTRODUCTION

A projected shortage of 12.9 million healthcare professionals globally BY 2035! We are talking real numbers here (PWC Global, 2017). World Economic Forum and OECD forecasted a 117% increase in health spending over the next decade for BRICS. Healthcare being the basic need and right, as also propagated by WHO rightfully so, is still struggling to be delivered to the ones who need it the most, especially when we talk about the resource-poor set-ups. With disproportionate income distributions and resource-poor healthcare delivery infrastructure especially in developing and under-developing countries, it is becoming more and more imperative to look for innovative solutions for best possible avenues to provide treatment to people and improve healthcare outcome (WHO, 2017). Hence a people-centered approach is needed amidst healthcare workforce crunch to deliver healthcare services effectively backed up by favoring policies and inclusive leadership.

India is struggling with an acute doctor shortage, especially when it comes to the rural areas. Many doctors decline to serve in rural areas and even suburban areas due to the lack for proper electricity, road facilities and not so attractive remuneration (Dinesh Sharma, 2015).

Talking about healthcare resource crunch and following compromise in treatment protocols, radiology is one area which is very crucial and needs to be made available for better diagnosis of a disease and hence better treatment. Public Health Founda-

tion of India stated that the healthcare skill gap in India is about 98%, out of which Radiology accounts for 88.7 % alone (Healthcare Business Euro News, 2017). For every radiologist in India, there are 120,000 patients to look after! For a country like India with a population of billion people, this poses a humongous challenge.

As per WHO, we have at least over 50 core healthcare conditions in rural areas which need X-RAY services.



Source: Use Health Technology to Strengthen Health Systems, WHO

The demand for image interpretation service in Radiology is growing rapidly in India. But this need gets further complicated by two main issues: lack of radiology specialty expertise and lack of adequate staff to do image interpretation for such huge demand (Nishigandha Burute, Bhavin Jankharia, 2009). Rural and suburban areas or resource-poor healthcare set-ups are usually struggling with hiring Radiologist or an adequate number of Radiologists as they cannot afford to pay them the expected remuneration year long. Small hospitals and diagnostic centers are struggling for resources, further struggle to provide quality diagnosis and care (Mollie Durkin, 2015). In order to address this problem, an IT-enabled solution has arisen titled Teleradiology.

Type	Condition	Intervention	Skill Level	Necessity
Chest	Pneumonia	Medical management	Basic	High
	Tuberculosis	Medical management	Basic	High
	Pneumothorax	Chest tube placement	Advanced	High
	Pleural effusion	Thoracentesis	Advanced	High
	Cardiac failure	Medical management	Advanced	Moderate
	Hemothorax	Thoracentesis	Advanced	High
	Chronic obstructive pulmonary disease	Medical management	Basic	Moderate
	Asthma	Medical management	Basic	Moderate
	Lung abscess	Medical management	Advanced	High
	Occupational lung diseases	Medical management	Basic	Moderate
Limb	Long bone fracture	Reduction and fixation	Advanced	High
	Small bone fracture	Reduction and fixation	Advanced	High
	Osteomyelitis	Medical and surgical management	Basic	Moderate
	Dietary deficiency diseases (scurvy, rickets)	Nutrient supplementation	Basic	Moderate

Type	Condition	Intervention	Skill Level	Necessity
Abdominal	Cephalopelvic disproportion	Cesarian section	Advanced	Moderate
	Ictopic pregnancy	Surgical management	Advanced	Moderate
	Retained products of conception	Dilation and Curettage	Advanced	High
	Abruptio placentae	Medical and surgical management	Advanced	High
	Peripartum hemorrhage	Medical management	Basic	Moderate
	Cholecystitis	Medical and surgical management	Advanced	High
	Tuberculosis (intra-abdominal)	Medical management	Advanced	High
	Hydronephrosis	Medical and surgical management	Basic	High
	Abdominal trauma	Medical and surgical management	Advanced	High
	Abdominal masses	Medical and surgical management	Basic	High
Chest	Pleural effusion	Thoracentesis	Advanced	High
	Pneumothorax	Chest tube	Advanced	Moderate
	Hemothorax	Thoracentesis	Advanced	High
	Deep vein thrombosis	Anticoagulation	Basic	High
Cardiovascular	Cardiac failure	Medical management	Basic	Moderate
	Cardiac valve disease	Medical and surgical management	Advanced	High
	Pericardial effusion	Medical management and pericardiocentesis	Advanced	High
Orthopedic	Spine, skull trauma	Surgical management	Advanced	Moderate
	Pediatric Osteomyelitis	Medical management	Basic	Moderate
Neurological	Rib, pelvis trauma	Surgical management	Advanced	Moderate
	Neonatal hemorrhage	Medical management	Advanced	High
	Neonatal infection	Medical management	Advanced	Moderate
Procedural	Intravenous Access	Procedural guidance	Basic	Moderate
	Abscess	Procedural guidance	Basic	Moderate
	Arthrocentesis	Procedural guidance	Basic	Moderate
	Picoentesis	Procedural guidance	Advanced	High
	Thoracentesis	Procedural guidance	Advanced	High
	Pericardiocentesis	Procedural guidance	Advanced	High
	Foreign Body	Procedural guidance	Basic	Moderate
	Lumbar Puncture	Procedural guidance	Basic	Moderate

Source: Maru DSR, et al. Globalization and Health 2010, WHO

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Rural and suburban areas or resource-poor healthcare set-ups are usually struggling with hiring Radiologist or an adequate number of Radiologists as they cannot afford to pay them the expected remuneration year long. Small hospitals and diagnostic centers are struggling for resources, further struggle to provide quality diagnosis and care (Mollie Durkin, 2015). In order to address this problem, an IT-enabled solution has arisen titled Teleradiology.

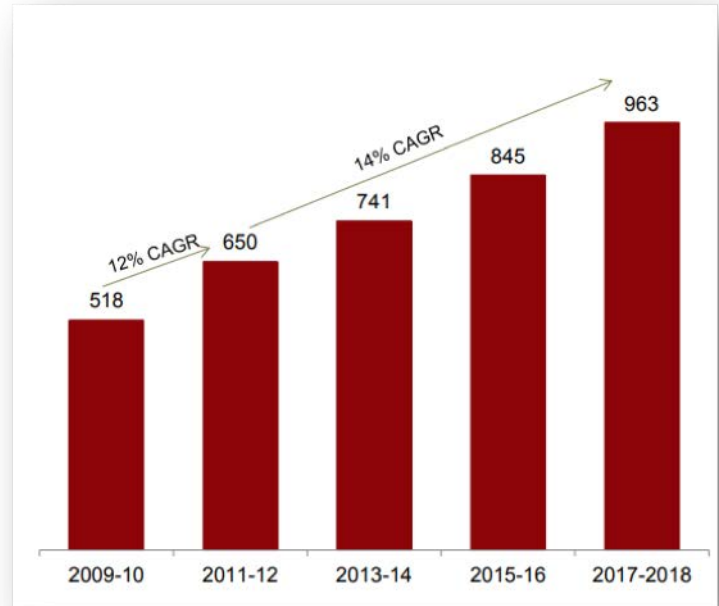
Teleradiology

Teleradiology is a branch of telemedicine in which using telecommunication systems, radiological images are transmitted from one location to another. Noninvasive imaging studies like X-rays, CT, MRI, ultrasound, and nuclear medicine studies are interpreted in this manner (Indian Journal of Radiology and Imaging, 2009). It mainly took birth due to an imbalance between the demand and availability of diagnostic services. It essentially performs the function of:

1.1 Problem Statement

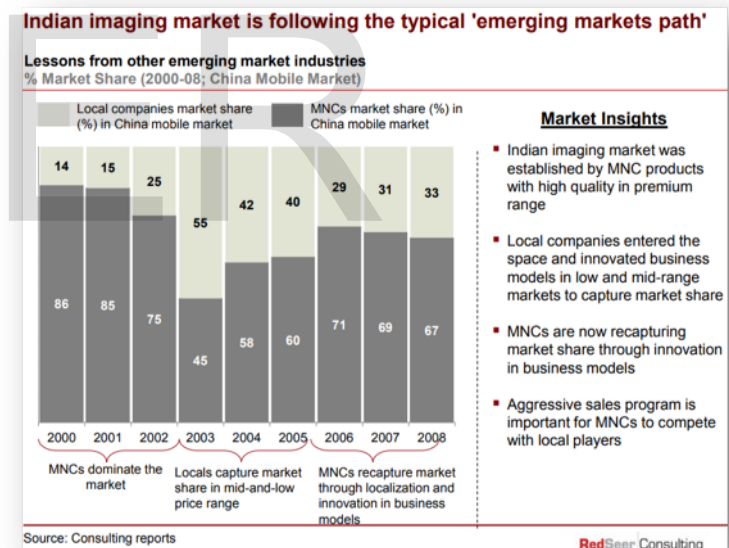
Though Teleradiology came into existence and popularity in the 1990s, over the years it has been criticized for many concerns like:

- a) **Regulatory Factors / Lack of board-certified radiologists in India:** Radiologists go to the USA for board certification and do not come back (Nishigandha Burute, Bhavin Jankharia, 2009). Also, a lot of others did not have required affiliations and accreditations.
- b) **Lack of qualified support staff/radio-technicians**
- c) **Quality Issues:** Reporting errors like inaccurate diagnosis, improper medical history, compromised image quality, primitive non-intelligent platforms etc. Most of them happen due to untrained staff or staff with very limited knowledge of teleradiology or healthcare in general. Though teleradiology has brought in efficiency, it poses an adoption challenge (Richard Heeks, 2006). An intelligent workflow, provision of rapid customization in solution and a smart mobility solution is needed.
- d) **Cost:** The cost of Teleradiology services for a resource-poor hospital/diagnostic center could be more and hence they look for cheaper solutions.
- e) **Training/Education system for Teleradiology:** No formal structure for training of radio-technicians or provision of tele-radiology education for radiologists. Adoption to Teleradiology poses many challenges like resistance, staffing, technology education and information management (Bertot et al., 2010). A lot of it is compromised today due to lack of training and technology readiness (Ramakrishna Dantu, RadhaKanta Mahapatra, 2013). For detailed factors related telemedicine and its adoption, please see appendix, section 9.1.



Source: Redseer Consulting, 2014

There has been a rise in the number tele-radiology players in the past 2 decades in India and globally but report quality, cost, training support for users has been a major concern. The global Teleradiology services market has an estimated valuation of US\$ 1,971.4 Million by the end of 2016 and registered a CAGR of 21.0% over the forecast period (2016–2026) (Future Market Insights, 2016). In India, Imaging market is worth 650 million USD and is growing at 14% CAGR (RedSeer Consulting, Industry Report, 2014).



Source: Redseer Consulting, 2014

Given this increasing demand for teleradiology services and multiple players in the market, quality of service, personalized service, and advanced user support will be the key to capture the market and further expand.

The organization under consideration, called 5C Network, is one such expanding teleradiology social enterprise trying to provide teleradiology services to resource-poor hospitals/diagnostic centers in India. They aspire to expand to other Indian states and maybe go global later from their current base in Southern India by improvising their marketing strate-

gy and enhancing their service quality.

1.2 Organization Under Consideration

'5C Network' (<https://www.5cnetwork.com>) is a Teleradiology service provider which is making radiology more accurate, accessible and affordable for resource-poor hospitals/diagnostic centers.

They are one of the incubatees under the incubator called 'Villgro' (<http://villgro.org/>), which is the largest non-profit technology incubator in India based out of Bangalore. 5C Networks receives business strategy and financial inputs from Villgro to meet their business needs. It's been almost 4 years for 5C Network in the market.

Their platform solution integrates hospitals/diagnostic centers (taking images) with the best of radiologists empaneled to get the radiology report as early as in 10-15 mins using advanced technology for fast image transfer.

1.3 Organization Under Consideration

The objective of the study is to:

- a) Propose a market expansion strategy for 5C Network to expand into other desired Indian states of Maharashtra and Madhya Pradesh, specifically targeting the tier 2 and tier 3 low-income cities by:
 - By analyzing the existing market using 5C analysis for decision making (Company, Customer, Competitor, Collaborators, Climate).
 - Use STP (Segmentation, Targeting, and Positioning) strategy for developing a marketing strategy.
 - Use 4P (Product, Price Place, Promotion) marketing mix for designing a proposed marketing strategy.
- b) To look into the bigger picture of ICT implementation in small and mid-size hospitals/diagnostic centers of low-income geographies to enhance the impact of radiology diagnostic healthcare services.
- c) To look at similar telemedicine solutions elsewhere globally and advice on best practices to the Indian organizations.

2 LITERATURE REVIEW

2.1 Global Scenario

The cost of healthcare is a burning issue globally for the healthcare policy makers which is further complicated by another issue which is quality of care (Ramakrishna Dantu, RadhaKanta Mahapatra, 2013). Rural, sub-urban areas suffer even more they remain to be underserved due to physician shortage (Michele Spont, Nancy Greer, Jenny Su, Patrick Fitzgerald, Indulis Rutks, Timothy J Wilt, 2011).

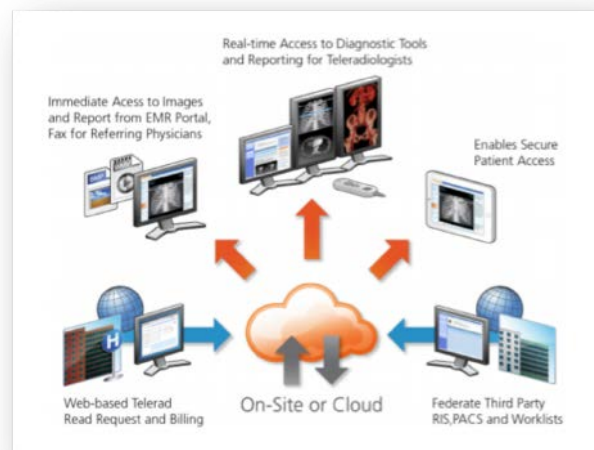
The role of information systems under such scenarios becomes even more crucial for timely delivery of healthcare using efficient, user-friendly system with quality data (Ramakrishna Dantu, RadhaKanta Mahapatra, 2013). If well-regulated and

contextually used, it can be a boon for healthcare delivery (WHO, 2011).



Source: WHO, 2011

Teleradiology is one such offering of fundamental principles of Telemedicine can help fasten the diagnosis process with accuracy in resource-poor, low-income areas and resource-poor hospitals which cannot afford to hire a specialist radiologist or have an adequate number of radiologists to support the increasing demand of healthcare. It can connect to a remote hospital to a radiologist in the city to get a quality reporting done in less time. Also is a big aid for small hospitals which cannot hire radiologists 'sufficiently'.



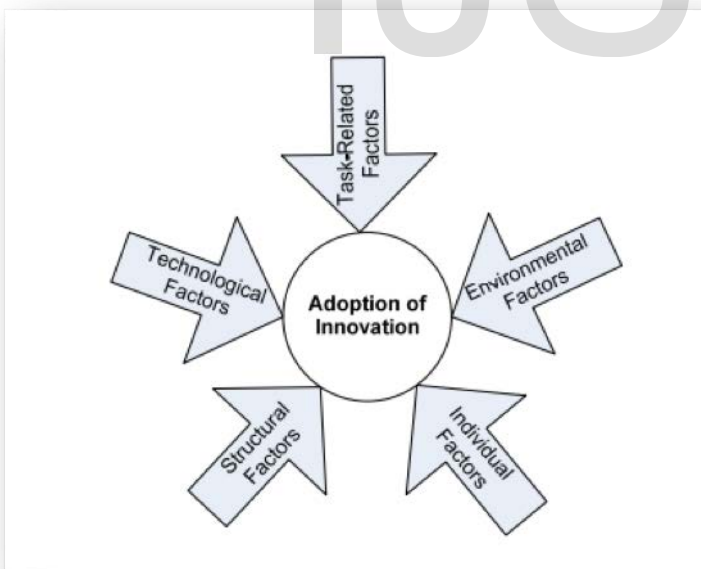
Source: CareStream Radiology, 2015

Medical error in diagnosis alone caused 251,454 deaths annu-

ally in the United States (CNN, 2016). As per NHS, 1 in 20 hospital deaths are preventable in NHS which happen due to miss-diagnosis. An interview published with leading India daily called 'The Hindu' on August 2018 with Dr. Soumya Swaminathan (Director General, Indian Council of Medical Research (ICMR) highlighted that lack of diagnostic facilities leads to doctors doing guesswork which can be leading to bad treatment and a further increase in mortality. As per WHO systematic review was done in 2014, lack of diagnosis facilities and misdiagnosis leads to compromised care and increase in preventable mortality (Rasika Rampatige a, Lene Mikkelsen b, Bernardo Hernandez c, Ian Riley & Alan D Lopez, Bulletin of the WHO, 2014).

But Teleradiology also poses multiple challenges. Teleradiology being very innovative and new is also affected by the effects of diffusion of innovation just like for any other new information technology which further impacts the work processes in an organization through specialization, centralization, and formalization (Ramakrishna Dantu, RadhaKanta Mahapatra, 2013). The main factors for adoption of Teleradiology or any other newer technology can be categories into 4 broader categories:

- a) Individual (Radiologists, Radio-technicians)
- b) Institutional (hospital, health centers, diagnostic centers)
- c) Regulatory (government/legal/healthcare regulatory bodies), and
- d) Technological (interoperability, data standards, data quality).



Source: Factors influencing adoption of innovation, Kwon and Zmud, 1987

Further, these adoption factors play a very important role in setting a pre-text in defining the factors which need to be kept

in mind while innovating.

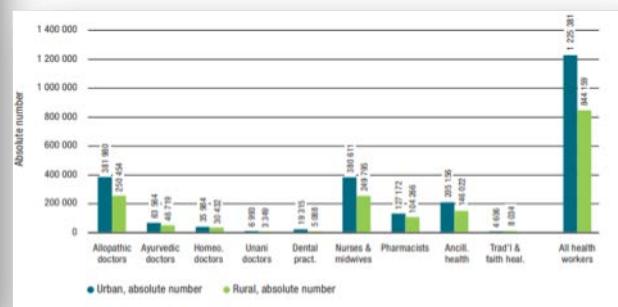
Talking about the individual factors, they are mostly related to attitudes, behaviors, and intentions. Loss of face to face interaction with the physician also affects Teleradiology adoption to a large extent. Resistance is often expected as the healthcare industry has the high touch environment. Hence amidst healthcare resource crisis, the user needs to be supported with correct knowledge and training support and make the user a part of service innovation and decision-making process (Everett M. Rogers, 1995).

Not just new technology adoption is critical for its success but also the rate at which it gets adopted. There are multiple factors which actually decide whether the technology will be vastly adopted or not. Innovation attributes like how easy or difficult is the technology to operate, whether the service innovation-decision is authority or collective (considering end users), whether communication channels are trustable and whether it fits a social context are all crucial for its adoption (Everett M. Rogers, 1995).

In the larger sense, if diffusion of innovation is controlled in right manner, it will definitely bring in more efficiency, accountability, standardization, better resource management and marketization for information technology solutions (Richard Heeks, 2006). Moreover, this effort will further facilitate performance acceptance, social acceptance and effort acceptance and generate more acceptance of such newer IT solutions (Bertot et al., 2010).

2.2 Indian Scenario

Healthcare resource crunch in India is massive. As per WHO's 2006 report, India had 0.60 doctors, 0.80 nurses, 0.47 midwives, 0.06 dentists and 0.56 pharmacists, respectively, per 1000 population. And has only 10,000 practicing radiologists for a population of over a billion (Global Healthcare Insights, 2017). With further growing demand of radiologists, this data is scary (Sudhir Anand and Victoria Fan, WHO, 2017)



Source: Health workers by category in India: absolute number by urban-rural stratum, WHO, 2016

In this scenario, a smart Teleradiology solution is the logical solution for the Indian case! Further, there is also a lack of skilled radiology technicians. A study from the Public Health

Foundation of India revealed that India has about 98 percent healthcare skill gap, and radiology accounts for 88.7 % of this gap alone (Lauren Dubinsky, 2017). Hence training needs are high which has the direct correlation with the service quality. Keeping in mind the SDG of universal healthcare to be achieved, high quality, cost-effective information technology solution is the way forward (Joseph V. Charyk, 1984).

3 METHODOLOGY & STAKEHOLDER ANALYSIS

3.1 Methodology

[1] Primary Research	[1] Method	[1] Number
	[2] In-depth semi-structure interview with radiologists	[2] 15
	[3] In-depth semi-structure interview with Radio-technicians in hospitals	[3] 20
	[4] In-depth semi-structure interview with Radio-technician in diagnostic centers	[4] 20
	[5] In-depth semi-structure interview with hospital purchase departments	[5] 3
[1] Secondary Research	[6] Market research reports/ Consumer reports / Public research reports/Consulting reports/International regulatory organization reports/ Indian governmental and non-government reports	[6]
	[7] Traditional and non-traditional media reports	[7]
	[8] Journal articles	[8]

[1] Note: Sample Interviews and Interview Transcript can be found in Appendix, section 9.4, 9.5, 9.6

3.2 Study Universe

The study was conducted in Bangalore city of Karnataka state in India. The hospitals/diagnostic centers being interviewed were all tier 2 and tier 3 hospitals/diagnostic centers with either no radiologist or fewer radiologists as compared to patient inflow. The radiologists empaneled with 5C Network were all based out of India, though in different states across India. List of hospitals/diagnostic centers can be found in the appendix, section 9.7.

3.2 Stakeholder Analysis

<p>Hospitals/Diagnostic Centers: They are direct beneficiaries as using Teleradiology solutions they will gain more efficiency, cost cutting and better patient satisfaction through the timely and quality report. They get a radiologist on demand 24x7, low cost innovative technology to increase their productivity and accuracy, provision of intelligent storage and retrieval of images and a completely digitized process to go filmless.</p>	<p>Doctor/Radiologist: More efficiency and being able to see more patients than usual in the same time, the reduction is perceived workload, better data storage for analysis, prediction, resource management, and decision making. And of course, they go filmless!</p>
<p>Patient: Indirect beneficiary as with these technologies in place, treatment satisfaction will increase (timely and quality report) and cost of treatment will go down as organizations scale-up these solutions.</p>	<p>State: Increasing healthcare outreach and ICT implementation for good are on the Indian government's agenda. It also aligns with SDG (Sustainable development goals) on improving healthcare outcomes globally.</p>

4 RESULTS, ANALYSIS & DISCUSSION

4.1 5C Analysis

4.1.1 Customer

The current clientele of '5C Network' mainly includes small and mid-size hospitals in rural and suburban areas in southern states India including Karnataka, Tamilnadu, Kerala, and Andhra Pradesh. They also have made a presence in West Bengal state and in small cities of Northern India. These hospitals/diagnostic centers are resource-poor and mostly either do not have a radiologist and have limited radiology support.

4.1.2 Company

5C Network is known for its very economic Teleradiology solution with no upfront cost, free image storage, free DICOM viewer and pays per use criteria. They provide free of cost 24x7 administration support being provided by 5C Network staff for any technical and functional concerns. This makes them a strong candidate in the market especially for the resource-poor hospitals/diagnostic center (Healthcare Business Euro News, 2017). They are already earning unit profits using economies of scale. But some of the concern areas which they need to work on to better capture the market are:

- Report quality related issues
- Training provisions for radio-technicians and radiologists
- Service standardization protocols
- Responsive platform design to assist the users better

As per research, technology adoption challenges are graver for late adopters' radiology technicians and support staff needs holistic training support and a friendlier platform to interact with (Everett M. Rogers, 1995).

4.1.3 Collaborators

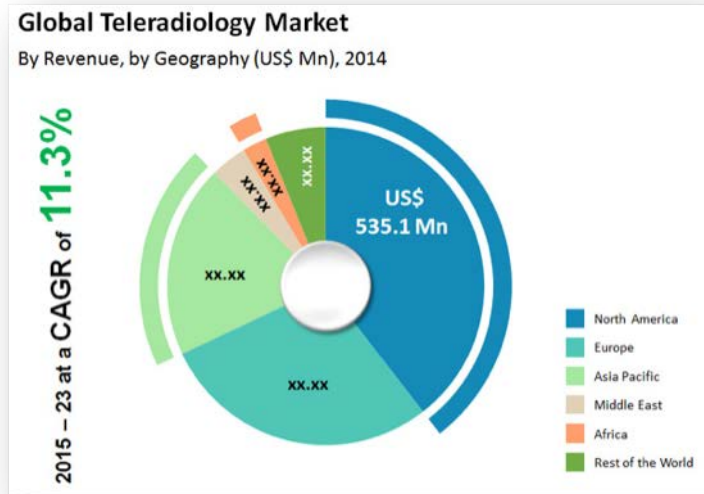
The organization is collaborating with an incubator like Villgro, the government of Karnataka and consulting like Deloitte for financial aid, strategic and marketing aid. The collaboration with the government of Karnataka has given them a social branding for serving the masses. Their initiative with the government is called 'eKirana' which is trying to provide Teleradiology services to the government hospital of Bangalore (<https://www.5cnetwork.com>). But they are yet to collaborate with any health care accreditation body or affiliation body (both national and international) to gain more credibility in the market.

4.1.4 Competitors

There is massive competition in telemedicine space, specifically in Teleradiology to conquer time and space boundaries (Olivia R. Liu Sheng, Paul Jen-Hwa Hu, Chih-Ping Wei, Member, IEEE, and Pai-Chun Ma, 1999). With the use of information technology in medical decision making, Teleradiology has been seeing many players mushrooming in the market providing or claiming to provide similar solutions. The size of Teleradiology market is estimated to be 8.2 billion USD by 2024 (Grand View Research Report, 2018). That signifies that they're going to be many players but also a huge potential to

excel with quality service and excellent support to stand apart.

themes that came out of it, concern areas were taken out rated on likelihood, impact and further supported by primary data being gathered from the interviews.



Source: Transparency Marker Research, 2018. Appreciate the share for Asia pacific

4.1.5 Collaborators

Though Teleradiology as a solution is booming today there are many concerns around it being raised by governmental and non-governmental bodies around data security and confidentiality, reliability, competence and interpersonal relations (R E Ashcroft, and P R Goddard, 2014). These need to be addressed through service enhancement, product feature enhancement and bettering the quality of service and data collected.

4.2 Risk, Impact & Probability

With help of risk assessment probability chart, factors for concern for 5C Network have been categories into various risk levels and need to be addressed.

Low impact/low probability	Low impact/high probability
<ul style="list-style-type: none"> Need for Network speed standardization Report Formatting Concerns - Font size/Prominent prefixing of the main text, better visibility 	<ul style="list-style-type: none"> Report Formatting Concerns - For better visual appeal and ease of reading and comprehension, this process can be made customizable for the radio-techs/radiologists
High impact/low probability	High impact/high probability
<ul style="list-style-type: none"> Need for best practices in application/platform coding- This will ensure better long term sustainability of the online platform in terms of being still relevant after years and easy to tweak if needed (Long-term approach) Need for responsive UI: Hover-over help text, conditional display of information display to facilitate easy navigation. A user experience design workshop to evolve application design - in collaboration with radiologists, radio-technicians and referring doctors. Artificial Intelligence and Deep Learning Investments to Enhance Clinical Performance -For future research purposes Need for live video- diagnostics The incentive system for radio-techs and radiologists 	<ul style="list-style-type: none"> Report quality concerns - Need for customized report structure with an integrated radiology dictation system for an error-free report Radiology-tech training needs - Need for free training/workshop modules for radiologists/technicians. Flexible and Scalable e-Training Initiatives - virtual classrooms /educational videos Radiologist training needs - Free training/workshop modules for radiologists/technicians. Flexible and Scalable e-Training Initiatives. Radiologists need to get specialized training in the use of digital technologies, such as PACS and voice recognition, general concepts of teleradiology Need for stringent teleradiology peer review platform Need for Admin support with AI-powered Chatbot for routine queries and ticket resolution Need for Best Practice Advisory (BPA): Alerts/pop-ups/suggestion tool Standardized Communication Platform: Other than the AI assistant, convenient, easy and intuitive communication options need to be facilitated between technician and radiologists. Artificial Intelligence and Deep Learning Investments to Enhance Clinical Performance Quality Control Program - with components like peer review, monitoring of quality matrix, clinical oversight and, management Customized 3D report viewers

Further risk assessment was done for 5C Network and a risk scale was used to assess the likelihood and impact of risks. The assessment scale can be found at appendix, section 9.8 On the basis of data gathered from the interviews and major

4.3 Risk, Impact & Probability

Primary data done through talking with the end users like radiologists and radio - technicians of various hospitals and diagnostics centers brought out a lot of intelligent and meaningful insights into light. Some of the important themes that came out of the primary research are:

- Quality issues with reports like miss-diagnosis, formatting issues, incorrect case triaging, miss-labelling

Frequency Table

		Role			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Radiologist	35	63.6	63.6	63.6
	Radio-technician	20	36.4	36.4	100.0
	Total	55	100.0	100.0	

ReportQualityIssues

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	formatting issues	7	12.7	12.7	12.7
	medical history issues	34	61.8	61.8	74.5
	image quality issues	14	25.5	25.5	100.0
	Total	55	100.0	100.0	

- Absence of communication platform for end users

Frequency Table

		Role			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Radiologist	35	63.6	63.6	63.6
	Radio-technician	20	36.4	36.4	100.0
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	medical history issues	34	61.8	61.8	74.5
	image quality issues	14	25.5	25.5	100.0
	Total	55	100.0	100.0	

- Image quality concerns, outdated Software
- Concerns related to technical features
- Better and quicker treatment management

Role

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Radiologist	35	63.6	63.6	63.6
	Radio-technician	20	36.4	36.4	100.0
	Total	55	100.0	100.0	

BetterandQuickerDiagnosis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	55	100.0	100.0	100.0

BetterOverallTreatmentManagement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	43	78.2	78.2	78.2
	No	12	21.8	21.8	100.0
	Total	55	100.0	100.0	

ReducedMortality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	55	100.0	100.0	100.0

ReductionhospitalReadmissionRates

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	39	70.9	70.9	70.9
	No	16	29.1	29.1	100.0
	Total	55	100.0	100.0	

BetterHospitalReputation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	46	83.6	83.6	83.6
	No	9	16.4	16.4	100.0
	Total	55	100.0	100.0	

IncreasedHopistalOPandRevenue

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	50	90.9	90.9	90.9
	No	5	9.1	9.1	100.0
	Total	55	100.0	100.0	

- Unmet training needs of end users- There was a strong association between unmet training needs and quality issues in reporting.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.561 ^a	2	.321
Likelihood Ratio	3.627	2	.328
Linear-by-Linear Association	.063	1	.802
N of Valid Cases	55		

The minimum expected count is 2.55.

- Performance pressure on reporting turn-around time

Details of data crunching can be found in the appendix - section 9.9.

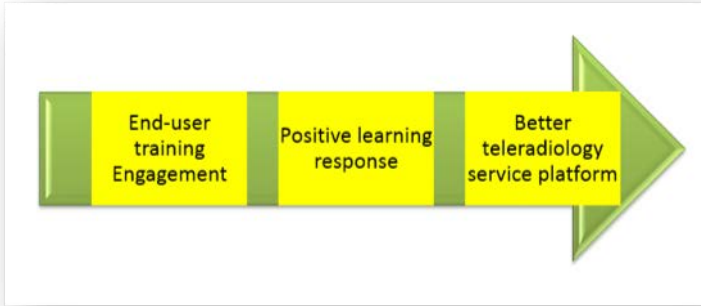
4.4 Proposed Theory of Change

The theory of change for 5C Network has been designed using various themes and insights from the primary and secondary data analysis to address the challenges around offering economic and affordable teleradiology services for resource-poor hospitals and diagnostic centers. The main concern areas are around reporting quality, compromised medical history writing by radio-technicians, imaging quality and gaps in training needs of the end users (Ramakrishna Dantu, RadhaKanta Mahapatra, 2013). This mainly can be achieved using:

- Interactive, intuitive and responsive technology design which will enable to user access information of interest, control the presentation of the information and be able to respond to information in a mediated environment (e.g., answer questions, send a message, gamification of action, receive feedback/response to a previous actions (Richard L. Street Jr., William R. Gold, Timothy Manning, 2009). This approach will tackle not just training needs of the end users but will assist them in writing error-free quality reports and medical history. Hence platform design should take care of –
 - User Control
 - Responsiveness
 - A game or simulation mechanism
 - Modular components in the program (e.g. animation, narration, graphics, user help information, hover text, motion pictures, tutorials, workshops etc.)
- Exclusion training program for both the users namely radio-technicians and radiologists with a special focus on technicians as they mostly have limited education and knowledge of systems and healthcare context.

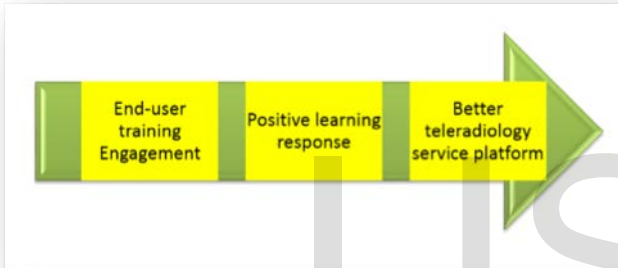
4.4.1 Output (Short Term Goal)

The proposed solution in short-term will lead to increased radio-technician and radiologist engagement in training programs and positive environment towards learning. It would also lead increase teleradiology platform and better usability. The platform will be co-created and co-innovated with end users and feedback will be taken by them



4.4.2 Mid-Term Goals

Further, there will be a visible change in the reporting quality with reduced diagnosis errors, reduced medical history errors, better platform usability and positive feedback from users on platform features.



4.4.3 Outcomes (Long Term Goals)

In the long term, it's expected to see a further reduction in reporting quality errors, increased and long-term clientele benefit for 5C Network on account great service and eventually a positive advantageous branding in the market.



- have many competitors already in the market. So, this is geographical segmentation!
- They will further attempt to segment this time on technology by using the 3D image viewer, responsive and intuitive UI design. As per Cision news 2018, at least till 2024. Technological advancement in teleradiology will be the key reason for its growth.
- Horizontal segmentation for the existing user groups by providing the next level of training support in the form of technical aids and in-person workshops; and further making the UI context specific to help the end user better. This should be done by co-creating and co-innovating with the end user to come up with excellent context specific designs (J. Paul Peter, 2008).
- Further do a product perception by doing context specific marketing with the help of brand evaluation and understanding sensitivity to marketing strategy by people in situations (J. Paul Peter, 2008).

5.2 Targeting

5C Network will be resource-poor small and mid-size hospitals and diagnostics centers of Maharashtra and Madhya Pradesh. The reason behind this is:

- The CAGR of teleradiology market growth is 11.3 % during 2015-25 and expanding into new geography is an obvious business advantage today (Transparency Market Research, 2018).
- Also, these 2 states are 2nd and 5th most populated states in India with a huge healthcare service demand. This will further help the states in generating more employment and better healthcare outcomes ((J. Paul Peter, 2008).
- These 2 states have also been in the news where their state governments have openly invited private teleradiology players to come and provide service to fill the demand and service gap in the states (The Indian Express, 2018)

5.3 Positioning – Perceptual Map

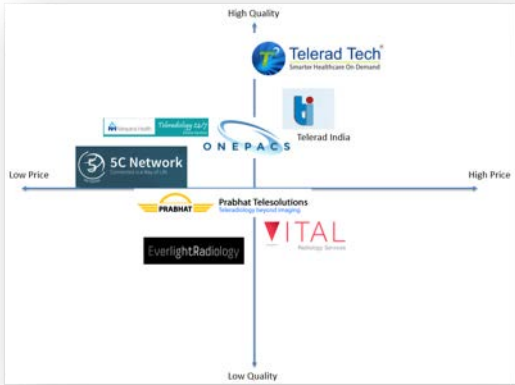
The below perceptual map describes the positioning of the 5C Network as compared to other competitors based on 2 important attributes which are the price of service and quality. Primary research suggested that the price of service is one of the main reason for selecting 5C Network by the end users. Hence the ideal move for the 5C Network is to move up in the first quadrant to achieve high-quality service delivery.

5 SEGMENTATION, TARGETING, POSITIONING

5.1 Segmentation

As 5C Network is already targeting the end user segment (Hospital & Diagnostic Centers), they are looking at:

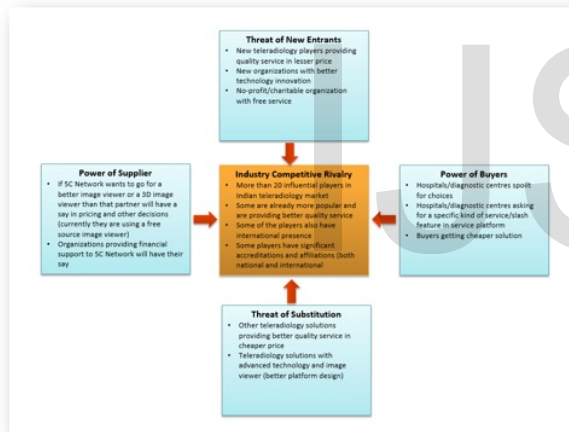
- Enter newer geographies of other Indian states namely Maharashtra and Madhya Pradesh targeting resource-poor small and mid-size hospitals and diagnostics centers. They have a huge demand for economic teleradiology but also



organization strategy around proposed mission, resource management, and message to be communicated in the market, media handling and measure of success (Oxford College of Marketing, 2014).

6 COMPETITIVE ANALYSIS

5C Network's current positioning in teleradiology can be understood Porter's 5 Force analysis. The analysis is done in comparison with 5C Network's other contemporaries who are their competitors.



7.2 4P Marketing

7.2.1. Product

1. Standardizing network speed for acquiring and updating services/updates/updates/updates to use the provided network speed for addressing the best performance of 5C Network platform.
2. This component can be integrated with the training program for radio techs and radiologists.
3. As per the 5C Network, it will provide a provision of learning facility by its users by allowing them to download the report in word documents/PDF format but looks like many radio techs are not aware enough to utilize the feature. The gap needs to be addressed through better training (local circuit) and awareness on application features and their utilization.
4. For better report speed and ease of reading and comprehension, the process can be made customizable for the radio-techs/radiologists.
5. Can be made better by 5C Network using UI/UX best practices to make the UI more appealing, simple, readable and content more simplified.
6. Comprehensive training modules for both radio techs and radiologists: Training program has to be interesting and effective enough to cause behavioral changes. Some of the approaches could be: Video tutorials on some common flows while interacting with the platform; Workshop sessions to provide hands on knowledge and on the spot query resolution.
7. Technical feature enhancements: <ul style="list-style-type: none"> 7a. Human centered design approach to understand user pain/obj points while interacting with 5C Network's platform. 7b. Real-time analysis of the application content for people with compromised readability. 7c. Provision of SMS features to enhance user experience with the platform. 7d. Provision of grouping view notes as appropriate and needed for a particular case by the radio tech. This will save time and help to avoid long queues for the radio techs. 7e. Provision of being able to store images of the affected area under diagnosis.
8. Customized report structure with an integrated radiology dictation system for an error free report <ul style="list-style-type: none"> 8a. Use of smart text blocks/flags for auto-repeating writing and assistance. 8b. Use of auto-repeating writing flags for assisting the user. Can be made available in multiple languages. 8c. Radiology dictation system.
9. Customized for diagnosis error mitigation: <ul style="list-style-type: none"> 9a. As a system in flag up diagnosis error on taking cases from existing information in the system (Or information is being filled by the user already in the system). 9b. Challenge: To send address on routine ticket resolution, to assist radio techs and radiologists on routine queries and workflow. This is long term will bring down the admin support cost as 5C Network's depends into other roles. 9c. Cost saving through AI by automatically measuring the emergency cases.
10. Better imaging software: <ul style="list-style-type: none"> 10a. Standardizing the specifications in tele-radiology, patients radiology etc. 10b. Ready-to-use training modules for radiologists and radio techs.
11. Research and innovation system in place for bettering the performance and generating healthy competition between hospitals and diagnostic centers. Some of the approaches could be: <ul style="list-style-type: none"> 11a. Offer training modules to radio-techs/radiologists. Provide cost benefits to training modules - virtual resources, educational content. 11b. Offer a challenge but also provide badges as appropriate. 11c. Gamification to build program incentives, collaborations, reduced levels of stress for the users, can be used for training staff in a fun way. Above all will lead to reduced costs for 5C in long term quality will lead to more financial benefits and better branding for 5C Network. 11d. Create challenges through gamification - create regular challenges to make users learn and compete for reward. 11e. Gamification for building knowledge: through the gamification system we can build a collaboration platform for radio techs and radiologists to communicate with each other and even resolve resolution to various concerns. This will be a fun way to empower the users and foster collaborative learning. 11f. This will also ensure the users to perform better and also give feedback on what they like and what they don't like. 11g. Use games for the top performance. 11h. Make gamification participation optional as elderly population may not be interested in it. Also don't make rewards easy to get and provide clear rules.
12. Real-time monitoring and analysis of radiologists/radiologists: Provide cost benefits to training modules - virtual resources, educational content.
13. Training can be gamified to generate interest with a greater reward and recognition system in place. This can be used as an effective platform to educate technicians while having fun and rewards.
14. Public recognition of good work: Motivation is essential to bring the best out of technicians' work. And for that public recognition of their space and good performance can actually motivate them to perform even better and provide 5C quality output.
15. Standardized Communication Platform: Other than the AI assistant, content, easy and intuitive communication system need to be followed between technician and radiologists. Artificial intelligence and deep learning investments to Enhance Clinical Performance.
16. Tele-radiology education needs an medical education level: It's good that today upcoming radiologists are better to be prepared for experiencing technology advancements in advance. This will adapt them easily in the technology practice when they interact with it comfortably for the first time.
17. A program designed in place to enroll and reward radiologists with 5C Network with criteria to assess their credibility and quality of services. <ul style="list-style-type: none"> 17a. EBB provision of a cross report review between the radiologists of a specific category. 17b. Awareness and recognition system around peer reviewing. Recognizing radiologists using effective peer reviewing and bringing in a quality review by posting out relevant concerns around reporting. This is long term will make the report quality and standardization process better.
18. Admin support with AI powered chatbot for queries and ticket resolution: This will optimize the performance of admin and as 5C Network grows, this will also bring down the recurring admin cost by eliminating the need of having more admin to support various cases.
19. Responsive or cross user role, conditional display of information based on facilitate easy navigation.
20. Real user support with AI powered chat: This will again ensure the number of calls being made to the admin for user support and in long term will bring down the admin cost.
21. Best Practice Advisory: An AI-powered/ML-powered tool to guide the user at every stage of interaction with the entire platform. This will reduce the human error incidence and simplify the navigation process through the platform.
22. Standardized Communication Platform: Other than the AI assistant, content, easy and intuitive communication system need to be followed between technician and radiologists. Artificial intelligence and deep learning investments to Enhance Clinical Performance can be a way forward.
23. QA Program - with components like peer review, monitoring of quality metrics, clinical oversight, and management.

7 RECOMMENDATIONS

Area	Current State	Recommendation	Impact
Product	Standardizing network speed for acquiring and updating services/updates/updates to use the provided network speed for addressing the best performance of 5C Network platform.	This component can be integrated with the training program for radio techs and radiologists.	As per the 5C Network, it will provide a provision of learning facility by its users by allowing them to download the report in word documents/PDF format but looks like many radio techs are not aware enough to utilize the feature. The gap needs to be addressed through better training (local circuit) and awareness on application features and their utilization.
Price	Comprehensive training modules for both radio techs and radiologists: Training program has to be interesting and effective enough to cause behavioral changes. Some of the approaches could be: Video tutorials on some common flows while interacting with the platform; Workshop sessions to provide hands on knowledge and on the spot query resolution.	Technical feature enhancements: <ul style="list-style-type: none"> 7a. Human centered design approach to understand user pain/obj points while interacting with 5C Network's platform. 7b. Real-time analysis of the application content for people with compromised readability. 7c. Provision of SMS features to enhance user experience with the platform. 7d. Provision of grouping view notes as appropriate and needed for a particular case by the radio tech. This will save time and help to avoid long queues for the radio techs. 7e. Provision of being able to store images of the affected area under diagnosis. 	Customized report structure with an integrated radiology dictation system for an error free report <ul style="list-style-type: none"> 8a. Use of smart text blocks/flags for auto-repeating writing and assistance. 8b. Use of auto-repeating writing flags for assisting the user. Can be made available in multiple languages. 8c. Radiology dictation system.
Place	Customized for diagnosis error mitigation: <ul style="list-style-type: none"> 9a. As a system in flag up diagnosis error on taking cases from existing information in the system (Or information is being filled by the user already in the system). 9b. Challenge: To send address on routine ticket resolution, to assist radio techs and radiologists on routine queries and workflow. This is long term will bring down the admin support cost as 5C Network's depends into other roles. 9c. Cost saving through AI by automatically measuring the emergency cases. 	Better imaging software: <ul style="list-style-type: none"> 10a. Standardizing the specifications in tele-radiology, patients radiology etc. 10b. Ready-to-use training modules for radiologists and radio techs. 	Research and innovation system in place for bettering the performance and generating healthy competition between hospitals and diagnostic centers. Some of the approaches could be: <ul style="list-style-type: none"> 11a. Offer training modules to radio-techs/radiologists. Provide cost benefits to training modules - virtual resources, educational content. 11b. Offer a challenge but also provide badges as appropriate. 11c. Gamification to build program incentives, collaborations, reduced levels of stress for the users, can be used for training staff in a fun way. Above all will lead to reduced costs for 5C in long term quality will lead to more financial benefits and better branding for 5C Network. 11d. Create challenges through gamification - create regular challenges to make users learn and compete for reward. 11e. Gamification for building knowledge: through the gamification system we can build a collaboration platform for radio techs and radiologists to communicate with each other and even resolve resolution to various concerns. This will be a fun way to empower the users and foster collaborative learning. 11f. This will also ensure the users to perform better and also give feedback on what they like and what they don't like. 11g. Use games for the top performance. 11h. Make gamification participation optional as elderly population may not be interested in it. Also don't make rewards easy to get and provide clear rules.
People	Real-time monitoring and analysis of radiologists/radiologists: Provide cost benefits to training modules - virtual resources, educational content.	Training can be gamified to generate interest with a greater reward and recognition system in place. This can be used as an effective platform to educate technicians while having fun and rewards.	Public recognition of good work: Motivation is essential to bring the best out of technicians' work. And for that public recognition of their space and good performance can actually motivate them to perform even better and provide 5C quality output.
Process	Standardized Communication Platform: Other than the AI assistant, content, easy and intuitive communication system need to be followed between technician and radiologists. Artificial intelligence and deep learning investments to Enhance Clinical Performance.	Tele-radiology education needs an medical education level: It's good that today upcoming radiologists are better to be prepared for experiencing technology advancements in advance. This will adapt them easily in the technology practice when they interact with it comfortably for the first time.	A program designed in place to enroll and reward radiologists with 5C Network with criteria to assess their credibility and quality of services. <ul style="list-style-type: none"> 17a. EBB provision of a cross report review between the radiologists of a specific category. 17b. Awareness and recognition system around peer reviewing. Recognizing radiologists using effective peer reviewing and bringing in a quality review by posting out relevant concerns around reporting. This is long term will make the report quality and standardization process better.
Performance	Admin support with AI powered chatbot for queries and ticket resolution: This will optimize the performance of admin and as 5C Network grows, this will also bring down the recurring admin cost by eliminating the need of having more admin to support various cases.	Responsive or cross user role, conditional display of information based on facilitate easy navigation.	Real user support with AI powered chat: This will again ensure the number of calls being made to the admin for user support and in long term will bring down the admin cost.
Partners	Best Practice Advisory: An AI-powered/ML-powered tool to guide the user at every stage of interaction with the entire platform. This will reduce the human error incidence and simplify the navigation process through the platform.	Standardized Communication Platform: Other than the AI assistant, content, easy and intuitive communication system need to be followed between technician and radiologists. Artificial intelligence and deep learning investments to Enhance Clinical Performance can be a way forward.	QA Program - with components like peer review, monitoring of quality metrics, clinical oversight, and management.

7.1 5M Strategy

The 5M strategy is an interesting market model and can be effectively used form

7.2.2. Price

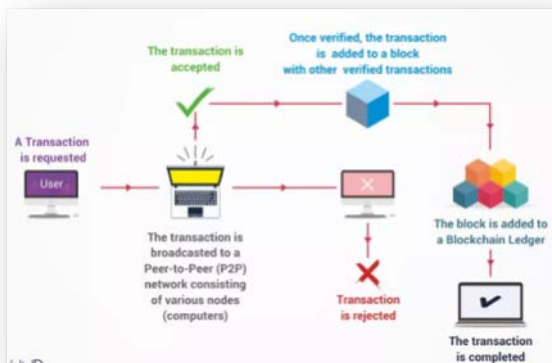
Though 5C Network is already providing services at lower prices, profitability can be increased using a price discrimination strategy in place while taking care of the fairness. In order to be financial self-sustainable, 5C Network and try price dif-

ferentiation between resource-poor hospitals and large resource-rich hospitals on the basis of:

- Tangible costs differentiators like added services for the more paying party. E.g. analytics report from 5C Network database with insights etc.
- Cross-subsidization model: In today's free market, cross-subsidization is an excellent way of a competitive entry. Not just this, it will allow 5C Network to try uncontested services which may give them a disruptive competitive edge (Guy David, Richard Lindrooth, Lorens A. Helmschen, Lawton R. Burns, 2011). It will also help them recover their fixed costs faster by charging relatively more to the players who can pay while enabling them to serve more customers at the same time. This will enable more competition as compared to just offering a single price (Financial Conduct Authority, 2016).

Hypothetically, it may increase their customer base to double the current size in 3 years considering if they continue to grow at the current pace (5C Made over 100 customers in 3 years).

- To hold the customers for long-term and continue to use 5C Network services, 5C Network can offer various kind of service packs like gold, silver, platinum etc. based on length of service chosen and provide some additional or free scans to hold the customers for long-term.
- Cross-subsidization model on blockchain for the supply chain to execute selective pricing: Blockchain's feature of being able to give selective access to different business players through a private key and transact in a secular environment gives 5C Network an advantage of executing selective pricing securely without a conflict and only between select peers (IBM, 2017).



Source: Velix, 2017

7.2.3. Place

5C Network has chosen Indian states of Maharashtra and Madhya Pradesh for expansion. Both states have major advantages for the following reasons:

- Governments open intention to welcome private teleradiology service providers to fill the gap in demand and supply (The Indian Express, 2018).
- The per capita income for the state of Maharashtra is highest in India which presents a high growth of healthcare solutions in the future to come (Alex George, Sunil Nandraj, 1993).
- As per Access Health International which released 'Madhya Pradesh Health Systems Assessment Report' in 2015, it highly recommended that given the grave need of huge healthcare infrastructure in the state, technology infrastructure and IT will be a future solution and teleradiology logically fits into this foreseen path (Madhya Pradesh Health Systems Assessment Report, 2016).

7.2.4. Promotion

Market credibility through accreditations and affiliations is very important. Some of the avenues that 5C Network should explore in their marketing communication and promotional strategy are:

- Clear and strong social message through advertising around teleradiology outreach to most needy segments of the healthcare providers i.e. resource-poor hospitals and diagnostic centers in tier 2 and tier 3 cities in India.
- Accreditation and affiliations are reputed national and international bodies which attest best healthcare products and services. Some of these organizations are:
 - Joint Commission on Accreditation of Healthcare Organizations (JCAHO)
 - National Accreditation Board for Hospitals & Healthcare Providers (NABH)
 - Associations of Healthcare Providers in India (AHPI)
 - Joint Commission International (JCI)
 - International Organization for Standardization (ISO)
 - Total Quality Management (TQM)
- Partnership with reputed diagnostics companies who can vouch for 5C Network's service platform. This will provide a positive branding advantage in the market.

7.3 Limitations of the Study

Following are the limitations of the study:

- The study has been conducted in a specific geography of Bangalore in South India with a limited time period of data collection (4 weeks).
- The sample size of respondents may not be representative as convenience sampling was used to get maximum respondents in specific user category.
- Respondent's bias.
- Recommendations are made based on current technology trends but may not always be 100% application as technology trends change as well unpredictably.

7. SUMMARY, CONCLUSION AND ROAD AHEAD

7.1 Summary

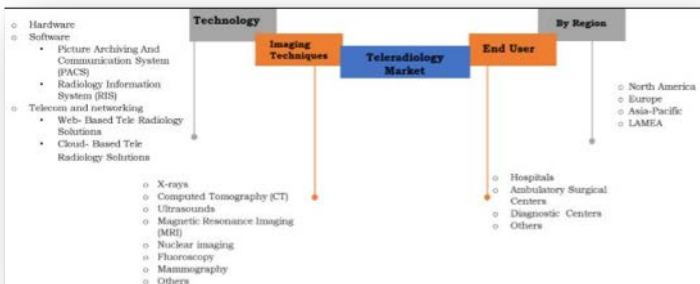
While it's imperative for the teleradiology services today to offer the users the best quality reporting in the least possible time with an excellent end to end support in order to stand apart in this mushrooming market of teleradiology services, we understood from the primary and secondary research that quality reporting is the key. An error-free report with diagnostic accuracy and provision of a best practice advisory toolkit to assist the users in documenting reports and facilitate communication between radio-technicians and radiologists is the key to success. It will eventually save a lot of resources and cost for resource-poor hospitals/diagnostic center and will further transfer less cost to the patient eventually paying for the scan (Prof. Peter M.T., 2006).

7.2 Conclusion

Teleradiology is estimated to be strengthening radiologist's role in managing individual patient care and stress on their role as image consultants as the reporting part is getting outsourced now (Prof. Peter M.T., 2006). This would allow the radiologists to focus more on image quality related concerns better and make radiology more rewarding. Rising cost and shortage of radiologists will also continue favoring the need for teleradiology services (Nicholas Gourtsoyannis, 2004). Going forward radiologists being the backbone of the diagnosis process in healthcare will have to add value to patient care curriculum by strengthening their role as an image consultant, and teleradiology is the answer to it!

7.3 Road Ahead

Below figure demonstrates the segmentation of Teleradiology market, 5C Network will have to look into other segmentations (other than hospitals/diagnostic center) which though are not directly in their control but can be influenced through advocacy and training. For example, motivating diagnostic centers to use best quality imaging machines is not in 5C Network's direct control but through training and awareness, they can make diagnostic centers being aware of the importance of best quality imaging equipment.



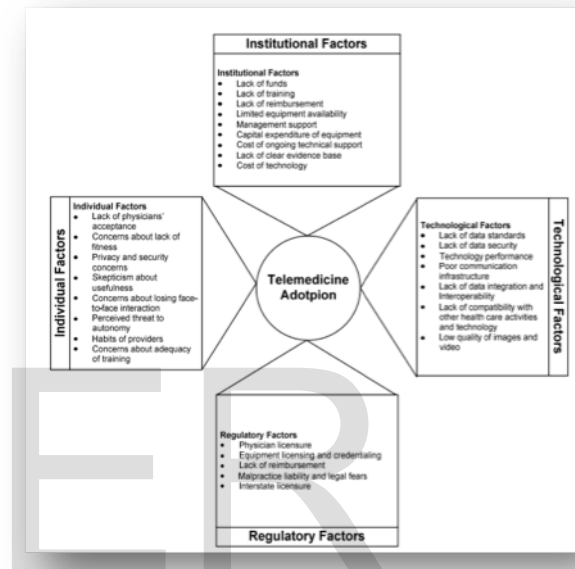
Source: Allied Market Research, 2017

With the help of statistics on global Teleradiology trends, a

market projection for future growth has been done for global, Indian and 5C Network market (Allied Market Research, 2017). Collaborating with other market segments which directly or indirectly influence the teleradiology market or radiology and healthcare in general will be the key for longevity!

8. APPENDIX

8.1 Factors affecting telemedicine adoption Source: DIFFUSION OF INNOVATIONS, Everett M. Rogers, 1995



8.2 Risk Assessment Scale for 5C Network

	Likelihood		Impact		Risk Rating	
1	Very Low	The risk will only occur in the most exceptional of circumstances.	1	Very Low	Minor issues that requires small local fixes	NEGLECTIBLE General awareness: hard to be missed
2	Low	The risk is not expected to occur in most circumstances	2	Low	Fixable minor issues: minor impact that can be treated without need for professional support	LOW Increased awareness from through training and Best Practice Advisory (BPA): generic instructions from 5C given
3	Medium	The risk will occur in some circumstances	3	Medium	Moderate issues that requires non-urgent fix and possible change: may require professional support	MEDIUM Heightened awareness and continual situational awareness through training and explanatory text on the UI. May require application of context-specific risk mitigation measures.
4	High	The risk will occur in most circumstances	4	High	Threatening issue with high impact that requires urgent fix: severe setback that requires lengthy and complex professional support	HIGH Priority Concern – will require the application robust risk mitigation and incident management measures. Requires escalation to concerned person if needed
5	Very High	The risk will occur in just about all circumstances	5	Very High	Single or multiple severe issues requiring immediate professional support	EXTREME Beyond 5C Network's Control – risk to be avoided entirely or transferred

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